جمهورية العراق/ وزارة التعليم العالي والبحث العلمي ....

الملحق 4: وصف المادة الدراسية

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية			
Module Title	**Plane Surveying**	**Module Delivery**	
Module Type	**Core**	☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 102**		
ECTS Credits	**7**		
SWL (hr/sem)	**200**		
Module Level	1	**Semester of Delivery**	1
Administering Department	SUT	**College**	
Module Leader	Dr. Mohammed Tareq Khaleel	**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Lecturer	**Module Leader's Qualification**	Ph.D.
Module Tutor		**e-mail**	
Peer Reviewer Name		**e-mail**	E-mail
Scientific Committee Approval Date			

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	• Understanding how to determine points, distances, and land areas. • Familiarity with surveying instruments related to the practical aspect. • Understanding the fundamentals of obstacles in field. • Understanding how to calculate the lengths of traverses. • Understanding the mathematical methods for calculations.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	• Recognize how to use tools in measurement of lengths and angles. • List the various method in measurement. • Summarize what is obstacles and how to avoid it in lengths measurement. • Discuss the errors through the measurement of lengths. • Describe the environmental effects on errors of measurement. • Define the mathematical formula to determine the errors in measurement. • Discuss the theory of fixing traverses in field. • Discuss the various errors in lengths and angles in traverses. • Explain the mathematical formula to determine the area of traverse. • Identify the methods to determine the regular and irregular areas.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. Introduction to Surveying – Types of surveying, plane surveying, methods of survey and advantages of surveying. [SSWL=5 hrs] Points, Lengths and Angles – Set of points and lines, measurement of lines and angles, types of errors in measurement. [SSWL=20 hrs] Obstacles – Types of obstacles, measurement lines through obstacles. [SSWL=10 hrs] Traverses – Types of traverses, interior angles, lines and corrections [SSWL=15 hrs] Area Measurement – Area measurement, typical area, area formula, trapezoidal method, Simpson's method [SSWL=15 hrs] Area of Traverses – Area of traverse, graphical paper, triangle method [SSWL=10 hrs] Total hrs = 75 = SSWL - (Exam hrs) = 79 - 4 = 75 hr (Time table hrs x 15 weeks)

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.
Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا	

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	175	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل		**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**175**		

Module Evaluation
تقييم المادة الدراسية

As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	1	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

Week	**Material Covered**
Week 1	Introduction to surveying
Week 2	Set of points and straight lines
Week 3	Set of angles and curves
Week 4	Measurement of lines and angles
Week 5	Measurement of curves and errors in tape
Week 6	General view of obstacles
Week 7	Measurement of lines through obstacles
Week 8	Types of traverses
Week 9	Interior angles and lines in traverses
Week 10	Angle correction in traverses
Week 11	Area measurement
Week 12	Mathematical formula of area measurement
Week 13	Trapezoidal and Simpson's methods in area measurement
Week 14	Graphical paper and triangle methods in area measurement

Week 15	Examples on area measurement
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

Week	Material Covered
Week 1	Lab 1: Introduction to survey
Week 2	Lab 2: Tools of measurement
Week 3	Lab 3: Obstacles
Week 4	Lab 4: Errors in measurement
Week 5	Lab 5: Fix in field: points, lines and angles
Week 6	Lab 6: Fix of traverse
Week 7	Lab 7: Area of traverse

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	N N Basak (2014). Surveying and Levelling. McGraw Hill Education. p. 542. ISBN 9789332901537	No
Recommended Texts	Brinker, Russell C; Minnick, Roy, eds. (1995). The Surveying Handbook. ISBN 978-1-4613-5858-9	No
Websites	https://www.youtube.com/watch?v=qgwBOVUFDAQ	

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Engineering Geology**			**Module Delivery**	
Module Type	**Support**			☒ Theory ☒ Lecture ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**SUT 101**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	1		**Semester of Delivery**	1	
Administering Department	SUT		**College**		
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq	
Module Leader's Acad. Title	lecturer		**Module Leader's Qualification**	Ph.D.	
Module Tutor			**e-mail**		
Peer Reviewer Name			**e-mail**		
Scientific Committee Approval Date			**Version Number**		

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	• Understanding geological phenomena: providing students with a comprehensive knowledge of various geological processes that affect the environment, such as erosion, weathering, earthquakes, landslides, and others. • Geological risk assessment: enabling students to identify and evaluate potential geological hazards at engineering project sites, such as landslides, groundwater seepage, and earthquake effects. • Selection of suitable sites: help students to choose the most suitable sites for engineering projects, taking into account geological factors that may affect the performance of these projects. • Design of engineering facilities: provide students with the necessary knowledge to design engineering facilities so that they are able to withstand changing geological conditions.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	• Geological processes: understanding the various geological processes that shape the Earth's surface and affect infrastructure, such as erosion, weathering, earthquakes, and landslides. • Properties of soils and rocks: knowledge of the physical and mechanical properties of soils and rocks, and how these properties affect the behavior of soils and rocks under loads. • Geotechnical hydrology: understanding the behavior of groundwater in soils and rocks, and its impact on the stability of engineering facilities. Geological maps: the ability to read and analyze geological maps and extract geological information from them. • Geotechnical investigations: understand the different methods used in geotechnical investigations, such as drilling, Soundar, and soil tests.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Geological **Processes:** • Weathering and erosion • Mass movements (landslides, rockfalls) • Earthquakes and seismic hazards • Volcanic activity • Fluvial and coastal processes • **Geotechnical Properties of Soils and Rocks:** • Soil classification (e.g., Unified Soil Classification System) • Soil properties (e.g., permeability, compressibility, shear strength)

	• Rock properties (e.g., strength, durability, weathering susceptibility) • In-situ testing (e.g., standard penetration test, cone penetration test) • Laboratory testing (e.g., particle size analysis, Atterberg limits) • **Groundwater:** • Hydrogeology (occurrence, movement, and quality of groundwater) • Well drilling and testing • Groundwater contamination and remediation • Groundwater-related hazards (e.g., subsidence, liquefaction) • **Site Investigation and Exploration:** • Geological mapping and remote sensing • Geophysical surveys (e.g., seismic, electrical resistivity) • Drilling and sampling techniques • Borehole logging and interpretation • **Foundation Engineering:** • Shallow foundations (e.g., footings, slabs) • Deep foundations (e.g., piles, caissons) • Settlement analysis • Bearing capacity evaluation • **Slope Stability:** • Stability analysis (e.g., limit equilibrium methods) • Slope stabilization techniques (e.g., retaining walls, buttresses) • Landslide hazard assessment and mitigation • **Geotechnical Hazards and Risk Assessment:** • Earthquake engineering • Liquefaction • Slope instability • Subsidence • Karst hazards • Coastal erosion

	• **Environmental Geotechnics:** • Contaminated sites • Waste disposal • Remediation techniques • Sustainability in geotechnical engineering • **Computational Geotechnics:** • Numerical modeling (e.g., finite element analysis, finite difference method) • Computer-aided design and analysis

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	50	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	3.3
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	50	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	6	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7

	Projects / Lab.	0	10% (10)	Continuous	All
	Report	6	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	1hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Geological processes of internal and external origin.
Week 2	Absolute and relative age of rocks
Week 3	Geological activities of wind and Eolian deposits
Week 4	Sheet erosion, Gullies and Geological work of rivers
Week 5	Glaciers, Glacial till and fluvioglacial
Week 6	limbo glacial deposits
Week 7	Determination of the coefficient of permeability
Week 8	Man-made geological process
Week 9	Fluvioglacial ,marine erosion and faulting
Week 10	Inflow to foundation pits ,limbo glacial deposits
Week 11	Water aggressiveness and Groundwater regime
Week 12	Aquicludes, Groundwater ,capillary fringe and perched water
Week 13	Origin of subsurface water
Week 14	Swamps, Peat depositions
Week 15	marine erosion ,Longshore drift
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	There is no practical material
Week 2	There is no practical material
Week 3	There is no practical material
Week 4	There is no practical material

Week 5	There is no practical material
Week 6	There is no practical material
Week 7	There is no practical material

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Engineering book by F. G. Bell	No
Recommended Texts	Engineering geology principles and practice by M. H. de Freitas	No
Websites	https://www.sciencedirect.com/journal/engineering-geology	

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
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MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Computer Engineering drawing**		**Module Delivery**	
Module Type	**Support**		☐**Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 103**			
ECTS Credits	**6**			
SWL (hr/sem)	**150**			
Module Level	1	**Semester of Delivery**	1	
Administering Department	SUT	**College**		
Module Leader	Mohammed Tareq Khaleel	**e-mail**	Mohammed.alsafaawe@ntu.edu.iq	
Module Leader's Acad. Title	Lecturer	**Module Leader's Qualification**	PhD	
Module Tutor		**e-mail**		
Peer Reviewer Name		**e-mail**		
Scientific Committee Approval Date		**Version Number**		

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module		**Semester**	
Co-requisites module		**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	

	The Module Objectives of an engineering drawing course define the aims or goals that guide the overall structure and content of the module. These objectives outline what the course intends to accomplish and what students should be able to do by the end of the module. Below are typical module objectives for an engineering drawing course: --- • To Introduce Fundamental Concepts of Engineering Drawing • To Develop Proficiency in 2D and 3D Drawing Techniques • To Teach the Use of Engineering Standards and Conventions • To Enable Students to Apply Dimensioning and Tolerancing • To Introduce Sectional and Auxiliary Views for Complex Features • To Develop Skills in Computer-Aided Design (CAD). • To Train Students in Creating Assembly and Detailed Drawings • To Introduce Welding Symbols and Surface Finish Notations • To Teach the Concepts of Limits, Fits, and Tolerances • To Develop the Ability to Read and Interpret Engineering Drawings • To Foster Visualization and Spatial Awareness Skills • To Emphasize Ethical and Professional Responsibility in Engineering Drawing • To Encourage Problem-Solving and Critical Thinking in Drawing • To Introduce the Application of Drawing in Various Engineering Fields
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks. The Module Learning Outcomes (MLOs) for an engineering drawing course define what students are expected to achieve by the end of the module. These outcomes focus on both the theoretical understanding and practical application of engineering drawing techniques. Below are typical learning outcomes for a course in engineering drawing. --- ▪ Understand and Apply Engineering Drawing Standards ▪ Create Accurate 2D Orthographic and Isometric Projections ▪ Dimension and Annotate Drawings Correctly ▪ Interpret and Create Sectional and Auxiliary Views ▪ Develop Assembly and Detail Drawings ▪ Apply Computer-Aided Design (CAD) Tools ▪ Interpret and Create Technical Drawings for Manufacturing ▪ Create Development Drawings for Fabrication ▪ Communicate Engineering Concepts Visually ▪ Understand Ethical and Professional Responsibilities in Engineering Drawing ▪ Develop Problem-Solving Skills in Technical Drawing ▪ Demonstrate Proficiency in Reading Complex Engineering Drawings

Indicative Contents المحتويات الإرشادية	Indicative content includes the following. The indicative content of an engineering drawing course typically outlines the topics and skills that students will need to master in order to effectively communicate technical ideas through precise drawings. Below is a breakdown of the key areas typically covered in an engineering drawing curriculum, including both traditional manual drawing and computer-aided design (CAD) skills. • Introduction to Engineering Drawing • Limits, grid, object snap, view menu (zoom, pan). • Draw menu (line, poly line, polygon, rectangle, arc, circle, point, text). [8 hrs.]. • Introduction to Engineering Drawing, modify menu, erase, copy, mirror offset, move, rotate, trim, extend, explode, perspective. [8 hrs.]. • Orthographic projection: Types of Projections • Fundamentals of orthographic projection. • First-Angle vs. Third-Angle Projections: Understanding the difference between these projection methods. • Creation of front, top, and side views (multi-view drawings). [10 hrs]. • Draw the projection, Draw the projection with the first angle projection, method Draw the projection with the third angle projection method. [10 hrs]. • Drawing the three projections, Drawing the three projections with the angle, Drawing the three projections with the third angle projection method. [10 hrs.] • Configuration of a printing layout and the print, configuration and scale of printing. [8 hrs.] • 7. Orthogonal projection: I. representation of a point, line, plane, solid ▪ ii. belonging of a point to a line, of a point/line to a plane [8 hrs.] • particular lays of a line, of a plane. particular lays of a line, of a • plane particular lays of a line, of a plane.[8 hrs.] • Perpendicularity between a line and a plane. v. Perpendicularity ▪ between a line and a plane. Perpendicular between two coplanar lines. Perpendicularity between planes Intersection between two planes (not parallel). Intersection between a plane and a line [8 hrs.] • Sections Perpendicularity between planes • Intersection between two planes (not parallel). Intersection between a plane

	and a line, Sections plane-plane. [8 hrs.] • Intersections Intersections among solids, solids/plane, • Intersections among solids/line [8 hrs.] • Axonometric, Orthogonal axonometry [8 hrs.] • Oblique axonometry [8 hrs.] • Representation of point, line, plane, solids [8 hrs.]

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Engineering drawing is a vital communication tool used by engineers and designers to convey design ideas, measurements, and technical information. Given the precision and complexity required, learning and teaching this subject effectively requires a combination of theoretical understanding and practical application. Here are strategies for both learners and educators to enhance the teaching and learning process. • Understanding Fundamentals First • Incremental Learning: Start Simple, Build Complexity • Use CAD Tools Early in Learning • Visualization and Spatial Awareness • Problem-Based Learning (PBL) • Feedback and Iterative Learning • Hands-on Projects and Workshops • Continuous Practice • Assessment through Practical Tests

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	120	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	8
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	80	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**200**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	6	10% (10)	Continuous	All
	Class work	6	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Limits, grid, object snap, view menu (zoom, pan), Draw menu (line, poly line, polygon, rectangle, arc, circle, point, text)
Week 2	erase, copy, mirror offset, move, rotate, trim, extend, explode, perspective
Week 3	First and third angle projection method
Week 4	Draw the projection with the first angle projection method, Draw the projection with the third angle projection method
Week 5	Drawing the three projections with the first angle, Drawing the three projections with the third angle projection method
Week 6	Configuration of a printing layout and the print, configuration and scale of printing
Week 7	Mid-term Exam + I. representation of a point, line, plane, solid, ii. belonging of a point to a line, of a point/line to a plane
Week 8	iii. particular lays of a line, of a plane, iv. Parallelism between two lines, parallelism between two planes, parallelism between a line and a plane.
Week 9	v. Perpendicularity between a line and a plane. Perpendicular between two coplanar lines. Perpendicularity between planes, Intersection between two planes (not parallel). Intersection between a plane and a line
Week 10	Perpendicularity between planes, Intersection between two planes (not parallel). Intersection between a plane and a line, Sections plane-plane
Week 11	Intersections among solids, solids/plane, Intersections among solids/line
Week 12	Orthogonal axonometry
Week 13+14	Oblique axonometry
Week 15	Representation of point, line, plane, solids
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

Week	Material Covered
Week 1	Lab 1: Introduction to Agilent VEE and PSPICE
Week 2	Lab 2: Thévenin's / Norton's Theorem and Kirchhoff's Laws
Week 3	Lab 3: First-Order Transient Responses
Week 4	Lab 4: Second-Order Transient Responses
Week 5	Lab 5: Frequency Response of RC Circuits
Week 6	Lab 6: Frequency Response of RLC Circuits
Week 7	Lab 7: Filters

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	• Geometric and Engineering Drawing by K. Morling • Fundamentals of Engineering Drawing by Thomas E. French	Yes
Recommended Texts	A Text -Book of Engineering Drawing and Design by Sidney H. Wells	No
Websites		

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	**A** - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
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Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية			
Module Title	Mathematics		**Module Delivery**
Module Type	Core		☐theory ☐Lecture ☒Lab ☒ Tutorial ☐Practical ☒ Seminar
Module Code	**SUT 104**		
ECTS Credits	**5**		
SWL (hr/sem)	125		
Module Level	1	**Semester of Delivery**	1
Administering Department	SUT	**College**	
Module Leader	Mohammed Tareq Khaleel	**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Lecturer	**Module Leader's Qualification**	PhD
Module Tutor		**e-mail**	
Peer Reviewer Name	Name	**e-mail**	
Scientific Committee Approval Date		**Version Number**	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	• Enhance students' ability to think logically and solve mathematical problems methodically, and apply these skills to engineering problems. • Provide a strong foundation in basic mathematical concepts such as calculus,

	algebra, and analytical geometry, helping in understanding other engineering courses. • Enable students to use mathematical tools to analyze and solve engineering problems, including structural system design and material calculations. • Improve students' ability to use mathematics for drafting engineering diagrams and analyzing geometric shapes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	• Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks. • A Cognitive objectives: • Understanding basic mathematical concepts. • Analyze mathematical and engineering problems. • Apply mathematics in practical contexts. • Understand mathematical and engineering relationships. • Develop logical thinking. • Recognize advanced mathematical applications. • Understand the role of mathematics in improving engineering designs. • Ability to interpret engineering data.. • B. Skills-Based Objectives: • Apply mathematical skills to solve engineering problems. • Use mathematical and engineering software. • Perform accurate engineering calculations. • Critical and analytical thinking. • Practical application of algebra and geometry concepts.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. The course covers a broad range of mathematical topics essential for engineering students, focusing on developing their mathematical reasoning, problem-solving skills, and the application of these concepts to engineering problems. Below is a breakdown of the main topics: • **Limits and Continuity (4 hours)** • Understanding the concept of limits • Evaluating limits algebraically • Continuity and discontinuities in functions • Real-world applications of limits in engineering • **Differentiation (4 hours)** • Concept of differentiation and rates of change • Basic rules of differentiation (product rule, quotient rule, chain rule) • Applications of differentiation in engineering, including velocity and acceleration • **Derivatives of Functions (4 hours)**

	• Differentiation of polynomial, trigonometric, exponential, and logarithmic functions • Higher-order derivatives • Engineering applications of derivatives, including optimization problems • **Integration (4 hours)** • Fundamental theorem of calculus • Indefinite and definite integrals • Basic techniques of integration (substitution, integration by parts) • Applications of integration in calculating areas and volumes • **Integration of Trigonometric Functions (4 hours)** • Integrating sine, cosine, tangent functions • Applications of trigonometric integrals in wave motion and electrical engineering • **Integration of Inverse Trigonometric Functions (4 hours)** • Derivation and integration of inverse trigonometric functions • Solving problems involving inverse trigonometric functions • **Integration of Exponential and Logarithmic Functions (4 hours)** • Integration of exponential and logarithmic functions • Applications of these integrals in growth models and decay processes • **Applications of Integration (4 hours)** • Using integrals to compute areas, volumes, and lengths of curves • Engineering applications, including fluid mechanics and material science • **Basic Integration Formulas (2 hours)** • Review of key integration formulas • Practice problems to solidify understanding • **Operations on Matrices (2 hours)** • Matrix addition, subtraction, and multiplication • Practical applications in solving linear equations • **Matrices and Determinants (4 hours)** • Properties of matrices and determinants • Solving linear systems using matrices • **Solving Linear Systems Using the Inverse of a Matrix and Cramer's Rule (4 hours)** • Solving linear systems of equations using matrix inverses • Application of Cramer's rule in engineering problems • **Eigenvalues and Eigenvectors (8 hours)** • Finding eigenvalues and eigenvectors • Applications in structural analysis and mechanical systems Throughout the course, emphasis is placed on practical applications of the mathematical concepts in real-world engineering scenarios. The course also includes frequent problem-solving exercises, practical examples, and

	theoretical discussions to help students understand the significance of these mathematical tools in engineering contexts.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Explanation using various modern presentation tools. Lecture method and use of interactive whiteboard. Forming discussion groups during lectures. Thinking questions such as what, how, when, and why. Homework assignments that require self-explanations in causal ways.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	125	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	8
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	0	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**125**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	4	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	0	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	limit and Continuity
Week 2	Differentiation
Week 3	Derivatives of Functions
Week 4	Derivatives of all Functions
Week 5	Integration
Week 6	Integration of Trigonometric Functions
Week 7	Integration of Inverse Trigonometric Functions
Week 8	Integration of Exponential and Logarithmic Functions
Week 9	Applications of Integration
Week 10	Basic Integration Formulas
Week 11	Operations on Matrices
Week 12	Matrices
Week 13	Solving Linear Systems Using the Inverse of a Matrix and Cramer's Rule
Week 14	Eigenvalues and Eigenvectors
Week 15	Eigenvalues and Eigenvectors
Week 16	**Preparatory week before the final Exam**

	Text	**Available in the Library?**
Required Texts	Calculus I, Paul Dawkins, 2007	Yes
Recommended Texts	.	No
Websites		

مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A** – Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX** – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

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حقوق الانسان والديمقراطية</th></tr>
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<tr><td colspan="2">Administering Department</td><td>SUT</td><td>College</td><td colspan="2"></td></tr>
<tr><td>Module Leader</td><td colspan="2">Mohammed Tareq Khaleel</td><td>e-mail</td><td colspan="2">Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td colspan="2">Module Leader’s Acad. Title</td><td>Lecturer</td><td colspan="2">Module Leader’s Qualification</td><td>PhD</td></tr>
<tr><td>Module Tutor</td><td colspan="2"></td><td>e-mail</td><td colspan="2"></td></tr>
<tr><td colspan="2">Peer Reviewer Name</td><td></td><td>e-mail</td><td colspan="2"></td></tr>
<tr><td colspan="2">Scientific Committee Approval Date</td><td></td><td>Version Number</td><td colspan="2"></td></tr>
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Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	- زيادة معرفة الطالب بالجانب المفاهيمي النظري والتطور التاريخي لمادة حقوق الانسان والديمقراطية - تنمية مهارات الطالب التحليلية والنقدية فيما يتعلق بواقع ومستقبل حقوق الإنسان والديمقراطية - تدريب الطالب على أهمية المشاركة الفاعلة في جوانب الحياة العامة كتعزيز احترام مبادئ حقوق الإنسان العامة والمشاركة الفاعلة في الحياة السياسية والثقافية. - تمكين الطلاب من فهم أهمية التعليم ودوره في نشر ثقافة حقوق الإنسان والديمقراطية في بناء مجتمع حضاري يقوم على أساس الحكم الصالح الذي من أهم مقوماته الإيمان بحقوق الإنسان والتربية عليها والمشاركة الفاعلة في الحكم عبر الانتخابات الحرة والعادلة
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	• حقوق الإنسان ، تعريفها ، أهدافها • حقوق الإنسان في التاريخ المعاصر والحديث • الاعتراف الإقليمي بحقوق الإنسان • حقوق الإنسان الحديثة • ضمانات احترام وحماية حقوق الإنسان على الصعيد الوطني • مصطلح الديمقراطية.
Indicative Contents المحتويات الإرشادية	• حقوق الانسان ، تعريفها ، أهدافها حقوق الإنسان في الحضارات القديمة وخصوصا حضارة وادي الرافدين ضمانات واحترام وحماية حقوق الإنسان على الصعيد الدولي : • دور الأمم المتحدة ووكالاتها المتخصصة في توفير الضمانات • دور المنظمات الإقليمية (الجامعة العربية ، الاتحاد الأوروبي ، الاتحاد الافريقي ، منظمة الدول الأمريكية ، منظمة آسيان) . [15 hrs] دور المنظمات الدولية الاقليمية غير الحكومية والرأي العام في احترام وحماية حقوق الانسان • مصطلح الديمقراطية ، نشأته، دلالته، تاريخ الديمقراطية. الأنظمة الديمقراطية في العالم/الديمقراطية في العالم الثالث/ المشاكل التي تواجه البلدان العربية في التحول الديمقراطي [15 hrs].

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	35	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	15	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	1
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**50**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	20% (20)	5 and 10	LO #1, #2, and #5, #6
	Assignments	2	10% (10)	6 and 12	LO#3 and #4
	Projects / Lab.	0	0% (0)		
	Report	1	10% (10)	14	LO #5
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #3
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	حقوق الإنسان ، تعريفها ، أهدافها حقوق الإنسان في الحضارات القديمة وخصوصا حضارة وادي الرافدين
Week 2	حقوق الانسان في الشرائع السماوية مع التركيز على حقوق الانسان في الاسلام
Week 3	حقوق الإنسان في التاريخ المعاصر والحديث : الاعتراف الدولي بحقوق الإنسان منذ الحرب العالمية الأولى وعصبة الامم المتحدة
Week 4	الاعتراف الإقليمي بحقوق الإنسان : الاتفاقية الاوربية لحقوق الانسان 1950 ، الاتفاقية الامريكية لحقوق الانسان 1969 ، الميثاق الافريقي لحقوق الانسان 1981 ، الميثاق العربي لحقوق الانسان 1994
Week 5	حقوق الإنسان الحديثة : الحقائق في التنمية ، الحق في البيئة النظيفة ، الحق في التضامن ، الحق في الدين حقوق الانسان ، (المنظمات الوطنية لحقوق الانسان
Week 6	حقوق الإنسان في الدساتير العراقية بين النظرية والواقع
Week 7	حقوق الإنسان الاقتصادية والاجتماعية والثقافية وحقوق الانسان المدنية والسياسية +Mid-term Exam
Week 8	حقوق الإنسان الحديثة : الحقائق في التنمية ، الحق في البيئة النظيفة ، الحق في التضامن ، الحق في الدين
Week 9	ضمانات احترام وحماية حقوق الإنسان على الصعيد الوطني ، الضمانات في الدستور والقوانين الضمانات في الرقابة الدستورية ، الضمانات في حرية الصحافة والرأي العام ، دور المنظمات غير الحكومية في احترام وحماية حقوق الإنسان
Week 10	ضمانات واحترام وحماية حقوق الإنسان على الصعيد الدولي : • دور الأمم المتحدة ووكالاتها المتخصصة في توفير الضمانات • دور المنظمات الإقليمية (الجامعة العربية ، الاتحاد الأوروبي ، الاتحاد الافريقي ، منظمة الدول الأمريكية ، منظمة آسيان) دور المنظمات الدولية الإقليمية غير الحكومية والرأي العام في احترام وحماية حقوق الإنسان
Week 11	مصطلح الديمقراطية ، نشأته، دلالته، تاريخ الديمقراطية.
Week 12	الإسلام والديمقراطية ومساوئ الحكم الاستبدادي .
Week 13	الانتقادات الموجهة للديمقراطية، ومحاسن النظام الديمقراطي .
Week 14	الأنظمة الديمقراطية في العالم/الديمقراطية في العالم الثالث/ المشاكل التي تواجه البلدان العربية في التحول الديمقراطي
Week 15	**Preparatory week before the final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	حقوق الإنسان والديمقراطية للدكتور محمد عابدالجابري 2006	Yes
Recommended Texts	حقوق الإنسان والديمقراطية اعداد أ.م.د. غسان كريم مجذاب و أ.م. امجد زين العابدين طعمة للعام 2018	No

Websites	" طرق وتعليم وثقافة حقوق الانسان" ، منشور على شبكة المعلومات الدولية (الانترنت) على الموقع الالكتروني **http://ghrorg-learning.blogspot.com**

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Code	**Course/Module Title**	**ECTS**	**Semester**
NTU 100	**Human Rights & Democracy**	**2**	**1**
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	**0**	**32**	**15**
Description			
مادة حقوق الإنسان والديمقراطية تقدم فهمًا شاملاً للمفاهيم والمبادئ الأساسية لحقوق الإنسان والنظم الديمقراطية. تركز المادة على دراسة القيم والمبادئ التي تحكم حقوق الإنسان وحمايتها، بالإضافة إلى فهم أهمية الديمقراطية في تنظيم الحكم وضمان مشاركة المواطنين في صنع القرارات. يتناول المقرر مواضيع مثل المساواة، وحرية التعبير، وحقوق المرأة والطفل، وحقوق الأقليات، وحقوق العمال واللاجئين، وأسس ومؤسسات الديمقراطية. تهدف المادة إلى تعزيز الوعي القانوني والأخلاقي بين الطلاب، وتمكينهم من فهم أهمية حقوق الإنسان والمشاركة الديمقراطية في بناء مجتمع عادل ومتقدم.			

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

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<tr><td colspan="3">Module Information
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<tr><td>Module Leader</td><td colspan="2">Mohammed Tareq Khaleel</td><td>e-mail</td><td colspan="3">Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td colspan="2">Module Leader’s Acad. Title</td><td>Lecturer</td><td colspan="3">Module Leader’s Qualification</td><td>M. Linguistics and English Language Teaching</td></tr>
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<tr><td colspan="2">Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
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<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
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Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	• To develop problem solving skills mainly speaking, reading, writing and listening skills and to understand the English language as a foreign language through the application of many techniques. • To understand the general principles of the English language. • This course deals with the basic concepts of learning the main rules of English grammar and English vocabularies. • This is the basic subject for writing and speaking English well. • To understand how to build a correct English sentence.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	• To recognize how to use the main and auxiliary verbs in addition to the possessive pronouns.. • To list the various words associated with questions and many subject pronouns. • To talk about social expressions and personal information mainly about jobs by using affirmative, negative and interrogative sentences. • To discuss how to use adjectives and their positions in the sentence. • To construct the simple present sentence by using I/ we/ you and they and to define the articles. • To describe the present simple tense with using he/ she and to discuss adverbs of frequency. • To identify the basic question words and demonstrative pronouns and their applications. • To discuss the use of there is/ are and many prepositions. • To discuss the structure of simple past sentences and various irregular verbs. • To explain the negative and interrogative structure of the simple past tense sentence in addition to the adverbs of the past tense. • To identify the use of many adverbs and the use of can/ can't in the sentence and to explain requests and offers. • To elaborate the use of like and would you like and the use of some and any in many expressions. • To discuss the use of the present continuous and the difference between present simple and present continuous sentences. • To explain the structures that are used to refer to future plants.
Indicative Contents المحتويات الإرشادية	• An introduction to the importance of English language learning and the role it

	plays in social communication. • An application of various tenses like present and past tenses. • Demonstrating many main concepts including (offers, requests, future plants, personal expressions and tenses). • Using many skills to learn English like listening, reading, writing and speaking skills, moreover; presenting different examples to elaborate any concept or structure.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The main strategy that will be adopted in this module is associated with the communicative approach which will be applied to develop students' skills to learn English and to enable students to use English in communication, therefore, using authentic materials in the class is so necessary. This approach is important to encourage students' participation in the class and to highlight their motivation in learning English, while at the same time refining and expanding their interactions and skills to achieve at least more success.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	32	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	18	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	1
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**50**		

Module Evaluation تقييم المادة الدراسية					
As		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	15% (15)	5 and 1	LO #1, #3 and #6, #13
	Assignments	2	15% (15)	2 and 12	LO #2, #4 and 7#, #12
	Projects / Lab.				
	Report	1	10% (10)	13	LO #5, #8 and #9 #10
Summative assessment	Midterm Exam	1hr	10% (10)	7	LO #1 - #7
	Final Exam	2hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Unit one: Hello Am/are/is. my/your This is with practice in work
Week 2	Unit two: Your world He/she/they, his/her Questions
Week 3	Unit three: All about you Personal information/ social expressions
Week 4	Unit four: Family and friends Possessive adjectives/ possessive 's Have/has , adjective + noun
Week 5	Unit five: The way i live Present simple l/we/you/they An/a , adjective + noun

Week 6	Unit six: Every day Present simple he/she Negatives and questions, adverbs of frequency
Week 7	Unit seven: My favorites Question words, pronouns, this/that
Week 8	Unit eight: Where l live There is/ are, prepositions
Week 9	Unit nine: Times past Was/ were born, past simple and irregular verbs
Week 10	Unit ten: We had a great time Past simple, regular and irregular Questions, negatives, ago
Week 11	Unit eleven: l can do that! Can/can't, adverbs, requests
Week 12	Unit twelve: Please and thank you I'd like, some and any Like and would like
Week 13	Unit thirteen: Here and now Present continuous Present simple and present continuous
Week 14	Unit fourteen: It's time to go! Future plans, writing email and information letter
Week 15	**Revision**
Week 16	**Preparatory week before the final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	John and liz Soar. (New Headway Beginner) 4th edition. Oxford: Oxford University Press.	Yes
Recommended Texts		No
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX** – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Module 1

Code	Course/Module Title	ECTS	Semester
NTU 100	English Language	2	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/sem)**
2	0	32	18
Description			
This module will be used to develop problem solving skills mainly speaking, reading, writing and listening skills and to understand English language as a foreign language through the application of many techniques. It is also important to understand the general principles of English language. This course deals with the basic concepts of learning the main rules of English grammar and English vocabularies. It is mainly the basic subject for writing and speaking English well. The module is to understand how to build a correct English sentence. It contains various grammatical rules and different vocabularies with using typical examples to explain the structure and the meaning of any word or expression. The module is valid and reliable to deal with many recognizable situations and how to use English in different contexts associating with life experiences.			

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Topographic Surveying**		**Module Delivery**	
Module Type	**Core**		☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 106**			
ECTS Credits	**8**			
SWL (hr/sem)	**200**			
Module Level		1	**Semester of Delivery**	2
Administering Department		SUT	**College**	
Module Leader	Dr. Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title		Lecturer	**Module Leader's Qualification**	Ph.D.
Module Tutor			**e-mail**	
Peer Reviewer Name			**e-mail**	E-mail
Scientific Committee Approval Date			**Version Number**	.

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	• Understanding how to determine level of points, horizontal distances, and elevations of points. • Familiarity with surveying instruments related to the practical aspect. • Understanding how to draw contour map. • Understanding how to sketch cross sections and profiles of construction. • Understanding the mathematical methods of cut and fill volumes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	• Recognize how to use tools in measurement of leveling. • List the various method in measurement. • Summarize what is slope areas and how to level that area. • Discuss the errors through the leveling. • Describe the environmental effects on leveling. • Define the method to draw contour lines. • Discuss the theory of fixing traverses using contour maps. • Define profiles and cross sections of construction. • Explain the mathematical formula to determine volumes using contour maps. • Identify the methods to determine volumes of cut and fill.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. Introduction to leveling – Local and global levels, leveling tools. [SSWL=5 hrs] Leveling skills in field – Types of Benchmarks, length Measure by level, procedure of Leveling, leveling Table. [SSWL=10 hrs] Leveling skills in field – Error adjustment, obstacles in field, leveling of slopes, close leveling. [SSWL=10 hrs] Contour maps – Contour lines, traverse fixing on contour maps, volume using contour maps. [SSWL=10 hrs] Profiles and cross sections – Types of profiles and cross sections, drawing of profiles and cross sections, leveling in profiles and cross sectionss [SSWL=15 hrs] Cut and fill calculation – Cut and fill on level, engineering application of cut and fill, cut and fill using contour maps, volume formula [SSWL=15 hrs] Volumes of cut and fill – End area method, Prismoidal Method [SSWL=10 hrs]

	Total hrs = 75 = SSWL - (Exam hrs) = 79 - 4 = 75 hr (Time table hrs x 15 weeks)

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	200	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	8
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	50	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.5
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**200**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	1	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Introduction to leveling
Week 2	Types of benchmarks
Week 3	Measurement of horizontal distance by level
Week 4	Error adjustment of level
Week 5	Leveling in slope area
Week 6	Contour lines
Week 7	Area of traverse using contour map
Week 8	Profiles of construction
Week 9	Cross sections of construction
Week 10	Area of cross section
Week 11	Cut and fill on level
Week 12	Cut and fill using contour maps
Week 13	Volume of cut and fill
Week 14	End area method
Week 15	Prismoidal Method
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Lab 1: Introduction to leveling
Week 2	Lab 2: Fix the leveling instrument
Week 3	Lab 3: Leveling in field
Week 4	Lab 4: Contour lines
Week 5	Lab 5: Contour maps
Week 6	Lab 6: Profiles and cross sections
Week 7	Lab 7: Volume of cut and fill

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	N N Basak (2014). Surveying and Levelling. McGraw Hill Education. p. 542. ISBN 9789332901537	No
Recommended Texts	Brinker, Russell C; Minnick, Roy, eds. (1995). The Surveying Handbook. ISBN 978-1-4613-5858-9	No
Websites	https://www.youtube.com/watch?v=qgwBOVUFDAQ	

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**ENGINEERING MECHANICS**			**Module Delivery**
Module Type	**Basic**			☒Theory ☒ Lecture ☐ Lab ☒ Tutorial ☐ Practical ☐ Seminar
Module Code	**SUT 107**			
ECTS Credits	**7**			
SWL (hr/sem)	175			
Module Level	1	**Semester of Delivery**		2
Administering Department	SUT	**College**		
Module Leader	Mohammed Tareq Khaleel	**e-mail**		Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Ass. Professor	**Module Leader's Qualification**		Ph.D.
Module Tutor	Dr. Mutanna Adel Najim	**e-mail**		
Peer Reviewer Name		**e-mail**		
Scientific Committee Approval Date		**Version Number**		

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	To give basic information about force vector, moment and vector algebra. To teach the basic principles of particle and rigid cismen balance in the plane and in space. To give basic information about the stability of ties and conveyor systems. To teach the calculation of bond

	forces, cages, frames and internal forces in cables.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Introduction and Main Principles, Vectors and Forces, Static of Material Points, Rigid Bodies, Equivalent Force Systems, Center of Gravity, Equilibrium of Rigid Bodies, Internal Forces in Plane Rod Elements, Cross-Section Effects, Plane and Space Lattice Systems, Cables, Moment of Inertia, Potential Energy, Stable.
Indicative Contents المحتويات الإرشادية	

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Lecture & In-Class Activities, Preliminary & Further Study, Assignment (Homework) , Final Exam, Mid-Term Exam and short Exam.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ أسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	130	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	9
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	45	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**175**		

Module Evaluation
تقييم المادة الدراسية

As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	8			
	Assignments	8			
Summative assessment	**Midterm Exam**	2hr		7	
	Final Exam	3hr		16	
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري	
Week	**Material Covered**
Weeks 1&2	• Demonstrates knowledge about the Introduction to mechanics, Force systems, Scalar & vector quantities, • Able to identify and apply the Parallelogram law, Triangle law, Forces & components.
Weeks 3&4	• Able to identify and apply the Moment of a force , Varignon's theorem, and their Applications
Weeks 5&6	• Demonstrates knowledge of the Couples, • Able to identify Resolution of a force into a force & a couple.
Weeks 7&8	• Demonstrates knowledge and correctly compute the Resultant of force systems, Resultant of concurrent force system, Resultant of parallel force system, Resultant of non-concurrent force system.
Weeks 9&10&11	• Demonstrates knowledge, identify and correctly compute Equilibrium of force system, Free body diagram, Equilibrium of concurrent force system, Equilibrium of parallel force system, Equilibrium of non-concurrent force system.
Week 12	• Demonstrates knowledge of the Types of beams, Supports, and loads, Equilibrium of beams.
Weeks 13&14,15	• Demonstrates knowledge of the Trusses • Able to analyses the trusses, method of Joint, method of section.

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 – 89	Above average with some errors
	C – Good	جيد	70 – 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 – 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 – 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	Engineering Physics		**Module Delivery**	
Module Type	Support		☒ Tutorial ☐ Lecture ☒ Lab ☐ Theory ☐ Practical ☐ Seminar	
Module Code	SUT 109			
ECTS Credits	**4**			
SWL (hr/sem)	**100**			
Module Level	1		**Semester of Delivery**	2
Administering Department	SUT		**College**	
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader’s Acad. Title	Lecturer		**Module Leader’s Qualification**	PhD
Module Tutor			**e-mail**	
Peer Reviewer Name			**e-mail**	
Scientific Committee Approval Date			**Version Number**	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	1.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks. 1. .
Indicative Contents المحتويات الإرشادية	Indicative content includes the following.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	50	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	50	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation
تقييم المادة الدراسية

As		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	1	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	Midterm Exam	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

Week	Material Covered
Week 1	Scope of Physics I, Units, Physical Quantities and Vectors
Week 2	Units and conversions, Uncertainty and Significant Figures
Week 3	Linear Motion
Week 4	compute 2-D and 3-D Motion
Week 5	Newton's Law
Week 6	Applications of Newton's Law
Week 7	Review and solutions of the homework
Week 8	Work and Kinetic Energy
Week 9	Work and Kinetic Energy
Week 10	calculation of the Potential Energy and Conservation of Energy
Week 11	calculation of the Momentum, Impulse and Collisions
Week 12	calculation of the Rotational motion of Rigid Bodies
Week 13	calculation of the Rotational motion of Rigid Bodies
Week 14	calculation of the Rotational Kinematics
Week 15	**Preparatory week before the final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	"Conceptual Physics" by Paul G. Hewitt.	Yes
Recommended Texts	"University Physics" by Young and Freedman.	No

Websites	https://www.coursera.org/browse/physical-science-and-engineering/electrical-engineering

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
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	C – Good	جيد	70 - 79	Sound work with notable errors
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	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**DESCRIPTIVE GEOMETRY**		**Module Delivery**	
Module Type	**Support**		☐ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☒ **Practical** ☒ **Seminar**	
Module Code	**SUT 110**			
ECTS Credits	**6**			
SWL (hr/sem)	**150**			
Module Level	1		**Semester of Delivery**	2
Administering Department	SUT		**College**	
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Assist. Prof.		**Module Leader's Qualification**	Ph.D.
Module Tutor	Ekhlas N. Alansari		**e-mail**	ekhlasmohammed@ntu.edu.iq
Peer Reviewer Name	Yasin Mohammad		**e-mail**	Mohammad1974yasin@ntu.edu.iq
Scientific Committee Approval Date			**Version Number**	1.0

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	1. Understanding the basics of projection: Students learn the different types of projections (orthogonal, oblique, etc.) and how to use them to represent shapes and objects. 2. Representing geometric shapes: Students practice representing points, lines, planes, and other geometric shapes on a drawing plane. 3. Solving geometric problems: Students learn to solve geometric problems related to measuring lengths, angles, areas, and volumes. 4. Analyzing geometric shapes: Students learn to analyze complex geometric shapes and understand their spatial relationships. 5. Applying descriptive geometry in different fields: Students learn about the applications of descriptive geometry in architecture, mechanical engineering, industrial design, and others.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	The student will be able to: 1. Use engineering design aids program. 2. Apply descriptive geometry concepts in various engineering fields. 3. Learn the four even angles and project points and lines into even angles. 4. Calculate dimensions, lengths and areas. 5. Imagine geometric shapes in three dimensions. 6. Express his/her geometric ideas clearly and effectively.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. Part A - Theory of Projection Theory of Projection / Central of Projection, Orthographic, Horizontal and vertical projection planes, Auxiliary Plane. Projection of the point Projection of Straight Line, Inclination of Straight Line to any plane Inclination Angles , True length. Rabatment on the H. P., Rabatment on the V. P. Projection of Straight Line, Inclination of Straight Line to any plane Inclination Angles , True length. Rabatment on the H. P., Rabatment on the V. P. Projection of Straight Line, Inclination of Straight Line to any plane Inclination Angles , True length. Rabatment on the H. P., Rabatment on the V. P. Projection of Straight Line, Inclination of Straight Line to any plane / frontal line, frontal plane Projection of Straight Line, Inclination of Straight Line to any plane / frontal line, frontal plane The Plane Surface/ Auxiliary plane cases in space to horizontal and vertical planes Projection of point, straight line and plane to auxiliary planes Projection of point, straight line and plane to auxiliary planes Projection of solid to auxiliary planes Projection of solid to auxiliary planes Conic sections / Ellipse / Parabola / Hyperbola Solid Sections and Section Shape Cases of Section planes/ Parallel to the horizontal plane/ Parallel to the vertical plane/ Perpendicular to the horizontal and vertical planes Solid Sections and Section Shape Cases of Section planes / Perpendicular to the vertical plane and inclined at an angle to the

	horizontal plane/ Perpendicular to the horizontal plane and inclined at an angle to the vertical plane

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	•Interactive lectures: Interactive lectures are a good way to encourage active student participation. Asking questions and encouraging discussions will help enhance students' understanding of theoretical concepts. •Practical exercises: Practical exercises are essential to apply theoretical concepts to real-world engineering problems. Providing opportunities for practical application will help students better understand concepts and develop their practical skills. •Graphs: Using graphs and illustrations is a valuable tool to illustrate complex engineering concepts. •Project-based learning: Dividing students into groups and assigning them engineering projects will help develop teamwork skills and practical application of concepts. •Use of computer-aided design (CAD) software: Training students in the use of CAD software will help them develop their engineering drawing and 3D modeling skills. •Allocating time to solve exercises: Allocating a specific time to solve exercises in class will help students get the necessary support and assistance. •Cooperative learning: Encouraging teamwork will help students exchange ideas and learn more from each other. •Continuous assessment: Using a variety of assessment tools will help evaluate students' progress comprehensively.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	3
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	40	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	6	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	8	10% (10)	Continuous	All

	Class work	2	10% (10)	Continuous	All
	Seminar	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

Week	**Material Covered**
Week 1-2	Theory of Projection / Central of Projection, Orthographic, Horizontal and vertical projection planes, Auxiliary Plane. Projection of the point
Week 3	Projection of Straight Line, Inclination of Straight Line to any plane
Week 4	Inclination Angles , True length. Rabatment on the H. P., Rabatment on the V. P.
Week 5-6	Projection of Straight Line, Inclination of Straight Line to any plane / frontal line, frontal plane
Week 7	The Plane Surface/ Auxiliary plane cases in space to horizontal and vertical planes
Week 8-9	Projection of point, straight line and plane to auxiliary planes
Week 10-11	Projection of solid to auxiliary planes
Week 12	Conic sections / Ellipse / Parabola / Hyperbola
Week 13	Solid Sections and Section Shape
Week 14 - 15	Cases of Section planes/ Parallel to the horizontal plane/ Parallel to the vertical plane/ Perpendicular to the horizontal and vertical planes
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

Week	**Material Covered**
Week 1-2	Theory of Projection / Central of Projection, Orthographic, Horizontal and vertical projection planes, Auxiliary Plane. Projection of the point
Week 3	Projection of Straight Line, Inclination of Straight Line to any plane
Week 4	Inclination Angles , True length. Rabatment on the H. P., Rabatment on the V. P.
Week 5-6	Projection of Straight Line, Inclination of Straight Line to any plane / frontal line, frontal plane
Week 7	The Plane Surface/ Auxiliary plane cases in space to horizontal and vertical planes
Week 8-9	Projection of point, straight line and plane to auxiliary planes
Week 10-11	Projection of solid to auxiliary planes
Week 12	Conic sections / Ellipse / Parabola / Hyperbola
Week 13	Solid Sections and Section Shape
Week 14 -	Cases of Section planes/ Parallel to the horizontal plane/ Parallel to the vertical plane/ Perpendicular to the horizontal and vertical planes

15	
Week 16	**Preparatory week before the final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Fundamentals of Electric Circuits, C.K. Alexander and M.N.O Sadiku, McGraw-Hill Education	Yes
Recommended Texts	DC Electrical Circuit Analysis: A Practical Approach Copyright Year: 2020, dissidents.	No
Websites	https://www.coursera.org/browse/physical-science-and-engineering/electrical-engineering	

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Computer**			**Module Delivery**	
Module Type	**Support**			☐ Theory ☒ Lecture ☒ Lab ☒ Tutorial ☒ Practical ☒ Seminar	
Module Code	**NTU 102**				
ECTS Credits	**3**				
SWL (hr/sem)	**75**				
Module Level	1		**Semester of Delivery**	2	
Administering Department	SUT		**College**		
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq	
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	Master	
Module Tutor			**e-mail**		
Peer Reviewer Name			**e-mail**		
Scientific Committee Approval Date			**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	• Teaching computer principles in civil engineering equips students with the ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics • Computer principles aid in applying engineering design to produce solutions that meet specified needs with consideration of various factors such as public health, safety, welfare, and environmental impacts. • Learning computer principles helps students effectively communicate with diverse audiences, a vital skill for successful engineering professionals. • Teaching computer principles encourages graduates to engage in lifelong learning through professional training, independent inquiry, and acquiring new knowledge as needed to meet career goals and contribute creative ideas to their profession • Computer education in civil engineering emphasizes recognizing ethical and professional responsibilities in engineering situations, fostering informed judgments considering global, economic,.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	• Understanding computer hardware components and their functions. • Windows: Proficiency in using the Windows operating system • The student will be able to use the word program such as creating tables in and inserting images into diagrams • The student will be able to use the EXCEL program such as writing functions, preparing tables and inserting charts • The student will be able to create a presentation that includes a number of Slides, using images, tables, diagrams, changing colors Influences • The student will get acquainted with the global network (the internet) and deal with it ,Search and create email
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. Part A - Computer fundamentals Definition of computer- Parts of computer- Devices related to computer, Software and hardware, Windows- Able to use the following items: Start menu, desktop, taskbar , mouse applications, My computer , My documents , drivers , folders , files , cut , copy Part B -Microsoft Word Introduction to Microsoft Word and the Interface, Text Formatting and Tables , Page Layout and References Part C- Excel Microsoft Excel Fundamentals and Data Entry, Formulas and Functions, Charts and Data Analysis Part D -PowerPoint Microsoft Introduction to PowerPoint and Basic Features, Enhancing Your Presentations

	, Advanced Techniques and Best Practices Part E –Internet Introduction to the World of the Internet, Search Engines, Create an email account

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Lecture: Introduce new concepts and demonstrate techniques. Hands-on Activities: Provide guided practice for students to apply what they've learned. Group Work: Encourage collaboration and problem-solving through group activities. Q&A: Facilitate discussion and address student questions

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	39	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	11	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	1
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	50		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Class work	8	10% (10)	Continuous	All
	seminar	2	10% (10)	6 and 11	All
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري والعملي	
Week	**Material Covered**

Week 1	Computer fundamentals / Definition of computer- Parts of computer- Devices related to computer
Week 2	Computer fundamentals/ Software and hardware
Week 3	Computer fundamentals/ Windows- Able to use the following items: Start menu, desktop, taskbar , mouse ....applications, My computer , My documents , drivers , folders , files , cut , copy ,
Week 4	Microsoft Word / Introduction to Microsoft Word and the Interface
Week 5	Microsoft Word/ Text Formatting and Tables
Week 6	Microsoft Word/ Page Layout and References
Week 7	Excel Microsoft / Excel Fundamentals and Data Entry
Week 8	Excel Microsoft / Formulas and Functions
Week 9	Excel Microsoft/ Charts and Data Analysis
Week 10	PowerPoint Microsoft / Introduction to PowerPoint and Basic Features
Week 11	PowerPoint Microsoft /Enhancing Your Presentations
Week 12	PowerPoint Microsoft / Advanced Techniques and Best Practices
Week 13	Internet/Introduction to the World of the Internet
Week 14	Internet/ Search Engines
Week 15	Internet/ Create an email account
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Computer fundamentals / Definition of computer- Parts of computer- Devices related to computer
Week 2	Computer fundamentals/ Software and hardware
Week 3	Computer fundamentals/ Windows- Able to use the following items: Start menu, desktop, taskbar , mouse .....applications, My computer , My documents , drivers , folders , files , cut , copy ,
Week 4	Microsoft Word / Introduction to Microsoft Word and the Interface
Week 5	Microsoft Word/ Text Formatting and Tables
Week 6	Microsoft Word/ Page Layout and References
Week 7	Excel Microsoft / Excel Fundamentals and Data Entry
Week 8	Excel Microsoft / Formulas and Functions
Week 9	Excel Microsoft/ Charts and Data Analysis
Week 10	PowerPoint Microsoft / Introduction to PowerPoint and Basic Features
Week 11	PowerPoint Microsoft /Enhancing Your Presentations
Week 12	PowerPoint Microsoft / Advanced Techniques and Best Practices
Week 13	Internet/Introduction to the World of the Internet
Week 14	Internet/ Search Engines
Week 15	Internet/ Create an email account
Week 16	Preparatory week before the final Exam

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**

Required Texts	Principles of Computer Security, Fourth Edition 4th Edition	Yes
Recommended Texts		
Websites	Microsoft Learn: • https://www.google.com/url?sa=E&source=gmail&q=https://learn.microsoft.com/ Office Support: • https://www.google.com/url?sa=E&source=gmail&q=https://support.microsoft.com/office Official Microsoft Channel https://www.youtube.com/microsoft •	

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
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MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

<table>
<tr><th colspan="6">Module Information</th></tr>
<tr><td>Module Title</td><td colspan="3"><u>Arabic Language</u></td><td colspan="2">Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="3"><u>Basic</u></td><td colspan="2" rowspan="4">☒ Theory
☐ Lecture
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="3">NTU 103</td></tr>
<tr><td>ECTS Credits</td><td colspan="3">2</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="3">50</td></tr>
<tr><td colspan="2">Module Level</td><td>1</td><td colspan="2">Semester of Deliver</td><td>2</td></tr>
<tr><td colspan="2">Administering Department</td><td><u>SUT</u></td><td>College</td><td colspan="2"></td></tr>
<tr><td>Module Leader</td><td colspan="2"><u>Saja Moaeed Ahmed</u></td><td>e-mail</td><td colspan="2"><u>Saja.moaeed@ntu.edu.iq</u></td></tr>
<tr><td colspan="2">Module Leader’s Acad. Title</td><td>Assist Lect.</td><td colspan="2">Module Leader’s Qualification</td><td>M.Sc.</td></tr>
<tr><td>Module Tutor</td><td colspan="2"></td><td>e-mail</td><td colspan="2"></td></tr>
<tr><td colspan="2">Peer Reviewer Name</td><td></td><td>e-mail</td><td colspan="2"></td></tr>
<tr><td colspan="2">Scientific Committee Approval Date</td><td></td><td>Version Number</td><td colspan="2"></td></tr>
</table>

<table>
<tr><th colspan="4">Relation with other Modules</th></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">Module Aims, Learning Outcomes and Indicative Contents</th></tr>
<tr><td>Module Objectives</td><td>• <u>Enhancing effective communication: Teaching Arabic aims to enable students to communicate effectively in the Arab environment, both in daily life and in academic and professional contexts.</u>
• <u>Understanding Arab culture: Learning Arabic is a key to understanding Arab culture and its values, helping students to explore the rich Arab heritage and comprehend the cultural diversity within the Arab world.</u>
• <u>Enhancing research and academic skills: Learning Arabic contributes to developing research and academic writing skills for students, enabling them to actively participate in academic discussions and contribute to knowledge production.</u>
• <u>Providing job opportunities: Proficiency in Arabic is a valuable skill in the job market, allowing students to</u></td></tr>
</table>

	.
Module Learning Outcomes	• Effective communication skills: Students acquire listening, speaking, reading, and writing skills in Arabic, enabling them to communicate fluently and understand content accurately. • Understanding texts and culture: Students learn to read and comprehend literary and cultural texts in Arabic, enhancing their understanding of Arab heritage and developing critical analysis of literary works. • Research and academic writing abilities: Students learn how to conduct research and engage in academic writing in Arabic, enabling them to present research papers and academic reports effectively. • Cultural and social interaction: Students are able to actively participate in the Arab community, gaining a deeper understanding of local traditions, values, and customs, fostering cultural understanding and peaceful coexistence.
Indicative Contents	• Introduction to Indicative Contents: Defining indicative contents and understanding their significance in various fields and disciplines. • Types and Formats of Indicative Contents: Exploring different types and formats of indicative contents, such as tables, charts, bullet points, and summaries. • Creating Indicative Contents: Techniques and strategies for effectively creating indicative contents, including selecting key information, simplifying complex concepts, and organizing content for easy comprehension. • Visual Representation of Indicative Contents: Utilizing visual aids, such as infographics, diagrams, and illustrations, to present indicative contents in an engaging and informative manner. • Examples and Case Studies: Analyzing real-life examples and case studies to understand how indicative contents are used in various contexts, such as research reports, marketing materials, and educational resources.

Learning and Teaching Strategies	
Strategies	• Interactive Language Activities: Engaging students in interactive activities such as role-plays, group discussions, and language games to practice and reinforce language skills. • Communicative Approach: Emphasizing real-life communication and providing opportunities for students to actively engage in speaking, listening, reading, and writing tasks to develop their language proficiency. • Authentic Materials: Incorporating authentic materials such as newspaper articles, songs, videos, and literature to expose students to real-world language usage and cultural contexts

Student Workload (SWL)			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	**35**	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	**2**

Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	**15**	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	**1**
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**50**		

Module Evaluation					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	**4**	**30% (30)**	**3,6,10 and 14**	**LO #1, #2 , #3, and #4**
	Assignments	**2**	**10% (10)**	**4 and 12**	**LO #1and #4**
	Projects / Lab.		**0% (0)**	**0**	**0**
	Report		**0% (0)**	**0**	**0**
Summative assessment	**Midterm Exam**	**1hr.**	**10% (10)**	**7**	**LO #1 - #2**
	Final Exam	**2hr.**	**50% (50)**	**16**	**All**
Total assessment			**100% (100 Marks)**		

Delivery Plan (Weekly Syllabus)		
Week	**Material Covered**	
Week 1	مقدمة عن الأخطاء اللغوية	Introduction to Language Errors:
Week 2	التاء المربوطة والتاء المفتوحة–	• Taa Marbuta and Taa Marbuta (Bound and Open Taa): Understanding the rules and usage of the Taa Marbuta and Open Taa in Arabic language.
Week 3	همزة الوصل والقطع	• Hamzat Al-Wasl and Al-Qat' (Hamza of Connection and Hamza of Disconnection): Differentiating between Hamzat Al-Wasl and Al-Qat' and their respective roles in pronunciation.
Week 4	الهمزة المتوسطة والمتطرفة	• Alif Al-Maddooda and Alif Al-Muqassara Writing Rules: Exploring the rules for writing Alif Al-Maddooda (elongated Alif) and Alif Al-Muqassara (shortened Alif).
Week 5	قواعد كتابة الالف الممدودة والمقصورة –	• Solar and Lunar Letters: Identifying the distinction between solar and lunar letters in Arabic pronunciation.
Week 6	الحروف الشمسية والقمرية	• Adad (Numbers): Learning about the numerical system in Arabic and its usage.
Week 7	الضاد والظاء	• Verbs: Understanding verb conjugation and the different verb forms in Arabic.
Week 8	العـــدد	• Parts of Speech: Exploring the different parts of speech, including nouns, verbs, adjectives, adverbs, etc.
Week 9	المفاعيل	• Meanings of Prepositions: Examining the meanings and usage of prepositions in Arabic.

Week 10	أقسام الكلام	• Common Language Errors: Analyzing common language errors and their applications in practical contexts.
Week 11	معاني حروف الجر	• Noon and Tanween: Understanding the usage and pronunciation of Noon and Tanween in Arabic.
Week 12	تطبيقات الأخطاء اللغوية الشائعة	• Taa Marbuta and Taa Marbuta (Bound and Open Taa): Understanding the rules and usage of the Taa Marbuta and Open Taa in Arabic language.
Week 13	النون والتنوين -	• Hamzat Al-Wasl and Al-Qat' (Hamza of Connection and Hamza of Disconnection): Differentiating between Hamzat Al-Wasl and Al-Qat' and their respective roles in pronunciation.
Week 14	مقدمة عن الأخطاء اللغوية	• Alif Al-Maddooda and Alif Al-Muqassara Writing Rules: Exploring the rules for writing Alif Al-Maddooda (elongated Alif) and Alif Al-Muqassara (shortened Alif).
Week 15	الأخطاء اللغوية	• Solar and Lunar Letters: Identifying the distinction between solar and lunar letters in Arabic pronunciation.
Week 16	Preparatory week before the final Exam	

Learning and Teaching Resources		
	Text	**Available in the Library?**
Required Texts	• "الكافية" للكندي: يعتبر من أهم الكتب في علم النحو، حيث يشرح القواعد والتراكيب النحوية بأسلوب مبسط وشامل. • "الصرف" لابن مالك: كتاب مشهور يتناول قواعد تصريف الأفعال والأسماء في اللغة العربية، ويعد من أعمال النحو الكلاسيكية. • "المفصل في علم العربية" لابن جني: كتاب شامل يغطي مجموعة واسعة من موضوعات النحو والصرف والبلاغة والأدب	**Yes**
Recommended Texts	• "الألفية" لابن مالك: كتاب مشهور في علم النحو والصرف، يعتبر من أهم المراجع الكلاسيكية في دراسة اللغة العربية. • "المستطرف في كل فن مستظرف" لابن الأنباري: كتاب يشمل العديد من الألفاظ والتعابير العربية المستخدمة في الأدب والشعر. • "البيان والتبيين" لابن حجر العسقلاني: كتاب يتناول موضوعات النحو والصرف والبلاغة، ويعتبر مرجعًا قيمًا في دراسة اللغة العربية.	**No**
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group	A - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors

(50 - 100)	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	FX – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

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Module 1

Code	**Course/Module Title**	**ECTS**	**Semester**
NTU 201	Arabic language	**2**	**4**
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/sem)**
2	**0**	**32**	**18**
Description			
The description for the Arabic language is: Arabic is a rich and diverse language spoken by millions of people around the world. It is the official language of over 20 countries and holds great cultural and historical significance. With its unique alphabet, intricate grammar, and beautiful calligraphy, Arabic offers a fascinating linguistic journey. Whether you are interested in exploring the language for academic, professional, or personal reasons, learning Arabic opens doors to understanding Arab culture, literature, and society. From basic greetings to advanced conversational skills, mastering Arabic provides opportunities for communication, travel, and career prospects. Embrace the beauty of Arabic as you embark on a journey of language discovery and cultural immersion.			

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

<table>
<tr><th colspan="6">Module Information
معلومات المادة الدراسية</th></tr>
<tr><td>Module Title</td><td colspan="3">ADVANCED SURVEYING</td><td colspan="2">Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="3">Core</td><td colspan="2" rowspan="4">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="3">SUT 201</td></tr>
<tr><td>ECTS Credits</td><td colspan="3">8</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="3">200</td></tr>
<tr><td colspan="2">Module Level</td><td>2</td><td colspan="2">Semester of Delivery</td><td>1</td></tr>
<tr><td colspan="2">Administering Department</td><td>SUT</td><td>College</td><td colspan="2"></td></tr>
<tr><td>Module Leader</td><td colspan="2"></td><td>e-mail</td><td colspan="2">Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td colspan="2">Module Leader’s Acad. Title</td><td>Lecturer</td><td colspan="2">Module Leader’s Qualification</td><td>Ph.D.</td></tr>
<tr><td>Module Tutor</td><td colspan="2">Mostafa Ismat Abdulrahman</td><td>e-mail</td><td colspan="2">Mustafa.ismat@ntu.edu.iq</td></tr>
<tr><td colspan="2">Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td colspan="2">E-mail</td></tr>
<tr><td colspan="2">Scientific Committee Approval Date</td><td></td><td colspan="2">Version Number</td><td></td></tr>
</table>

<table>
<tr><th colspan="4">Relation with other Modules
العلاقة مع المواد الدراسية الأخرى</th></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</th></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>1. The objective is to provide knowledge and skills related to the practical application of surveying techniques and methods in various engineering and construction projects. It aims to equip individuals with the necessary tools and techniques to accurately measure, map, and analyze land and other physical features.
2. The objective of studying applied surveying is to provide individuals with the knowledge, skills, and techniques required to carry out accurate and reliable measurements, mapping, and analysis in engineering and construction projects. It enables individuals to effectively contribute to land development, infrastructure projects, resource management, and spatial data analysis in various industries.</td></tr>
<tr><td>Module Learning Outcomes

مخرجات التعلم للمادة الدراسية</td><td>1. Understanding Fundamental Concepts: Demonstrate a clear understanding of the basic principles and concepts of plane surveying, including types of surveys and common surveying instruments.
2. Instrument Proficiency: Operate surveying instruments such as theodolites, total stations, and levels, effectively and safely, ensuring accurate measurements.
3. Measurement Techniques: Apply techniques for measuring distances, angles, and elevations, and understand how to minimize errors in these measurements.
4. Data Collection and Analysis: Collect, record, and analyze field data using appropriate surveying methods, ensuring accuracy and precision.
5. Mapping Skills: Produce accurate maps and plans based on collected data, utilizing software tools and manual drafting techniques.
6. Error Analysis: Identify and correct systematic and random errors in surveying measurements and calculations, applying statistical methods as necessary.
7. Legal and Ethical Considerations: Understand the legal implications of surveying practices, including land ownership, boundaries, and ethical considerations in the field.
8. Project Management: Plan and execute a surveying project, including budgeting, scheduling, and resource allocation.
9. Team Collaboration: Work effectively as part of a team, demonstrating communication skills and collaborative problem-solving in a surveying context.
10. Application of Technology: Utilize modern surveying technologies and software applications to enhance data collection and analysis processes.</td></tr>
<tr><td></td><td>Indicative content includes the following.

1. Introduction to Surveying
• Definition and importance of surveying
• Types of surveys: plane vs. geodetic
• Applications of surveying in various fields
2. Surveying Instruments
• Overview of common surveying tools
• Theodolites
• Levels
• Total stations
• Tape measures and EDMs (Electronic Distance Measurement)</td></tr>
</table>

Indicative Contents المحتويات الإرشادية	• Instrument calibration and maintenance 3. Measurement Techniques • Distance measurement techniques (chain, tape, EDM) • Angle measurement methods (horizontal and vertical angles) • Elevation measurement techniques (leveling) 4. Field Procedures • Setting up the survey: site preparation and layout • Conducting field surveys: procedures and best practices • Field data recording methods 5. Error Theory and Adjustment • Types of errors: systematic, random, and blunders • Error propagation and analysis • Methods of adjustment (e.g., least squares) 6. Data Processing and Analysis • Data organization and management • Calculation of coordinates and reduced levels • Use of software for data processing (e.g., CAD, GIS) 7. Mapping and Representation • Principles of map design and cartography • Preparing topographic maps and plans • Understanding scales and projections 8. Legal Aspects of Surveying • Land ownership and property boundaries • Legal descriptions and land surveys • Ethical considerations in surveying practices 9. Special Topics in Surveying • Photogrammetry and remote sensing • GPS and its applications in surveying • Geographic Information Systems (GIS) 10. Project Work • Planning and executing a small surveying project • Teamwork and collaboration in fieldwork • Presentation of results and findings This content outline provides a comprehensive overview of the topics typically covered in a Plane Surveying course, ensuring students gain both theoretical knowledge and practical skills.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم

Strategies	1. Measurement Techniques • Use of Techniques: Apply appropriate measurement techniques (tape, EDM, leveling) based on the survey requirements. • Double-Check Measurements: Re-measure critical points to verify accuracy. 4. Data Collection • Consistent Recording: Maintain accurate and consistent data recording practices, using digital methods where possible. • Field Notes: Take detailed field notes, including conditions, instrument setups, and any anomalies. 5. Error Management • Error Identification: Regularly check for systematic and random errors during measurements. • Adjustment Techniques: Use error adjustment methods (like least squares) to improve data accuracy. 6. Data Processing • Organize Data: Systematically organize collected data for analysis. • Software Utilization: Leverage software tools (CAD, GIS) for processing and visualizing survey data. 7. Quality Control • Field Checks: Conduct regular field checks to ensure data integrity. • Cross-Verification: Validate results with independent measurements or alternate methods.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**200**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	0	10% (10)	Continuous	All

	Report	5	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Demonstrates knowledge of the General basics of surveying, fundamentals of surveying, units of measurements, Plotting scale.
Week 2	Demonstrates knowledge of the General basics of surveying, fundamentals of surveying, units of measurements, Plotting scale.
Week 3	Conducts Linear measurements. Means for measuring distances, Direct method of horizontal distances measurement, Target survey, Details, Electronic distance measuring instruments.
Week 4	Conducts Linear measurements. Means for measuring distances, Direct method of horizontal distances measurement, Target survey, Details, Electronic distance measuring instruments.
Week 5	Demonstrates awareness of the Errors in surveying. Types of errors, Accuracy and precision, Principles of errors scattering theory.
Week 6	Demonstrates knowledge and awareness of the Obstacles to measuring.
Week 7	Demonstrates knowledge and awareness of the Obstacles to measuring.
Week 8	Sinusoidal Forcing, Complex Forcing, Phasors, and Complex Impedance, Sinusoidal Steady State Response
Week 9	Implement the calculation of Traversing.
Week 10	Identify the Types of traverses,
Week 11	Conducts Coordinates measurement, Traverse adjustment.
Week 12	Uses correctly Leveling equipment.
Week 13	Demonstrates knowledge of the Types of leveling, leveling instrumentation, Leveling by taping, Trigonometric leveling
Week 14	Demonstrates knowledge of the Types of leveling, leveling instrumentation, Leveling by taping, Trigonometric leveling
Week 15	Identify the Sources of errors in leveling (vertical, horizontal).
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**

Week 1	Lab 1: Demonstrates knowledge of the Basic fundamentals of surveying.
Week 2	Lab 2: Able to Use tape and chain in the linear measurement and perpendicular construction.
Week 3	Lab 3: Demonstrates knowledge of the Details survey by measuring tape and obstacles to measuring.
Week 4	Lab 4: Demonstrates knowledge of the Traversing, types of traverses.
Week 5	Lab 5: Conducts training how to use leveling instrument.
Week 6	Lab 6: Carries out Height difference between two points from one station of level.
Week 7	Lab 7: Uses correctly Trigonometric leveling.

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	• **Surveying for Construction"** fot William Irvine Finlay Maclennan: و	Yes
Recommended Texts	• **"Elementary Surveying: An Introduction to Geomatics"** للمؤلفين Charles D. Ghilani و. Paul R. Wolf: • **مساحة الأراضي والمسطحات** "مراجع عربية متوفرة في الجامعات":	No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A** – Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX** – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Cartography**			**Module Delivery**	
Module Type	**Core**			☒ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**SUT 203**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	2		**Semester of Delivery**	1	
Administering Department	SUT		**College**		
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq	
Module Leader's Acad. Title	Ass. Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	Mostafa Ismat Abdulrahman		**e-mail**	Mustafa.ismat@ntu.edu.iq	
Peer Reviewer Name	Name		**e-mail**	E-mail	
Scientific Committee Approval Date			**Version Number**		

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	1. The objective of studying "Cartography" topics is to provide individuals with the knowledge and skills necessary to create accurate, visually appealing, and informative maps. Cartography is the art and science of map-making, and its objective is to effectively represent spatial information and geographic phenomena. 2. the objective of studying cartography is to equip individuals with the knowledge and skills to create accurate, visually appealing, and informative maps. It involves understanding map design principles, geographic data representation, map projection, and symbology. Cartography also includes the application of spatial analysis techniques and the use of modern mapping technologies. By mastering cartographic skills, individuals can effectively communicate spatial information, support decision-making processes, and contribute to various

	fields such as geography, urban planning, environmental studies, and transportation.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Understanding Cartographic Principles: Demonstrate a comprehensive understanding of the fundamental principles of cartography, including scale, projection, and map design. 2. Map Interpretation: Analyze and interpret various types of maps, understanding their purpose, features, and the information they convey. 3. Map Design and Creation: Design and create maps that effectively communicate spatial information, using appropriate symbols, colors, and layouts. 4. Cartographic Techniques: Apply various cartographic techniques, including thematic mapping, contouring, and the use of GIS tools for map production. 5. Projection Knowledge: Understand different map projections and their implications for representing spatial data accurately. 6. Data Visualization: Use data visualization techniques to represent geographical data effectively on maps, enhancing user comprehension. 7. Geographic Information Systems (GIS): Utilize GIS software to analyze spatial data and produce high-quality cartographic outputs. 8. Ethical Considerations: Recognize and address ethical considerations in cartography, including data representation, bias, and user impact. 9. Collaborative Skills: Work effectively in teams to create maps, demonstrating strong communication and collaborative problem-solving skills. 10. Critical Thinking: Evaluate the effectiveness of different cartographic methods and approaches, applying critical thinking to improve map design and utility. These outcomes can be tailored based on the specific focus and goals of the course but generally encompass the essential skills and knowledge needed in cartography.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. 1. Introduction to Cartography • Definition and importance of cartography • Historical development of cartography • Types of maps and their uses 2. Map Design Principles • Basic design elements: symbols, colors, and typography • Layout and composition: visual hierarchy and balance • Effective map communication: clarity and aesthetics 3. Map Projections • Understanding map projections: definitions and purposes • Types of projections: cylindrical, conic, and azimuthal • Distortions and trade-offs in different projections 4. Thematic Mapping • Types of thematic maps: choropleth, dot density, and graduated symbol maps • Data classification methods: equal intervals, quantiles, and natural breaks

	• Visualizing qualitative and quantitative data 5. Geographic Information Systems (GIS) • Introduction to GIS and its role in cartography • Data collection and management in GIS • Spatial analysis techniques and map production using GIS software 6. Cartographic Techniques and Tools • Traditional cartographic methods: hand-drawing and engraving • Digital mapping techniques: software tools and applications • Using remote sensing data in cartography 7. Cartographic Symbols and Standards • Development and use of cartographic symbols • National and international cartographic standards (e.g., ISO, OGC) • Symbolization for different themes and audiences 8. Map Interpretation and Use • Skills for reading and interpreting maps • Understanding scale, orientation, and legends • Practical applications of maps in decision-making and analysis 9. Ethical Considerations in Cartography • Issues of accuracy and representation • Addressing bias and ensuring inclusivity in map design • The impact of maps on society and policy 10. Project Work • Designing and creating a comprehensive map or series of maps • Incorporating feedback from peers and instructors • Presenting and defending the final cartographic project

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	1. Lectures and Presentations • Use engaging lectures to introduce key concepts and theories. • Incorporate multimedia presentations to illustrate cartographic examples and techniques. 2. Hands-On Workshops • Conduct practical workshops where students can apply cartographic principles using software (e.g., GIS, mapping tools). • Provide guided sessions for creating maps, focusing on design and analysis. 3. Field Exercises • Organize field trips to collect spatial data and understand real-world mapping challenges. • Encourage students to practice observational skills and gather information

	for their projects. 4. Collaborative Projects • Assign group projects that promote teamwork and collaborative map-making. • Encourage peer feedback and discussion to enhance learning and creativity. 5. Case Studies • Analyze real-world case studies that highlight effective and innovative cartographic practices. • Discuss the implications of map design decisions in various contexts. 6. Problem-Based Learning (PBL) • Present students with real-world cartographic problems to solve, encouraging critical thinking and application of knowledge. • Facilitate discussions that explore multiple solutions and perspectives. 7. Use of Technology • Integrate GIS software and other digital mapping tools into the curriculum for hands-on experience. • Provide access to online resources, tutorials, and databases for research and project development. 8. Guest Lectures and Expert Talks • Invite professionals from the field of cartography and GIS to share their insights and experiences. • Encourage students to ask questions and engage with guest speakers.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All

Total assessment	100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Introduction
Week 2	Map scale
Week 3	Map scale
Week 4	Grid coordinate system
Week 5	Grid coordinate system
Week 6	Geographic coordinate system
Week 7	Relation between Grid & Geographic coordinate system
Week 8	Relation between Grid & Geographic coordinate system
Week 9	Relation between Grid & Geographic coordinate system
Week 10	Map projection
Week 11	Cylindrical projection
Week 12	Mercator projection
Week 13	Mercator projection
Week 14	Lambert projection
Week 15	Conical projection
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Lab 1: Compute map scale
Week 2	Lab 2: Changing map scale
Week 3	Lab 3: Ex. for Grid coordinate system
Week 4	Lab 4: Ex. for Geographic coordinate system
Week 5	Lab 5: Ex. for Relation between Grid & Geographic coordinate system
Week 6	Lab 6: Construction of map projection
Week 7	Lab 7: Construction of cylindrical & Mercator & lambert projection

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	• **"Elements of Cartography"** للمؤلفين Arthur H. Robinson وJoel L. Morrison: هذا الكتاب يُعتبر من الكتب الكلاسيكية والمهمة في مجال رسم الخرائط، ويغطي الأساسيات والاعتبارات الفنية في تصميم الخرائط.	Yes
Recommended Texts	• **"Thematic Cartography and Geovisualization"** للمؤلفين Terry A. Slocum و Robert B. McMaster: يغطي تقنيات تصميم الخرائط المواضيعية ويشرح كيفية تحليل البيانات الجغرافية وعرضها.	No
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Fundamental of Engineering Surveying**		**Module Delivery**	
Module Type	**Core**		☒ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**SUT 204**			
ECTS Credits	**6**			
SWL (hr/sem)	**150**			
Module Level	2		**Semester of Delivery**	1
Administering Department	SUT		**College**	
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	Ph.D.
Module Tutor	Mostafa Ismat Abdulrahman		**e-mail**	Mustafa.ismat@ntu.edu.iq
Peer Reviewer Name	Name		**e-mail**	E-mail
Scientific Committee Approval Date			**Version Number**	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The main objectives to be achieved after the completion of this course are summarized below: 1. To introduce students to the principles, techniques, and equipment used in surveying for engineering projects. 2. To provide students with an understanding of the basic concepts of geodesy, coordinate systems, and map projections. 3. To develop students' skills in measuring distances, angles, and elevations using various surveying equipment and techniques. 4. To teach students how to interpret survey data, and prepare plans, maps, and cross-sections for engineering projects.

	5. To provide students with knowledge of surveying safety practices and protocols. 6. To help students understand how to apply surveying principles and techniques in the design, construction, and maintenance of engineering projects. 7. To develop students' skills in communication, teamwork, and problem-solving, which are critical for successful engineering surveying. 8. To introduce students to the latest technological advancements in surveying, such as GPS, GIS, and remote sensing, and how these technologies can be used in engineering projects.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Understanding the fundamental principles and concepts of surveying techniques and their applications in engineering projects. 2. Knowledge of various types of surveying instruments and equipment, including their accuracy, limitations, and proper use. 3. Ability to collect, process, and analyze surveying data using appropriate mathematical and statistical techniques. 4. Ability to perform fieldwork, including planning and organizing surveying projects, measuring and recording data, and setting up control points. 5. Knowledge of safety practices and procedures in surveying, including the use of personal protective equipment and safety guidelines for working in hazardous conditions. 6. Understanding the impact of surveying on the environment and the importance of sustainability in surveying practices. 7. Ability to communicate effectively with stakeholders, including clients, contractors, and other members of the engineering team, about surveying results and their implications for the project. 8. Understanding the legal and ethical responsibilities of surveyors and their role in ensuring compliance with relevant laws and regulations. 9. Ability to use computer software and technology for data processing, mapping, and presentation. 10. Knowledge of the professional standards and codes of conduct that govern surveying practice and their role in maintaining high-quality standards in engineering surveying.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Basic concepts of surveying (2 hrs) • Distance measurement (6 hrs) • Earthworks (4hrs) • Vertical control (6 hrs) • Angle measurement (6 hrs) • Curves: Circular (2 hrs) • Underground surveying (4 hrs)

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	This course is to introduce environmental engineering students with the basic knowledge of land measurement and surveying techniques. The overall course is designed to make the students able to learn and understand the theory and field procedure by applying suitable surveying methods to produce map.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Basic concepts of surveying: Definition – Principles – Basic measurements – Control networks – Locating position – Plotting detail
Week 2	Basic concepts of surveying: Definition – Principles – Basic measurements – Control networks – Locating

	position – Plotting detail
Week 3	Basic concepts of surveying: Definition – Principles – Basic measurements – Control networks – Locating position – Plotting detail
Week 4	Basic concepts of surveying: Definition – Principles – Basic measurements – Control networks – Locating position – Plotting detail
Week 5	Distance measurement: Tapes – Field work – Distance adjustment – Errors in taping – Accuracies – Electromagnetic distance measurement (EDM) – Measuring principles – Meteorological corrections – Geometrical reductions – Errors, checking and calibration – Other error sources – Instrument specifications – Developments in EDM
Week 6	Distance measurement: Tapes – Field work – Distance adjustment – Errors in taping – Accuracies – Electromagnetic distance measurement (EDM) – Measuring principles – Meteorological corrections – Geometrical reductions – Errors, checking and calibration – Other error sources – Instrument specifications – Developments in EDM
Week 7	Distance measurement: Tapes – Field work – Distance adjustment – Errors in taping – Accuracies – Electromagnetic distance measurement (EDM) – Measuring principles – Meteorological corrections – Geometrical reductions – Errors, checking and calibration – Other error sources – Instrument specifications – Developments in EDM
Week 8	Distance measurement: Tapes – Field work – Distance adjustment – Errors in taping – Accuracies – Electromagnetic distance measurement (EDM) – Measuring principles – Meteorological corrections – Geometrical reductions – Errors, checking and calibration – Other error sources – Instrument specifications – Developments in EDM
Week 9	Presentation
Week 10-15	Earthworks: Areas – Partition of land – Cross-sections – Dip and strike – Volumes – Mass-haul diagrams
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Identification Surveying Equipment + Distance Measurement By Tape + Horizontal Angle Measurement By Tape
Week 2	Setting and Stakeout a column by Rule 2,3,4
Week 3	Stakeout a map on the ground using a tape measure
Week 4	Identification Leveling and Using Equipment
Week 5	Two Page Test
Week 6	Reciprocal Leveling
Week 7	Final Exam

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	N.N. BASAK. Surveying and leveling, ISBN: 9780074603994, 9780074603994	No
Recommended Texts	SURVEYING VOL. I&2 BY DR. B. C. PUNMIA, ER. ASHOK KR. : 978-8170088837, JAIN, DR. ARUN KUMAR JAIN ISBN-13 ISBN-13: 9788189401238)	No
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

<table>
<tr><th colspan="6">Module Information
معلومات المادة الدراسية</th></tr>
<tr><td>Module Title</td><td colspan="3">Photogrammetry</td><td colspan="2">Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="3">Core</td><td colspan="2" rowspan="4">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="3">SUT 205</td></tr>
<tr><td>ECTS Credits</td><td colspan="3">4</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="3">100</td></tr>
<tr><td>Module Level</td><td>2</td><td colspan="2">Semester of Delivery</td><td colspan="2">1</td></tr>
<tr><td>Administering Department</td><td>SUT</td><td>College</td><td colspan="3"></td></tr>
<tr><td>Module Leader</td><td>Mohammed Tareq Khaleel</td><td>e-mail</td><td colspan="3">Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td>Module Leader’s Acad. Title</td><td>Ass. Professor</td><td colspan="2">Module Leader’s Qualification</td><td colspan="2">Ph.D.</td></tr>
<tr><td>Module Tutor</td><td>Mostafa Ismat Abdulrahman</td><td>e-mail</td><td colspan="3">mustafa.ismat@ntu.edu.iq</td></tr>
<tr><td>Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td>Scientific Committee Approval Date</td><td></td><td>Version Number</td><td colspan="3"></td></tr>
</table>

<table>
<tr><th colspan="4">Relation with other Modules
العلاقة مع المواد الدراسية الأخرى</th></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</th></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>1. The objective of studying photogrammetry is to provide individuals with the necessary skills to accurately capture, process, and analyze imagery to create reliable and precise spatial information. This knowledge enables them to generate accurate measurements, models, and maps that are vital in various fields, including surveying, mapping, engineering, environmental monitoring, and cultural heritage preservation.
2. the objective of studying photogrammetry is to equip individuals with the knowledge and skills to capture, process, analyze, and derive valuable information from photographs or imagery. Photogrammetry enables the creation of accurate maps, 3D models, and digital elevation data for a wide range of applications. It plays a</td></tr>
</table>

	significant role in surveying, mapping, and spatial analysis and is an essential tool for professionals in geomatics, civil engineering, environmental science, and related fields.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Understanding Photogrammetric Principles: Demonstrate a comprehensive understanding of the fundamental principles of photogrammetry, including the geometric and physical concepts involved in image capture and interpretation. 2. Image Acquisition Techniques: Identify and utilize appropriate techniques for capturing aerial and terrestrial images, including the use of drones, cameras, and sensors. 3. Camera Calibration and Setup: Explain the importance of camera calibration and demonstrate the ability to set up and calibrate photogrammetric equipment for accurate data collection. 4. 3D Model Creation: Apply photogrammetric methods to create accurate 3D models from images, utilizing software tools for processing and modeling. 5. Data Processing and Analysis: Analyze and process photogrammetric data, including point cloud generation, orthophoto creation, and surface modeling. 6. Measurement Techniques: Conduct measurements using photogrammetric data, including distance, area, and volume calculations, ensuring accuracy and precision. 7. Error Analysis: Identify potential sources of error in photogrammetric processes and apply methods to minimize and correct these errors. 8. GIS Integration: Integrate photogrammetric outputs with Geographic Information Systems (GIS) for enhanced spatial analysis and visualization. 9. Ethical and Legal Considerations: Understand and address the ethical and legal implications of photogrammetric practice, including issues of privacy, data ownership, and professional standards. 10. Project Management Skills: Plan and execute a photogrammetric project, including budget considerations, time management, and resource allocation.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. 1. Introduction to Photogrammetry • Definition and significance of photogrammetry • Historical development and applications • Comparison with other remote sensing techniques 2. Basic Principles of Photogrammetry • Geometry of imaging: perspective and projection • Photographic principles: exposure, focus, and image quality • Coordinate systems and reference frames 3. Image Acquisition • Types of cameras and sensors (aerial, terrestrial, UAV) • Image capture techniques and flight planning • Ground control points (GCPs) and their importance 4. Camera Calibration

	• Principles of camera calibration • Calibration methods and tools • Importance of lens distortion correction 5. Data Processing Techniques • Overview of photogrammetric workflows • Software tools for photogrammetry (e.g., Agisoft, Pix4D) • Image processing: stitching, filtering, and classification 6. 3D Model Generation • Techniques for creating 3D models from images • Point cloud generation and densification • Mesh generation and texture mapping 7. Measurement and Analysis • Techniques for measuring distances, areas, and volumes from photogrammetric data • Accuracy assessment and validation methods • Applications in engineering, architecture, and land surveying 8. Orthophoto Creation • Principles of orthophotography and its significance • Techniques for creating orthophotos from aerial images • Georeferencing and accuracy considerations 9. Integration with GIS • Combining photogrammetric data with GIS software • Applications in spatial analysis and mapping • Case studies demonstrating GIS and photogrammetry integration

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	1. Interactive Lectures • Deliver engaging lectures that introduce key concepts, supported by visuals and examples. • Use real-world case studies to illustrate the applications of photogrammetry. 2. Hands-On Workshops • Conduct practical sessions where students can use cameras and drones for image acquisition. • Provide guided workshops on photogrammetric software for data processing and model creation. 3. Field Exercises • Organize field trips for students to collect data using photogrammetric techniques. • Teach students how to set up ground control points (GCPs) and plan aerial surveys.

	4. Project-Based Learning • Assign projects where students apply photogrammetry techniques to solve real-world problems. • Encourage creativity and innovation in project design and implementation. 5. Collaborative Learning • Promote teamwork through group projects, allowing students to share responsibilities and learn from each other. • Facilitate peer reviews where students critique each other's work and provide feedback. 6. Use of Technology • Integrate GIS and photogrammetry software into the curriculum for practical experience. • Utilize online platforms and resources for supplementary learning and research.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Introduction
Week 2	Image coordinate system
Week 3	Refinement of image coordinates
Week 4	Refinement of image coordinates
Week 5	2D conformal transformation
Week 6	2D conformal transformation
Week 7	2D affine Transformation
Week 8	2D affine Transformation
Week 9	Model coordinate system
Week 10	3D conformal Transformation
Week 11	3D conformal Transformation
Week 12	Rotation matrix
Week 13	Collinearity condition equation
Week 14	Collinearity condition equation
Week 15	Linearized collinearity condition equation
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Introduction
Week 2	Ex. For Image coordinate system
Week 3	Ex. For 2D conformal transformation
Week 4	Ex. For 2D affine Transformation
Week 5	Ex. For Model coordinate system
Week 6	Ex. For 3D conformal Transformation
Week 7	Ex. for Collinearity & Linearized collinearity condition equation

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	• **"Photogrammetry: Geometry from Images and Laser Scans"** للمؤلف Karl Kraus: يُعتبر هذا الكتاب مرجعًا أكاديميًا مهمًا يغطي المبادئ الأساسية للمسح التصويري وتحليل الصور. • **"Manual of Photogrammetry"**: يُعتبر من الكتب المرجعية الشاملة حول التقنيات الحديثة في المسح التصويري.	Yes
Recommended Texts		No
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
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MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

<table>
<tr><td colspan="6">Module Information
معلومات المادة الدراسية</td></tr>
<tr><td>Module Title</td><td colspan="3">FUNDAMENTAL OF ESTIMATION & QUANTITY SURVEYING</td><td colspan="2">Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="3">Core</td><td colspan="2" rowspan="4">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="3">SUT 202</td></tr>
<tr><td>ECTS Credits</td><td colspan="3">4</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="3">100</td></tr>
<tr><td colspan="2">Module Level</td><td>2</td><td colspan="2">Semester of Delivery</td><td>1</td></tr>
<tr><td colspan="2">Administering Department</td><td>SUT</td><td>College</td><td colspan="2"></td></tr>
<tr><td>Module Leader</td><td colspan="2">Mohammed Tareq Khaleel</td><td>e-mail</td><td colspan="2">Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td colspan="2">Module Leader’s Acad. Title</td><td>Ass. Lecturer</td><td colspan="2">Module Leader’s Qualification</td><td>PhD</td></tr>
<tr><td>Module Tutor</td><td colspan="2">Name (if available)</td><td>e-mail</td><td colspan="2">E-mail</td></tr>
<tr><td colspan="2">Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td colspan="2">E-mail</td></tr>
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العلاقة مع المواد الدراسية الأخرى</td></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
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<tr><th colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</th></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>The objective of studying "Quantity Surveying & Estimating" topics is to provide individuals with the knowledge and skills required to accurately estimate and manage the costs of construction projects. Quantity surveying is a professional discipline that involves the measurement, estimation, and management of construction costs, while estimating focuses specifically on predicting the costs of construction projects.
the objective of studying quantity surveying and estimating is to provide individuals with the knowledge, skills, and techniques required to accurately estimate, manage, and control the costs of construction projects. It equips individuals with the ability to assess project requirements, estimate costs, prepare tender documents, manage project budgets, and ensure cost-effective project delivery. Effective quantity surveying and estimating skills are essential for successful project planning, execution, and financial management in the construction industry.</td></tr>
<tr><td>Module Learning Outcomes

مخرجات التعلم للمادة الدراسية</td><td>1. Knowledge and Understanding:
○ What knowledge should students acquire?
○ Example: "By the end of this module, students will understand the key principles of Estimation ."
2. Intellectual Skills (Critical Thinking and Analysis):
○ How will students use critical thinking and analytical skills related to the subject?
3. Practical Skills (Application):
○ What practical skills should students be able to demonstrate?
4. Transferable Skills:
○ These are skills that can be applied across different areas and situations, such as teamwork, problem-solving, or communication.

Characteristics of Effective MLOs:

• Specific: Clearly define what is expected.
• Measurable: Can be assessed through exams, assignments, or projects.
• Achievable: Realistic within the scope and duration of the module.
• Relevant: Directly related to the content and goals of the module.
• Time-bound: Should be achievable by the end of the module.

These outcomes guide curriculum design, teaching methods, and assessment strategies to ensure that students gain the intended knowledge and skills from the module.</td></tr>
<tr><td>Indicative Contents
المحتويات الإرشادية</td><td>Indicative Contents refer to the key topics, themes, and areas of study that will be covered in a module or course. They provide an outline or a guide to what students can expect to learn and explore, without necessarily being exhaustive or overly detailed. This content is aligned with the Module Learning Outcomes to ensure that students gain the necessary knowledge and skills.

Purpose of Indicative Contents:

• To give students a clear idea of the scope and depth of the material covered in the module.</td></tr>
</table>

	• To help instructors structure lectures, assignments, and assessments. • To align the teaching material with the intended **Learning Outcomes**.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل		**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Demonstrates knowledge of the Introduction: engineering projects &estimation, definition of estimation
Week 2	benefits of estimation, factors affecting cost estimation, types of estimation, practical examples on approximate estimation.
Week 3	Demonstrates knowledge of the General rules in quantitative survey: Principles in selecting units of measurement for items, various units and modes of measurement for different items of works, details of quantities measuring.
Week 4	Demonstrates knowledge of the rate analysis, factors affecting the cost of materials and labour, Plants and equipment -hour costs based on total costs and Outputs, Overhead charges, rates for various items of construction of civil engineering works, problems and examples on rate analysis .
Week 5	Demonstrates knowledge of the Methods of working quantities for various items of works Able to perform the Measurement and abstract sheets and recording, excavation and fill works for wall footings .
Week 6	Estimation of walls and other items of buildings up to D. P. C. level, methods used to calculate the length of various works: method of strips and center lines method, examples and problems.
Week 7	Demonstrates knowledge of the Earthworks for various engineering projects: irrigation channels, roadway embankments,
Week 8	Demonstrates knowledge of the methods used for calculating earthwork quantities and volumes, Mass diagrams, calculations of excavation volumes due to cut works (grid leveling method and triangular method), examples and problems.
Week 9	Able to perform the Estimation of masonry works, Demonstrates knowledge of the basic units and materials used, Able to perform the Estimation of walls construction, damp proofing used, brick works, block , works, stone works, examples and problems .
Week 10	Able to perform the Estimation of concrete works, primary materials used, mixing of concrete materials, types of concrete mixers .
Week 11	calculating quantities of concrete materials, examples and problems
Week 12	Able to perform the Estimation of concrete works quantities for spread
Week 13	Able to perform the combined footings .
Week 14	Able to perform the Estimation of concrete works quantities for lintels, beams, roofs, columns and stairs

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Compute map scale
Week 2	Changing map scale
Week 3	Ex. for Grid coordinate system
Week 4	Ex. for Geographic coordinate system
Week 5	Ex. for Relation between Grid & Geographic coordinate system
Week 6	Construction of map projection
Week 7	Construction of cylindrical projection
Week 8	Construction of mercater projection
Week 9	Construction of lambert projection

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	الدار الجديد، تصميم وتخمين، م . احمد شهاب احمد، 1987 .	Yes
Recommended Texts	التخمين والمواصفات، مدحت فضيل فتح اهلل، الطبعة الرابعة المنقحة، 1985.	Yes
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
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MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	AL-Baath Regime Crimes in Iraq		**Module Delivery**	
Module Type	**Support**		☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**NTU 203**			
ECTS Credits	**2**			
SWL (hr/sem)	**50**			
Module Level	2		**Semester of Delivery**	1
Administering Department	SUT		**College**	
Module Leader	Mohammed Tareq Khaleel		**e-mail**	
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	PhD
Module Tutor	Name (if available)		**e-mail**	E-mail
Peer Reviewer Name	Name		**e-mail**	E-mail
Scientific Committee Approval Date			**Version Number**	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	Understanding the History of the Baath Party in Iraq: Explore the origins of the Baath Party in Iraq and its rise to power . Examine key ideological elements of Baathism, including Arab nationalism, socialism, and authoritarian governance. Study the political and social landscape of Iraq prior to and during Baath rule. Investigating Human Rights Violations and Crimes: Analyze the human rights abuses committed by the Baath regime, including political repression, mass executions, torture, and other forms of violence. Legal and Ethical Considerations: Accountability for Baath Crimes: Study the challenges and international responses to holding individuals accountable for crimes committed by a dictatorial regime. Understand the role of international law, including the International Criminal Court (ICC) and other tribunals, in prosecuting war crimes and crimes against humanity. Impact on Iraqi Society and Politics Post-Baath: Analyze how Baathist crimes and the collapse of the regime have shaped post-Saddam Iraq. Study the challenges of national reconciliation and justice, and how Iraq has dealt with its legacy of Baathist oppression. Comparative Analysis of Other Totalitarian Regimes: Compare the Baathist regime’s crimes with those of other totalitarian regimes in history (e.g., Nazi Germany, Stalinist Soviet Union, etc.). Explore common patterns in the use of violence and repression by dictatorial governments. Exploring Memory, Trauma, and Healing: Examine the psychological and social impact of the Baath Party's violence on Iraqis. Explore the processes of truth and reconciliation in post-Baath Iraq, including efforts to confront the trauma caused by the regime's policies.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Understanding the History of the Baath Party in Iraq: Explore the origins of the Baath Party in Iraq and its rise to power . Examine key ideological elements of Baathism, including Arab nationalism, socialism, and authoritarian governance. Study the political and social landscape of Iraq prior to and during Baath rule. Investigating Human Rights Violations and Crimes: Analyze the human rights abuses committed by the Baath regime, including political repression, mass executions, torture, and other forms of violence. Legal and Ethical Considerations: Accountability for Baath Crimes:

	Study the challenges and international responses to holding individuals accountable for crimes committed by a dictatorial regime. Understand the role of international law, including the International Criminal Court (ICC) and other tribunals, in prosecuting war crimes and crimes against humanity. Impact on Iraqi Society and Politics Post-Baath: Analyze how Baathist crimes and the collapse of the regime have shaped post-Saddam Iraq. Study the challenges of national reconciliation and justice, and how Iraq has dealt with its legacy of Baathist oppression. Comparative Analysis of Other Totalitarian Regimes: Compare the Baathist regime's crimes with those of other totalitarian regimes in history (e.g., Nazi Germany, Stalinist Soviet Union, etc.). Explore common patterns in the use of violence and repression by dictatorial governments. Exploring Memory, Trauma, and Healing: Examine the psychological and social impact of the Baath Party's violence on Iraqis. Explore the processes of truth and reconciliation in post-Baath Iraq, including efforts to confront the trauma caused by the regime's policies.
Indicative Contents المحتويات الإرشادية	Understanding the History of the Baath Party in Iraq: Explore the origins of the Baath Party in Iraq and its rise to power . Examine key ideological elements of Baathism, including Arab nationalism, socialism, and authoritarian governance. Study the political and social landscape of Iraq prior to and during Baath rule. Investigating Human Rights Violations and Crimes: Analyze the human rights abuses committed by the Baath regime, including political repression, mass executions, torture, and other forms of violence. Legal and Ethical Considerations: Accountability for Baath Crimes: Study the challenges and international responses to holding individuals accountable for crimes committed by a dictatorial regime. Understand the role of international law, including the International Criminal Court (ICC) and other tribunals, in prosecuting war crimes and crimes against humanity.

	Impact on Iraqi Society and Politics Post-Baath: Analyze how Baathist crimes and the collapse of the regime have shaped post-Saddam Iraq. Study the challenges of national reconciliation and justice, and how Iraq has dealt with its legacy of Baathist oppression. Comparative Analysis of Other Totalitarian Regimes: Compare the Baathist regime's crimes with those of other totalitarian regimes in history (e.g., Nazi Germany, Stalinist Soviet Union, etc.). Explore common patterns in the use of violence and repression by dictatorial governments. Exploring Memory, Trauma, and Healing: Examine the psychological and social impact of the Baath Party's violence on Iraqis. Explore the processes of truth and reconciliation in post-Baath Iraq, including efforts to confront the trauma caused by the regime's policies.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Understanding the History of the Baath Party in Iraq: Explore the origins of the Baath Party in Iraq and its rise to power . Examine key ideological elements of Baathism, including Arab nationalism, socialism, and authoritarian governance. Study the political and social landscape of Iraq prior to and during Baath rule. Investigating Human Rights Violations and Crimes: Analyze the human rights abuses committed by the Baath regime, including political repression, mass executions, torture, and other forms of violence. Legal and Ethical Considerations: Accountability for Baath Crimes: Study the challenges and international responses to holding individuals accountable for crimes committed by a dictatorial regime. Understand the role of international law, including the International Criminal Court (ICC) and other tribunals, in prosecuting war crimes and crimes against humanity. Impact on Iraqi Society and Politics Post-Baath:

	Analyze how Baathist crimes and the collapse of the regime have shaped post-Saddam Iraq. Study the challenges of national reconciliation and justice, and how Iraq has dealt with its legacy of Baathist oppression. Comparative Analysis of Other Totalitarian Regimes: Compare the Baathist regime's crimes with those of other totalitarian regimes in history (e.g., Nazi Germany, Stalinist Soviet Union, etc.). Explore common patterns in the use of violence and repression by dictatorial governments. Exploring Memory, Trauma, and Healing: Examine the psychological and social impact of the Baath Party's violence on Iraqis. Explore the processes of truth and reconciliation in post-Baath Iraq, including efforts to confront the trauma caused by the regime's policies.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل		**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**50**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

Week	Material Covered
Week 1	Understanding the History of the Baath Party in Iraq:
Week 2	Explore the origins of the Baath Party in Iraq and its rise to power . Examine key ideological elements of Baathism, including Arab nationalism, socialism, and authoritarian governance. Study the political and social landscape of Iraq prior to and during Baath rule.
Week 3	Investigating Human Rights Violations and Crimes:
Week 4	Analyze the human rights abuses committed by the Baath regime, including political repression, mass executions, torture, and other forms of violence.
Week 5	Analyze the human rights abuses committed by the Baath regime, including political repression, mass executions, torture, and other forms of violence.
Week 6	Analyze the human rights abuses committed by the Baath regime, including political repression, mass executions, torture, and other forms of violence.
Week 7	Legal and Ethical Considerations: Accountability for Baath Crimes:
Week 8	Study the challenges and international responses to holding individuals accountable for crimes committed by a dictatorial regime.
Week 9	Study the challenges and international responses to holding individuals accountable for crimes committed by a dictatorial regime.
Week 10	Understand the role of international law, including the International Criminal Court (ICC) and other tribunals, in prosecuting war crimes and crimes against humanity.
Week 11	mpact on Iraqi Society and Politics Post-Baath: Analyze how Baathist crimes and the collapse of the regime have shaped post-Saddam Iraq. Study the challenges of national reconciliation and justice, and how Iraq has dealt with its legacy of Baathist oppression.
Week 12	Comparative Analysis of Other Totalitarian Regimes: Compare the Baathist regime’s crimes with those of other totalitarian regimes in history (e.g., Nazi Germany, Stalinist Soviet Union, etc.). Explore common patterns in the use of violence and repression by dictatorial governments.
Week 13	Exploring Memory, Trauma, and Healing: Examine the psychological and social impact of the Baath Party's violence on Iraqis. Explore the processes of truth and reconciliation in post-Baath Iraq, including efforts to confront the

	trauma caused by the regime's policies.
Week 14	Exploring Memory, Trauma, and Healing: Examine the psychological and social impact of the Baath Party's violence on Iraqis. Explore the processes of truth and reconciliation in post-Baath Iraq, including efforts to confront the trauma caused by the regime's policies.

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		Yes
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

<table>
<tr><th colspan="6">Module Information
معلومات المادة الدراسية</th></tr>
<tr><td>Module Title</td><td colspan="3">GEODETIC SURVEYING</td><td colspan="2">Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="3">Core</td><td colspan="2" rowspan="4">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="3">SUT 207</td></tr>
<tr><td>ECTS Credits</td><td colspan="3">7</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="3">175</td></tr>
<tr><td>Module Level</td><td>2</td><td>Semester of Delivery</td><td colspan="3">2</td></tr>
<tr><td>Administering Department</td><td>SUT</td><td>College</td><td colspan="3"></td></tr>
<tr><td>Module Leader</td><td>Mohammed Tareq Khaleel</td><td>e-mail</td><td colspan="3">Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td>Module Leader’s Acad. Title</td><td>Lecturer</td><td>Module Leader’s Qualification</td><td colspan="3">Ph.D.</td></tr>
<tr><td>Module Tutor</td><td>Name (if available)</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td>Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td>Scientific Committee Approval Date</td><td></td><td>Version Number</td><td colspan="3"></td></tr>
</table>

<table>
<tr><th colspan="4">Relation with other Modules
العلاقة مع المواد الدراسية الأخرى</th></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</th></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>The objective is to provide knowledge and skills related to the practical application of surveying techniques and methods in various engineering and construction projects. It aims to equip individuals with the necessary tools and techniques to accurately measure, map, and analyze land and other physical features.
The objective of studying applied surveying is to provide individuals with the knowledge, skills, and techniques required to carry out accurate and reliable measurements, mapping, and analysis in engineering and construction projects. It enables individuals to effectively contribute to land development, infrastructure projects, resource management, and spatial data analysis in various industries.</td></tr>
<tr><td>Module Learning Outcomes

مخرجات التعلم للمادة الدراسية</td><td>Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks.
11. Understand the basic principles and terminology used in plain surveying, including distance measurement, leveling, and angle measurement..
12. Students should grasp fundamental concepts like datum, control points, horizontal and vertical measurements, and types of surveys.Summarize what is meant by a basic electric circuit.
13. Apply appropriate methods and instruments to carry out basic surveying tasks such as leveling, traversing, and setting out.Describe electrical power, charge, and current.
14. Students should gain practical skills in using surveying equipment like theodolites, total stations, levels, and GPS receivers.Identify the basic circuit elements and their applications.
15. Collect, analyze, and interpret field data obtained from plain surveying activities. Discuss the various properties of resistors, capacitors, and inductors.
16. Solve practical problems in the field related to measurements and land surveying using mathematical and geometrical principles.
17. Students should be able to calculate areas, volumes, and other geometrical properties from field data.</td></tr>
<tr><td>Indicative Contents
المحتويات الإرشادية</td><td>Indicative content includes the following.

<u>Part A - Surveying Theory</u>
Leveling, types of leveling, leveling instrumentation, leveling by taping, and trigonometric leveling. [SSWL=20 hrs]

Computes Bearing and angles. [20 hrs]

Draws Contour lines. [SSWL=20 hrs]

Calculates Areas and volumes. [SSWL=20 hrs]

<u>Part B – Surveying Practical</u>

Trigonometric leveling. Close leveling, Topographic survey [SSWL=25 hrs]</td></tr>
</table>

	Level test by two pegs methods, **Area computation**. [SSWL=30 hrs] **survey by total station instrument.**. [SSWL=25 hrs] Total hrs = 160 = SSWL - (Exam hrs) = 40 hr (Time table hrs x 15 weeks)

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Provide structured lectures to introduce students to the fundamental concepts, principles, and mathematics behind plain surveying. Use visuals like diagrams, maps, and videos to explain topics such as angle measurement, distance measurement, leveling, and error analysis. Ensure key topics like coordinate systems and datums are covered with illustrative examples..

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	150	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	10
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	25	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**175**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	2 to 14	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2,4,6,10 12	LO #3, #4 and #6, #7
	Out Assignments	5	10% (10)	2,4,6,10 12	All
	Reports	5	10% (10)	continous	All
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
1, 2	Demonstrates knowledge of the Leveling, types of leveling, leveling instrumentation, leveling by taping, and trigonometric leveling, • Identifies Sources of errors in leveling (vertical, horizontal).
3-5	Computes Bearing and angles: (Methods of angles measurement and bearing calculation)
6-8	Demonstrates knowledge of the Vertical sections, Longitudinal sections, • Calculates of cut and fill.
9-11	Draws Contour lines: Method of drawing and construction.
12-15	Calculates Areas and volumes: Volume computation from cross-section, Volume from topographic maps and grid net, Volume computation from contour maps.
16	Preparatory week before the final Exam

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
1-2	Uses correctly Trigonometric leveling.
3-4	Carries out Close leveling.
5-6	Carries out Topographic survey using level instrument.
7-8	Carries out Level test by two pegs methods.
9-10	Carries out Area computation.
11-13	Carries out Details survey by stadia method.
13-15	Carries out Details survey using total station instrument.

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		
Recommended Texts		
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors

	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Fundamentals of Geographic Information System**		**Module Delivery**	
Module Type	**Core**		☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 208**			
ECTS Credits	**4**			
SWL (hr/sem)	**100**			
Module Level	2		**Semester of Delivery**	2
Administering Department	SUT		**College**	Mohammed Tareq Khaleel
Module Leader			**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Ass. Professor		**Module Leader's Qualification**	Ph.D.
Module Tutor	Mostafa Ismat Abdurahman		**e-mail**	Mostafa.ismat@nti.edu.iq
Peer Reviewer Name	Name		**e-mail**	E-mail
Scientific Committee Approval Date			**Version Number**	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective is to provide a comprehensive understanding of the principles, concepts, and applications of GIS. GIS is a powerful technology used for the collection, storage, analysis, and visualization of spatial data, and understanding its fundamentals is crucial for working in the field of surveying and related disciplines. the objective of studying the fundamentals of GIS is to provide individuals with the knowledge and skills to effectively use GIS technology in various applications. It equips individuals with the ability to collect, manage, analyze, and visualize geospatial data, enabling informed decision-making, problem-solving, and spatial analysis in diverse fields.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks. 1. Demonstrate an understanding of the fundamental concepts, definitions, and terminology used in Geographic Information Systems (GIS). 2. Students should be able to explain how GIS is used in land surveying, urban planning, environmental management, disaster response, transportation, and other fields. 3. Understand the role of GIS within the field of surveying and its applications in various industries. 4. Students should be able to explain how GIS is used in land surveying, urban planning, environmental management, disaster response, transportation, and other fields. 5. Analyze spatial data using GIS tools to solve real-world problems. 6. Students should learn how to apply spatial analysis techniques such as buffering, overlay, interpolation, and proximity analysis to derive meaningful insights and solutions from data. 7. Acquire, manage, and organize spatial data from various sources (satellite imagery, GPS, surveying data, etc.).
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. Part A - Surveying Theory Mapping GIS, Classifying Data، Labeling Features [SSWL=30 hrs] Presenting GIS Data as a Map, Map Project Proposals Due. [30 hrs] Querying Data، Selecting Features، . [SSWL=30 hrs] Incorporating GIS into an Organization. [SSWL=30 hrs]

	Total hrs = 120 = SSWL - (Exam hrs) = 30 hr (Time table hrs x 15 weeks)

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	To effectively teach the **Fundamentals of Geographic Information Systems (GIS)** in a surveying **technical engineering** program, a combination of theoretical and practical learning strategies is essential. Lectures help establish a solid understanding of core concepts like spatial data models, coordinate systems, and map projections, while hands-on sessions using GIS software (e.g., ArcGIS or QGIS) allow students to practice data manipulation and spatial analysis. Problem-based learning (PBL) encourages students to solve real-world geographic problems, enhancing critical thinking skills and reinforcing the application of GIS tools in scenarios like urban planning or environmental analysis.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	75	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	25	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	2 to 14	LO #1, #2 and #4, #5
	Assignments	5	10% (10)	2,4,6,10 12	LO #3, #4 and #6, #7
	Projects	2	10% (10)	continous	All
	Online Assigm.	5	10% (10)	continous	1,2,3,5,6
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
1	Mapping GIS.
2	Classifying Data.
3-4	Labeling Features
5-6	Presenting GIS Data as a Map
7-8	Map Project Proposals Due
9-10	Querying Data
11-12	Selecting Features
13-14	Intro to Geo-processing, Incorporating GIS into an Organization, Future Trends for GIS
15	Seminars & Map Project Due

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	• **Surveying for Construction"** للمؤلفين William Irvine و Finlay Maclennan: كتاب شامل يغطي أساسيات المساحة ويُستخدم في الجامعات والكليات الهندسية	
Recommended Texts	• **"Elementary Surveying: An Introduction to Geomatics"** للمؤلفين Charles D. Ghilani و Paul R. Wolf: يُعتبر مرجعًا مهمًا يحتوي على شرح لمفاهيم المساحة التقليدية والحديثة. • **" مساحة الأراضي والمسطحات"** (مراجع عربية متوفرة في الجامعات): كتب متخصصة في أساسيات المساحة وتطبيقاتها في البيئات المختلفة	
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	ESTIMATION & QUANTITY SURVEYING		**Module Delivery**	
Module Type	**Core**		☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 209**			
ECTS Credits	**4**			
SWL (hr/sem)	**100**			
Module Level	2	**Semester of Delivery**	1	
Administering Department	SUT	**College**		
Module Leader	Mohammed Tareq Khaleel	**e-mail**	Mohammed.alsafaawe@ntu.edu.iq	
Module Leader's Acad. Title	Lecturer	**Module Leader's Qualification**	PhD	
Module Tutor	Name (if available)	**e-mail**	E-mail	
Peer Reviewer Name	Name	**e-mail**	E-mail	
Scientific Committee Approval Date		**Version Number**		

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective of studying "Quantity Surveying & Estimating" topics is to provide individuals with the knowledge and skills required to accurately estimate and manage the costs of construction projects. Quantity surveying is a professional discipline that involves the measurement, estimation, and management of construction costs, while estimating focuses specifically on predicting the costs of construction projects. the objective of studying quantity surveying and estimating is to provide individuals with the knowledge, skills, and techniques required to accurately estimate, manage, and control the costs of construction projects. It equips individuals with the ability to assess project requirements, estimate costs, prepare tender documents, manage project budgets, and ensure cost-effective project delivery. Effective quantity surveying and estimating skills are essential for successful project planning, execution, and financial management in the construction industry.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	5. **Knowledge and Understanding:** o What knowledge should students acquire? o Example: "By the end of this module, students will understand the key principles of Estimation ." 6. **Intellectual Skills (Critical Thinking and Analysis):** o How will students use critical thinking and analytical skills related to the subject? 7. **Practical Skills (Application):** o What practical skills should students be able to demonstrate? 8. **Transferable Skills:** o These are skills that can be applied across different areas and situations, such as teamwork, problem-solving, or communication. **Characteristics of Effective MLOs:** • **Specific:** Clearly define what is expected. • **Measurable:** Can be assessed through exams, assignments, or projects. • **Achievable:** Realistic within the scope and duration of the module. • **Relevant:** Directly related to the content and goals of the module. • **Time-bound:** Should be achievable by the end of the module. These outcomes guide curriculum design, teaching methods, and assessment strategies to ensure that students gain the intended knowledge and skills from the module.
Indicative Contents المحتويات الإرشادية	**Indicative Contents** refer to the key topics, themes, and areas of study that will be covered in a module or course. They provide an outline or a guide to what students can expect to learn and explore, without necessarily being exhaustive or overly detailed. This content is aligned with the **Module Learning Outcomes** to ensure that students gain the necessary knowledge and skills.

	Purpose of Indicative Contents: • To give students a clear idea of the scope and depth of the material covered in the module. • To help instructors structure lectures, assignments, and assessments. • To align the teaching material with the intended **Learning Outcomes**.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	70	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	30	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation

تقييم المادة الدراسية

As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Demonstrates knowledge of the Introduction: engineering projects &estimation, definition of estimation
Week 2	benefits of estimation, factors affecting cost estimation, types of estimation, practical examples on approximate estimation.
Week 3	Demonstrates knowledge of the General rules in quantitative survey: Principles in selecting units of measurement for items, various units and modes of measurement for different items of works, details of quantities measuring.
Week 4	Demonstrates knowledge of the rate analysis, factors affecting the cost of materials and labour, Plants and equipment -hour costs based on total costs and Outputs, Overhead charges, rates for various items of construction of civil engineering works, problems and examples on rate analysis .
Week 5	Demonstrates knowledge of the Methods of working quantities for various items of works Able to perform the Measurement and abstract sheets and recording, excavation and fill works for wall footings .
Week 6	Estimation of walls and other items of buildings up to D. P. C. level, methods used to calculate the length of various works: method of strips and center lines method, examples and problems.
Week 7	Demonstrates knowledge of the Earthworks for various engineering projects: irrigation channels, roadway embankments,
Week 8	Demonstrates knowledge of the methods used for calculating earthwork quantities and volumes, Mass diagrams, calculations of excavation volumes due to cut works (grid leveling method and triangular method), examples and problems.
Week 9	Able to perform the Estimation of masonry works, Demonstrates knowledge of the basic units and materials used, Able to perform the Estimation of walls construction, damp proofing used, brick works, block , works, stone works, examples and problems .
Week 10	Able to perform the Estimation of concrete works, primary materials used, mixing of concrete materials, types of concrete mixers .
Week 11	calculating quantities of concrete materials, examples and problems
Week 12	Able to perform the Estimation of concrete works quantities for spread
Week 13	Able to perform the combined footings .

Week 14	Able to perform the Estimation of concrete works quantities for lintels, beams, roofs, columns and stairs

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Compute map scale
Week 2	Changing map scale
Week 3	Ex. for Grid coordinate system
Week 4	Ex. for Geographic coordinate system
Week 5	Ex. for Relation between Grid & Geographic coordinate system
Week 6	Construction of map projection
Week 7	Construction of cylindrical projection
Week 8	Construction of mercater projection
Week 9	Construction of lambert projection

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	الدار الجديد، تصميم وتخمين، م . احمد شهاب احمد، 1987 .	Yes
Recommended Texts	التخمين والمواصفات، مدحت فضيل فتح اهلل، الطبعة الرابعة المنقحة، 1985.	Yes
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Digital Photogrammetry**			**Module Delivery**	
Module Type	**Core**			☒ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**SUT 211**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	1			**Semester of Delivery**	1
Administering Department	Type Dept. Code			**College**	Type College Code
Module Leader	Mohammed Tareq Khaleel			**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Lecturer			**Module Leader's Qualification**	Ph.D.
Module Tutor	Mostafa Ismat Abdurahman			**e-mail**	Mostafa.ismat@nti.edu.iq
Peer Reviewer Name	Name			**e-mail**	E-mail
Scientific Committee Approval Date				**Version Number**	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	3. The objective of studying photogrammetry is to provide individuals with the necessary skills to accurately capture, process, and analyze imagery to create reliable and precise spatial information. This knowledge enables them to generate accurate measurements, models, and maps that are vital in various fields, including surveying, mapping, engineering, environmental monitoring, and cultural heritage preservation. 4. the objective of studying photogrammetry is to equip individuals with the knowledge and skills to capture, process, analyze, and derive valuable information from photographs or imagery. Photogrammetry enables the creation of accurate maps, 3D models, and digital elevation data for a wide range of applications. It plays a significant role in surveying, mapping, and spatial analysis and is an essential tool for

	professionals in surveying , civil engineering, environmental science, and related fields.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	11. Understanding Photogrammetric Principles: Demonstrate a comprehensive understanding of the fundamental principles of photogrammetry, including the geometric and physical concepts involved in image capture and interpretation. 12. Image Acquisition Techniques: Identify and utilize appropriate techniques for capturing aerial and terrestrial images, including the use of drones, cameras, and sensors. 13. Camera Calibration and Setup: Explain the importance of camera calibration and demonstrate the ability to set up and calibrate photogrammetric equipment for accurate data collection. 14. 3D Model Creation: Apply photogrammetric methods to create accurate 3D models from images, utilizing software tools for processing and modeling. 15. Data Processing and Analysis: Analyze and process photogrammetric data, including point cloud generation, orthophoto creation, and surface modeling. 16. Measurement Techniques: Conduct measurements using photogrammetric data, including distance, area, and volume calculations, ensuring accuracy and precision. 17. Error Analysis: Identify potential sources of error in photogrammetric processes and apply methods to minimize and correct these errors. 18. GIS Integration: Integrate photogrammetric outputs with Geographic Information Systems (GIS) for enhanced spatial analysis and visualization. 19. Ethical and Legal Considerations: Understand and address the ethical and legal implications of photogrammetric practice, including issues of privacy, data ownership, and professional standards. 20. Project Management Skills: Plan and execute a photogrammetric project, including budget considerations, time management, and resource allocation.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. 1. Introduction to Photogrammetry • Definition and significance of photogrammetry • Historical development and applications • Comparison with other remote sensing techniques 2. Basic Principles of Photogrammetry • Geometry of imaging: perspective and projection • Photographic principles: exposure, focus, and image quality • Coordinate systems and reference frames 3. Image Acquisition • Types of cameras and sensors (aerial, terrestrial, UAV) • Image capture techniques and flight planning • Ground control points (GCPs) and their importance 4. Camera Calibration • Principles of camera calibration

	• Calibration methods and tools • Importance of lens distortion correction 5. Data Processing Techniques • Overview of photogrammetric workflows • Software tools for photogrammetry (e.g., Agisoft, Pix4D) • Image processing: stitching, filtering, and classification 6. 3D Model Generation • Techniques for creating 3D models from images • Point cloud generation and densification • Mesh generation and texture mapping 7. Measurement and Analysis • Techniques for measuring distances, areas, and volumes from photogrammetric data • Accuracy assessment and validation methods • Applications in engineering, architecture, and land surveying 8. Orthophoto Creation • Principles of orthophotography and its significance • Techniques for creating orthophotos from aerial images • Georeferencing and accuracy considerations 9. Integration with GIS • Combining photogrammetric data with GIS software • Applications in spatial analysis and mapping • Case studies demonstrating GIS and photogrammetry integration

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	1. Interactive Lectures • Deliver engaging lectures that introduce key concepts, supported by visuals and examples. • Use real-world case studies to illustrate the applications of photogrammetry. 2. Hands-On Workshops • Conduct practical sessions where students can use cameras and drones for image acquisition. • Provide guided workshops on photogrammetric software for data processing and model creation. 3. Field Exercises • Organize field trips for students to collect data using photogrammetric techniques. • Teach students how to set up ground control points (GCPs) and plan aerial surveys. 4. Project-Based Learning

	• Assign projects where students apply photogrammetry techniques to solve real-world problems. • Encourage creativity and innovation in project design and implementation. 5. Collaborative Learning • Promote teamwork through group projects, allowing students to share responsibilities and learn from each other. • Facilitate peer reviews where students critique each other's work and provide feedback. 6. Use of Technology • Integrate GIS and photogrammetry software into the curriculum for practical experience. • Utilize online platforms and resources for supplementary learning and research.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
16	Application of collinearty condition equation
17-18	SPRO I
19-20	Space intersection
21-23	Relative orientation
24	Absolute orientation
25	Analytical instrument
26	Aero triangulation
27	Analogue Aero triangulation
28	Semi-analytical Aero triangulation
29-30	Analytical Aero triangulation

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
1	Ex. For Application of collinearty condition equation
2-3	Ex. For SPRO I
4-5	Ex. For Space intersection
6-8	Ex. For Relative orientation
9	Ex. For Absolute orientation
10	Ex. For Analytical instrument
11	Ex. For Aero triangulation
12	Ex. For Analogue Aero triangulation
13	Ex. For Semi-analytical Aero triangulation
14-15	Ex. For Analytical Aero triangulation

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	• **"Photogrammetry: Geometry from Images and Laser Scans"** للمؤلف Karl Kraus: يُعتبر هذا الكتاب مرجعًا أكاديميًا مهمًا يغطي المبادئ الأساسية للمسح التصويري وتحليل الصور. • **"Manual of Photogrammetry"**: يُعتبر من الكتب المرجعية الشاملة حول التقنيات الحديثة في المسح التصويري.	Yes
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Professional Ethics**			**Module Delivery**	
Module Type	**support**			☒ **Theory** ☐ **Lecture** ☐ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**NTU 204**				
ECTS Credits	**2**				
SWL (hr/sem)	**50**				
Module Level	2		**Semester of Delivery**	2	
Administering Department	SUT		**College**		
Module Leader			**e-mail**	Mohammed.alsafaawe@ntu.edu.iq	
Module Leader's Acad. Title	Ass. Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name	Name		**e-mail**	E-mail	
Scientific Committee Approval Date			**Version Number**		

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	1. **فهم المبادئ الأساسية لأخلاقيات المهنة**: تعليم الطلبة القيم والمبادئ الأخلاقية الأساسية في الهندسة ودورها في المسؤولية المجتمعية. 2. **تعزيز المسؤولية المهنية**: إدراك أهمية الالتزام بالمعايير المهنية والقانونية عند ممارسة العمل في مجالات الجيوماتكس. 3. **تطوير مهارات اتخاذ القرارات الأخلاقية**: تمكين الطلبة من اتخاذ قرارات مهنية تتماشى مع

	القيم الأخلاقية وتوازن بين المصالح الشخصية والعامة. 4. **تحفيز على النزاهة والشفافية**: التأكيد على أهمية النزاهة في العمل الهندسي والابتعاد عن أي نوع من أنواع التضليل أو التلاعب في البيانات الجيوماتية. 5. **الالتزام بالممارسات المستدامة**: غرس فكرة الاستدامة وحماية البيئة عند تطبيق الحلول الهندسية المتعلقة بالجيوماتكس.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. **فهم الأخلاقيات المهنية**: القدرة على تحديد المفاهيم الأساسية لأخلاقيات المهنة وتطبيقها في ممارسات الجيوماتكس. 2. **تحليل المواقف الأخلاقية**: تقييم المواقف المهنية المعقدة واختيار الحلول الأخلاقية المناسبة. 3. **الالتزام بالمعايير الدولية**: التعرف على المعايير الدولية والمحلية التي تنظم العمل في هندسة الجيوماتكس والالتزام بها. 4. **التعامل مع البيانات بمسؤولية**: فهم أهمية التعامل الأخلاقي مع البيانات الحساسة والبيانات المتعلقة بالأراضي والمعلومات الجغرافية. 5. **تعزيز القيم المهنية**: القدرة على العمل بفعالية ضمن فريق مع الحفاظ على القيم المهنية وأخلاقيات العمل الجماعي.
Indicative Contents المحتويات الإرشادية	يتضمن المحتوى الإرشادي ما يلي. **مفهوم الاخلاق والعمل والمهنة**[SSWL=10 hrs] . **اخلاقيات مهنة المهندس**[10 hrs] . **القيم الهندسية الاخلاقية**[SSWL=10 hrs] . **ميثاق اخلاق مهنة المهندس**[SSWL=10 hrs] . Total hrs = 50 = SSWL - (Exam hrs) = 10 hr (Time table hrs x 15 weeks)

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	تمثل استراتيجيات تدريس مادة "أخلاقيات المهنة" للمهندسين في المزج بين المحاضرات التفاعلية ودراسات الحالة التي تعزز النقاش حول المواقف الأخلاقية. يتم التركيز على التعلم القائم على حل المشكلات ولعب الأدوار لتطوير التفكير النقدي والقدرة على اتخاذ قرارات أخلاقية. تُستخدم المشاريع الجماعية والبحوث لتعميق الفهم، إلى جانب التعلم المدمج الذي يجمع بين التعليم التقليدي والإلكتروني. كما يتم تشجيع التأمل الذاتي وتقديم زيارات ميدانية ومحاضرات من خبراء الصناعة لإثراء التجربة التعليمية .

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	40	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	3
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	10	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	1

Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**50**

Module Evaluation
تقييم المادة الدراسية

As		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	5	10% (10)	2 to 14	LO #1, #2 and #4, #6
	Assignments	2	10% (10)	2,4,5,11 12	LO #3, #4 and #6, #7
	Out Assignments	2	10% (10)	2,4,6,10 12	All
	Reports	2	10% (10)	continous	All
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #6
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

Week	Material Covered
1	مفهوم الاخلاق
2,3	العمل و المهنة
4,5	اخلاقيات المهنة
6,7	القيم و اخلاقيات المهنة
8,9	أنماط السلوك غير ألاخلاقي في المهنة
10,11	وسائل واساليب ترسيخ اخلاقيات المهنة
12,13	اخلاقيات ممارسة المهن الهندسية , اخلاقيات مهنة الهندسة
14,15	ميثاق اخلاق مهنة الهندسة لاتحاد المهندسين العرب

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Professional ethics/a methodological course for students of technical colleges/prepared by the Middle Technical University	YES
Recommended Texts		
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
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Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Surveying Equipment's 1**		**Module Delivery**	
Module Type	**Core**		☒ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**SUT 301**			
ECTS Credits	**6**			
SWL (hr/sem)	**150**			
Module Level	1		**Semester of Delivery**	1
Administering Department	Type Dept. Code		**College**	Type College Code
Module Leader	Name		**e-mail**	E-mail
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)		**e-mail**	E-mail
Peer Reviewer Name	Name		**e-mail**	E-mail
Scientific Committee Approval Date			**Version Number**	1.0

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Objectives أهداف المادة الدراسية	**1. Understand the Different Types of Surveying Equipment** 3. **Objective**: Identify and describe various types of surveying equipment used in field and construction surveying, such as total stations, theodolites, levels, GPS systems, laser scanners, and measuring tapes. 4. **Key Learning Outcomes**: 5. Classify surveying instruments based on their function. 6. Understand the application of each tool in different surveying tasks. **2. Familiarity with Equipment Components and Functions** A. **Objective**: Understand the basic components, features, and functions of common surveying equipment. B. **Key Learning Outcomes**: C. Describe the parts of a total station and theodolite and their respective functions. D. Learn the principles of operation for electronic distance measurement (EDM) and angle measurement. **3. Proper Setup and Calibration of Surveying Equipment** A. **Objective**: Learn how to set up and calibrate surveying equipment for accurate data collection. B. **Key Learning Outcomes**: C. Demonstrate proper leveling and instrument calibration techniques. D. Adjust and align equipment to ensure accurate readings.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Identification and Understanding of Surveying Equipment** • **Learning Outcome**: **Identify and describe** the different types of surveying equipment used in various surveying tasks, such as total stations, theodolites, GPS systems, levels, and laser scanners. ○ **Indicator**: Students will be able to list the names, features, and functions of at least five types of surveying equipment. --- **2. Knowledge of Surveying Equipment Components** • **Learning Outcome**: **Understand the components and working principles** of common surveying instruments. ○ **Indicator**: Students will be able to explain how each component (e.g., prism, EDM, theodolite, or level) contributes to the operation of the equipment. --- **3. Proficiency in Setting Up Surveying Equipment** • **Learning Outcome**: **Demonstrate the ability to set up and calibrate** different surveying instruments for accurate measurements. ○ **Indicator**: Students will successfully complete setup and calibration of a total station or theodolite in a hands-on exercise, ensuring correct leveling and alignment. **4. Competence in Data Collection and Measurement** • **Learning Outcome**: **Accurately collect data** using different surveying equipment, including measuring angles, distances, and coordinates. ○ **Indicator**: Students will perform a survey using a total station and GPS device, correctly collecting distance, angle, and position data. --- **5. Application of Surveying Equipment in Real-World Scenarios** • **Learning Outcome**: **Apply the correct surveying equipment** for specific survey

	tasks in real-world settings, such as boundary surveys, topographic surveys, and construction layout. ○ **Indicator**: Students will demonstrate their ability to select and use appropriate equipment for a field task, such as measuring a site boundary or elevation. **6. Safety and Maintenance Procedures** • **Learning Outcome**: **Follow proper safety protocols** and understand the maintenance needs for the effective use of surveying equipment. ○ **Indicator**: Students will identify potential hazards when using surveying equipment and perform routine maintenance tasks, such as cleaning lenses and checking calibrations. **7. Interpretation and Analysis of Survey Data** • **Learning Outcome**: **Interpret and analyze** survey data collected from various instruments and apply it to generate practical outputs, such as maps or construction plans. ○ **Indicator**: Students will convert raw data from surveying equipment into meaningful outputs, such as plotting coordinates on a map or determining the elevation of a site. **8. Troubleshooting Surveying Equipment** • **Learning Outcome**: **Diagnose and troubleshoot common issues** encountered with surveying equipment during data collection. ○ **Indicator**: Students will be able to identify common problems with survey instruments (e.g., misalignment or error in measurements) and take corrective action.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Surveying and Surveying Equipment** • **Overview of Surveying**: ○ Definition and importance of surveying in construction, mapping, and land development. ○ Different branches of surveying (e.g., land surveying, construction surveying, geodetic surveying). • **Surveying Equipment**: ○ Types of equipment used in surveying. ○ Historical evolution of surveying instruments. **2. Types of Surveying Equipment** • **Total Stations**: ○ Working principles (Electronic Distance Measurement, EDM). ○ Components: telescope, electronic display, and measuring devices. ○ Uses: angle and distance measurement, setting out. • **Theodolites**: ○ Functionality and components: horizontal and vertical circles, micrometer, and vernier scales. ○ Types: transit theodolite, digital theodolite. ○ Applications in angle measurement. • **Levels**: ○ Types: optical levels, laser levels, digital levels. ○ Uses: measuring elevation, checking horizontal planes. ○ Principles of leveling (line of sight, bubble level).

	• **GPS (Global Positioning Systems)**: ○ Working principles: GNSS (Global Navigation Satellite System) basics. ○ Equipment: RTK (Real-Time Kinematic) and Static GPS. ○ Uses: site location, geodetic surveys, mapping. • **Measuring Tapes and Chains**: ○ Manual and digital tapes. ○ Uses: basic distance measurements in land surveying. --- **3. Surveying Equipment Components and Functions** • **Electronic Distance Measurement (EDM)**: ○ Principles of EDM. ○ Measurement of distances using electromagnetic waves. • **Optical Systems**: ○ Role of lenses, telescopes, and magnification in surveying instruments. • **Electronics and Displays**: ○ Digital readings and data recording. • **Prisms and Reflectors**: ○ Function in total stations and GPS surveys. --- **4. Setting Up Surveying Equipment** • **Instrument Setup**: ○ Stationing and leveling the instrument. ○ Ensuring proper alignment (horizontal and vertical). ○ Setup procedures for different equipment (e.g., theodolite, total station). • **Calibration**: ○ Importance of calibration for accuracy. ○ Methods for calibrating instruments. ○ Checking and adjusting optical and electronic systems. --- **5. Measurement Techniques and Data Collection** • **Measuring Angles and Distances**: ○ Angle measurement using theodolites and total stations. ○ Distance measurement with total stations and GPS devices. • **Coordinate Systems**: ○ Horizontal and vertical coordinate systems. ○ The importance of datum in surveying. • **Field Surveying Methods**: ○ Traversing: open and closed traverses. ○ Differential leveling. ○ Triangulation and trilateration methods. --- **6. Surveying Data Interpretation and Analysis** • **Data Collection Techniques**: ○ Recording data (manual vs. digital). ○ Use of field notebooks, digital loggers, and survey software. • **Data Processing**: ○ Converting measurements into coordinates. ○ Plotting survey data on maps or CAD systems. • **Error Analysis**:

	○ Identifying sources of errors (instrumental, observational, systematic). ○ Techniques for minimizing errors. **7. Troubleshooting Surveying Equipment** • **Common Equipment Issues**: ○ Misalignment, calibration issues, and other common faults. ○ Error messages and how to address them. • **Troubleshooting Techniques**: ○ Diagnosing problems with measurements and instrument function. ○ Steps to reset or recalibrate equipment. **8. Surveying Applications** • **Field Applications**: ○ Practical use cases in construction, land development, road layout, etc. • **Mapping and GIS**: ○ Integration of surveying data with Geographic Information Systems (GIS). • **Site Layout and Design**: ○ Using surveying equipment for construction staking and site design. ○ Determining boundaries, leveling, and elevation control. • **Automation in Surveying**: ○ Robotic total stations. ○ Autonomous survey vehicles and drones.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures and Demonstrations** • **Strategy**: Deliver engaging lectures that introduce surveying concepts and equipment. Use multimedia tools, including images, videos, and diagrams, to demonstrate how different equipment functions. • **Teaching Methods**: ○ **Visual aids**: Use 3D models, animations, and videos to explain the working principles of surveying instruments. ○ **Live demonstrations**: Conduct live demonstrations of equipment setup, calibration, and measurement processes in the classroom or lab. ○ **Guest lectures**: Invite professionals from the field (e.g., land surveyors, civil engineers) to share their expertise and real-world applications of surveying equipment. **2. Hands-On Practical Training** • **Strategy**: Provide students with practical, hands-on experiences using surveying equipment in a controlled environment (laboratory or field). • **Teaching Methods**: ○ **Field exercises**: Organize field trips where students can work with real surveying instruments (total stations, GPS devices, levels) to collect data. ○ **Simulations**: Use survey software and virtual simulation tools to mimic the use of surveying equipment, especially when field trips are not feasible. ○ **Practice sessions**: Allocate time for students to practice setting up and using equipment independently or in small groups, with instructors providing guidance.

	3. Collaborative Learning and Group Work • **Strategy**: Promote collaborative learning by organizing group activities where students can work together to complete tasks involving surveying equipment. • **Teaching Methods**: ○ **Group projects**: Assign projects that require students to plan and execute a survey, analyze data, and present results. This can simulate real-world surveying scenarios. ○ **Peer-to-peer teaching**: Encourage students to explain concepts to each other, helping reinforce their own understanding while building teamwork skills. ○ **Problem-solving tasks**: Provide group challenges such as troubleshooting errors in survey setups or interpreting unclear data from field measurements. **4. Problem-Based Learning (PBL)** • **Strategy**: Use problem-based learning to encourage critical thinking and practical application of surveying techniques. Present students with real-world surveying problems that they need to solve using the equipment. • **Teaching Methods**: ○ **Case studies**: Present case studies of surveying projects (e.g., land subdivision or construction layout), and ask students to analyze and propose solutions using the equipment and data they collect. ○ **Scenarios**: Provide a scenario where students must design and carry out a survey, making decisions about which equipment to use, how to troubleshoot issues, and how to analyze the results. ○ **Field troubleshooting**: Set up simulated issues in the field, such as incorrect instrument calibration, and have students identify and correct the problems. •

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	0	10% (10)	Continuous	All

	Report	5	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Global Position System
Week 2	Global Position System
Week 3	General Definition
Week 4	GPS component
Week 5	How work GPS
Week 6	Satellite message
Week 7	Satellite message
Week 8	Surveying using GPS
Week 9	Surveying using GPS
Week 10	GPS Application
Week 11	GPS Application
Week 12	GPS Coordinate system
Week 13	GPS Coordinate system
Week 14	Design traverse using GPS
Week 15	Design traverse using GPS
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Introduction
Week 2	Ex. About map projection
Week 3	Ex. About map projection
Week 4	GIS program
Week 5	Use ARCVIEW pro.
Week 6	Project map use arc view
Week 7	Open satellite imagery use arc view
Week 8	Draw themes use arc view

Week 9	Point themes
Week 10	Line themes
Week 11	Polygon theme
Week 12	Design data base use arc view
Week 13	Design data base use arc view
Week 14	Design data base use arc view
Week 15	Design data base use arc view

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts		Yes
Recommended Texts		No

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Global Position System1**		**Module Delivery**		
Module Type	**Core**		☒ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar		
Module Code	**SUT 302**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	1		**Semester of Delivery**	1	
Administering Department	Type Dept. Code		**College**	Type College Code	
Module Leader	Name		**e-mail**	E-mail	
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name	Name		**e-mail**	E-mail	
Scientific Committee Approval Date			**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective of studying "Global Positioning System (GPS)" topics is to provide individuals with an understanding of the principles, operation, and applications of GPS technology. GPS is a satellite-based navigation system that enables users to determine their precise location, velocity, and time anywhere on or near the Earth's surface. The objective is to provide individuals with the knowledge and skills necessary to understand, utilize, and benefit from GPS technology. This knowledge enables them to accurately determine positions, navigate efficiently, conduct precise surveys, and leverage GPS for various applications in diverse fields.

<table>
<tr>
<td rowspan="1">Module Learning Outcomes

مخرجات التعلم للمادة الدراسية</td>
<td>
1. Understand the Principles of GPS Technology
• Learning Outcome: Understand the fundamental principles of the Global Positioning System (GPS), including its components and how it operates.
○ Indicator: Students will be able to explain how GPS works, including the roles of satellites, receivers, and ground control stations.
○ Key Concepts: Satellite constellations, signal propagation, trilateration.
<hr>
2. Identify the Components of GPS
• Learning Outcome: Identify and describe the key components of the GPS system and how they contribute to accurate positioning.
○ Indicator: Students will identify the roles of GPS satellites, ground control stations, and receivers in the system.
○ Key Concepts: GPS satellites, signal transmission, and reception.
<hr>
3. Analyze GPS Signal Structure
• Learning Outcome: Analyze the structure of GPS signals and understand how the signals are used to determine position.
○ Indicator: Students will explain how GPS signals carry time-stamped information and how the receiver calculates distance based on signal travel time.
○ Key Concepts: Signal modulation, pseudo range, and time synchronization.
<hr>
4. Perform Basic GPS Measurements
• Learning Outcome: Demonstrate the ability to use GPS equipment to measure positions and distances accurately.
○ Indicator: Students will successfully set up and operate a GPS receiver to collect data in the field.
○ Key Skills: Collecting position data, measuring distances, recording waypoints.
<hr>
5. Understand GPS Accuracy and Sources of Error
• Learning Outcome: Understand the factors that affect GPS accuracy and how to mitigate errors in positioning data.
○ Indicator: Students will identify sources of error in GPS measurements, such as satellite geometry, signal interference, and atmospheric conditions, and describe methods to improve accuracy.
○ Key Concepts: Dilution of Precision (DOP), multipath error, ionospheric and tropospheric effects.
<hr>
6. Apply Differential GPS (DGPS) for Improved Accuracy
• Learning Outcome: Understand and apply the principles of Differential GPS (DGPS) to enhance positioning accuracy.
○ Indicator: Students will describe how DGPS works and use a DGPS system to improve position accuracy.
○ Key Concepts: Base stations, corrections, and real-time positioning.
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<tr>
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<td>
1. Introduction to GPS
• Overview of GPS:
○ History and development of GPS.
○ Importance of GPS in modern navigation, surveying, and geospatial
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Indicative Contents المحتويات الإرشادية	applications. • **Applications of GPS**: ○ Surveying, mapping, navigation, geodesy, agriculture, and environmental monitoring. ○ Emerging uses of GPS in various industries. **2. GPS System Components** • **Satellites**: ○ GPS satellite constellations (e.g., NAVSTAR). ○ Roles of satellites in GPS: orbit, positioning, and signal transmission. • **Ground Control Stations**: ○ Overview of ground control operations: monitoring and maintaining satellite health. ○ Satellite tracking and corrections. • **GPS Receivers**: ○ Types of GPS receivers: handheld, geodetic, differential, etc. ○ How receivers work: receiving signals, calculating position, and displaying data. **3. GPS Signal Structure** • **Signal Modulation**: ○ The components of GPS signals: carrier waves, pseudoranges, codes, and the navigation message. ○ Types of GPS signals: C/A code (coarse/acquisition), P-code (precise), and L2C. • **Time Synchronization**: ○ How GPS signals are time-stamped and how time is used for positioning calculations. • **Signal Propagation**: ○ How GPS signals travel through the atmosphere, including ionospheric and tropospheric effects. **4. Working Principles of GPS** • **Trilateration**: ○ How positions are calculated using the distances from multiple satellites. ○ The concept of range measurement and time-of-flight of GPS signals. • **Coordinate Systems**: ○ Geodetic coordinates (latitude, longitude, and altitude). ○ The role of reference frames such as WGS84 (World Geodetic System 1984). • **Accuracy and Precision**: ○ The concept of positional accuracy and factors that affect it (e.g., satellite geometry, signal interference). **5. Sources of Error in GPS** • **Satellite Geometry**: ○ Dilution of Precision (DOP) and its impact on accuracy. ○ The effect of satellite positioning on measurement quality. • **Atmospheric Effects**: ○ Ionospheric and tropospheric delays and how they influence GPS accuracy.

	• **Multipath Errors**: ○ The impact of reflected signals from buildings, terrain, or other objects. • **Receiver and Signal Quality**: ○ Issues with receiver calibration, signal blockage, and interference. --- **6. Differential GPS (DGPS)** • **Concept of DGPS**: ○ How DGPS improves GPS accuracy by using correction signals from a fixed base station. • **DGPS Components**: ○ The role of base stations, reference stations, and correction data. • **Real-Time DGPS**: ○ How DGPS is used for high-precision applications like land surveying and geodesy. ○ Integration with real-time kinematic (RTK) positioning. --- **7. GPS Data Collection and Measurement** • **Field Data Collection**: ○ Setting up GPS receivers for data collection in the field. ○ Using GPS for various surveying tasks: waypoints, route tracking, and area measurements. • **Post-Processing GPS Data**: ○ Transferring and processing GPS data on computers or GIS software. ○ Data correction, conversion to coordinates, and analysis of results. --- **8. GPS Accuracy and Performance** • **Factors Affecting Accuracy**: ○ Number of visible satellites, satellite geometry, signal quality, and environmental factors. • **Accuracy Assessment**: ○ Methods for evaluating and improving GPS accuracy: using multiple frequencies (L1, L2) and post-processing techniques. • **GPS Error Correction**: ○ Correcting GPS data through software and processing techniques.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures and Discussions** • **Strategy**: Provide clear, engaging lectures that introduce the theoretical foundations of GPS. Use multimedia and interactive tools to help visualize complex concepts. • **Teaching Methods**: ○ **Visual Aids**: Use diagrams, animations, and videos to demonstrate how GPS signals travel, satellite orbits, and the concept of trilateration. ○ **Class Discussions**: Engage students in discussions about the uses and limitations of GPS technology, as well as its impact on various industries (e.g., navigation,

	surveying, agriculture). ○ **Real-World Examples**: Present case studies of how GPS is used in different fields, such as autonomous vehicles, land surveying, and precision agriculture. **2. Hands-On Practical Training** • **Strategy**: Offer hands-on sessions where students can use GPS receivers, perform measurements, and analyze GPS data. • **Teaching Methods**: ○ **Field Exercises**: Organize practical sessions where students use GPS devices to collect real-time data, such as measuring distances, waypoints, and areas. ○ **Data Collection in the Field**: Allow students to collect GPS data for specific tasks (e.g., mapping, surveying), and later analyze it in the classroom using software tools. ○ **Simulations**: For situations where fieldwork isn't feasible, use GPS simulation software that mimics real GPS data collection processes. **3. Problem-Based Learning (PBL)** • **Strategy**: Encourage critical thinking and application of GPS concepts by having students work on real-world problems. • **Teaching Methods**: ○ **Case Studies**: Provide complex, real-world case studies where students must analyze and interpret GPS data to solve problems, such as mapping land boundaries, optimizing routes for navigation, or planning a construction site survey. ○ **Scenario-Based Tasks**: Create scenarios where students must troubleshoot common GPS issues (e.g., signal interference, low satellite visibility) and apply corrections using real-time or post-processed GPS data. ○ **Group Problem-Solving**: Organize group projects where students need to design a survey, collect GPS data, and present their findings, mimicking a professional GPS project. **4. Flipped Classroom** • **Strategy**: Utilize the flipped classroom model to allow students to learn the theoretical concepts before class, so they can apply them during practical sessions. • **Teaching Methods**: ○ **Pre-Class Learning**: Assign students to watch videos or read materials related to GPS basics (e.g., signal structure, trilateration, and types of GPS receivers). ○ **Interactive In-Class Activities**: Use class time for problem-solving activities, hands-on practice with GPS equipment, and discussions about the pre-assigned material. ○ **Assessment via Online Quizzes**: Use quizzes or reflection tasks after each pre-class module to ensure that students understand the foundational concepts before engaging in practical work. **5. Collaborative Learning and Group Projects** • **Strategy**: Promote teamwork through collaborative learning activities that allow students to share knowledge and solve complex GPS-related tasks together. • **Teaching Methods**: ○ **Group Surveys**: Assign group projects where students use GPS equipment to conduct surveys, collect data, and present the results. Encourage students to divide roles such as data collection, data analysis, and presentation.

	○ **Peer Review**: Have students critique each other's work, especially in data collection and analysis, to foster collaboration and improve understanding. ○ **Group Discussions**: Encourage discussion among students on how to troubleshoot common GPS issues, such as poor satellite coverage or multipath errors.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Introduction
Week 2	Introduction
Week 3	The History of GPS
Week 4	The History of GPS
Week 5	Getting to Know Trimble / Setting the Unit Up for GPS
Week 6	Getting to Know Trimble / Setting the Unit Up for GPS
Week 7	Creating & Navigating / Waypoints
Week 8	Creating & Navigating / Waypoints

Week 9	Creating a Data Dictionary
Week 10	Creating a Data Dictionary
Week 11	GPS Campus
Week 12	GPS Campus
Week 13	GPS Campus
Week 14	GPS Campus
Week 15	Presentations
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	N/A
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية			
Module Title	**REMOTE SENSING 1**	**Module Delivery**	
Module Type	**Core**	☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 303**		
ECTS Credits	**4**		
SWL (hr/sem)	**100**		
Module Level	1	**Semester of Delivery**	1
Administering Department	Type Dept. Code	**College**	Type College Code
Module Leader	Name	**e-mail**	E-mail
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)	**e-mail**	E-mail
Peer Reviewer Name	Name	**e-mail**	E-mail
Scientific Committee Approval Date		**Version Number**	1.0

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective of studying remote sensing is to equip individuals with the knowledge and skills necessary to effectively acquire, process, analyze, and interpret remote sensing data. This knowledge enables them to extract valuable information about the Earth's surface, monitor changes, and make informed decisions in various fields that require geospatial information. Overall, the objective of studying remote sensing topics is to equip individuals with the knowledge and skills to effectively acquire, interpret, and analyze remote sensing data. By understanding remote sensing principles, sensor technologies, image interpretation techniques, and applications, individuals can leverage remote sensing data for various purposes, including environmental monitoring, resource management, land use planning, and disaster response. Remote sensing plays a vital role in supporting informed decision-making and providing valuable insights about
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Principles of Remote Sensing** • **Learning Outcome**: Understand the fundamental principles of remote sensing, including the physics of electromagnetic radiation and how it interacts with Earth's surface. ○ **Indicator**: Students will be able to explain the basic principles of remote sensing, including the electromagnetic spectrum, sensors, and how different wavelengths are used to capture surface information. ○ **Key Concepts**: Electromagnetic spectrum, remote sensing platforms (satellites, aircraft), active vs passive sensing. **2. Identify Different Remote Sensing Platforms and Sensors** • **Learning Outcome**: Identify and describe various remote sensing platforms and sensors used for Earth observation. ○ **Indicator**: Students will be able to list and describe different platforms (e.g., satellites, drones, aircraft) and sensors (e.g., optical, radar, LiDAR) used for remote sensing applications. ○ **Key Concepts**: Satellite systems (e.g., Landsat, MODIS), sensor types (e.g., multispectral, hyperspectral, radar), spatial, spectral, and temporal resolution. **3. Analyze Remote Sensing Data** • **Learning Outcome**: Analyze remote sensing data to extract useful information about the Earth's surface. ○ **Indicator**: Students will demonstrate the ability to process and interpret remote sensing images, identifying land cover, vegetation, and other features. ○ **Key Concepts**: Image preprocessing, classification techniques (supervised, unsupervised), image interpretation. **4. Apply Remote Sensing for Environmental Monitoring**

	• **Learning Outcome**: Apply remote sensing techniques for environmental monitoring and resource management. ○ **Indicator**: Students will apply remote sensing data to monitor environmental changes such as deforestation, urbanization, and changes in land use. ○ **Key Concepts**: Vegetation indices (e.g., NDVI), land use/land cover change detection, environmental monitoring (e.g., forest health, water bodies). **5. Interpret Remote Sensing Images for Land Use and Land Cover Mapping** • **Learning Outcome**: Interpret remote sensing images for land use and land cover classification and mapping. ○ **Indicator**: Students will demonstrate the ability to classify land cover types (e.g., forest, water, urban) using remote sensing data and create maps for decision-making. ○ **Key Concepts**: Land use classification, supervised vs unsupervised classification, accuracy assessment. **6. Understand the Role of Remote Sensing in Disaster Management** • **Learning Outcome**: Understand the role of remote sensing in disaster management, including natural disasters such as floods, wildfires, and earthquakes. ○ **Indicator**: Students will describe how remote sensing is used to assess and respond to natural disasters, including damage assessment and recovery efforts. ○ **Key Concepts**: Damage assessment, disaster response, real-time monitoring. **7. Utilize Geographic Information Systems (GIS) with Remote Sensing Data** • **Learning Outcome**: Integrate remote sensing data with GIS for spatial analysis and decision-making. ○ **Indicator**: Students will demonstrate how to combine remote sensing imagery with GIS software to perform spatial analysis, create maps, and generate reports. ○ **Key Concepts**: GIS integration, spatial analysis, geospatial data visualization. **8. Evaluate the Accuracy and Quality of Remote Sensing Data** • **Learning Outcome**: Evaluate the accuracy and quality of remote sensing data and images for different applications. ○ **Indicator**: Students will assess the quality of remote sensing data using accuracy metrics and validation techniques, ensuring its suitability for specific applications. ○ **Key Concepts**: Accuracy assessment, confusion matrix, validation, ground truthing. **9. Understand and Apply Remote Sensing in Agriculture** • **Learning Outcome**: Understand and apply remote sensing technologies for precision agriculture. ○ **Indicator**: Students will explain how remote sensing is used to monitor crop health, soil moisture, and other agricultural parameters, and how to interpret these for agricultural management. ○ **Key Concepts**: Crop monitoring, soil moisture, precision agriculture, yield prediction.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Remote Sensing** • **Overview and History of Remote Sensing**:

	○ Origins and evolution of remote sensing technologies. ○ Key milestones in the development of remote sensing tools. • **Basic Principles**: ○ Electromagnetic radiation and its interaction with Earth's surface. ○ Passive vs. active remote sensing. ○ Remote sensing terminology: spatial, spectral, radiometric, and temporal resolution. --- **2. Remote Sensing Platforms and Sensors** • **Platform Types**: ○ Satellite-based platforms (e.g., geostationary, polar orbiting). ○ Airborne platforms (e.g., UAVs, aircraft). ○ Ground-based and terrestrial remote sensing. • **Sensor Types**: ○ Optical (visible, infrared, thermal). ○ Microwave (radar, synthetic aperture radar - SAR). ○ LiDAR (Light Detection and Ranging). ○ Hyperspectral and multispectral sensors. ○ Advantages and limitations of each sensor type. --- **3. The Electromagnetic Spectrum** • **Electromagnetic Spectrum Basics**: ○ Wavelength, frequency, and energy relationship. ○ Key regions of the electromagnetic spectrum: UV, visible, near-infrared, thermal infrared, microwave, and radar. • **Remote Sensing in Different Bands**: ○ How different wavelengths are used to detect various features (e.g., vegetation, water, soil). • **Interaction of Electromagnetic Radiation with the Earth's Surface**: ○ Reflection, absorption, and transmission. ○ Spectral signatures of different materials (e.g., vegetation, water bodies, urban areas). --- **4. Remote Sensing Data Acquisition and Processing** • **Data Acquisition**: ○ How remote sensing data is collected from satellites, aircraft, and drones. ○ The role of ground control points and calibration. • **Preprocessing Techniques**: ○ Geometric correction (orthorectification, map projection). ○ Radiometric correction (sensor calibration, atmospheric correction). ○ Image enhancement techniques (contrast stretching, filtering). • **Data Formats and Storage**: ○ Common remote sensing data formats (e.g., GeoTIFF, HDF, NetCDF). ○ Data compression and storage considerations. --- **5. Remote Sensing Image Interpretation** • **Image Interpretation Techniques**: ○ Visual interpretation: Identifying patterns and features in imagery. ○ Digital image processing: Quantitative analysis of pixel values.

	• **Image Classification**: ○ Supervised classification (e.g., maximum likelihood, decision trees). ○ Unsupervised classification (e.g., K-means clustering, ISODATA). ○ Accuracy assessment of classification results (confusion matrix, kappa coefficient). • **Change Detection**: ○ Methods for detecting changes over time using multi-temporal images. ○ Applications in monitoring deforestation, urban expansion, and climate change. --- **6. Geographic Information Systems (GIS) and Remote Sensing Integration** • **GIS Integration with Remote Sensing**: ○ Combining remote sensing data with GIS for spatial analysis and visualization. ○ Coordinate systems, map projections, and georeferencing. • **Applications of GIS-Remote Sensing Integration**: ○ Land use/land cover mapping, natural resource management, and urban planning. ○ 3D modeling and visualization using remote sensing data. --- **7. Applications of Remote Sensing** • **Environmental Monitoring**: ○ Vegetation and forest monitoring (e.g., NDVI, biomass estimation). ○ Water quality and hydrological studies (e.g., water bodies, wetlands, flood mapping). ○ Soil moisture and drought monitoring. • **Disaster Management**: ○ Monitoring and assessing the impacts of natural disasters (e.g., wildfires, floods, earthquakes). ○ Emergency response and recovery using remote sensing data. • **Agriculture**: ○ Precision farming and crop health monitoring (e.g., crop yield prediction, pest and disease detection). ○ Use of remote sensing in irrigation management and soil analysis. • **Urban and Regional Planning**: ○ Land use/land cover classification and urban expansion monitoring. ○ Infrastructure planning and transportation networks. • **Climate Change Studies**: ○ Monitoring global warming, melting ice caps, and sea level rise. ○ Analysis of urban heat islands and other climate-related phenomena.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures and Discussions** • **Strategy**: Deliver engaging lectures that introduce key concepts in remote sensing

	while promoting active participation and critical thinking. • **Teaching Methods**: ○ **Multimedia and Visual Aids**: Use diagrams, animations, and videos to illustrate complex remote sensing concepts such as electromagnetic radiation, sensor types, and image interpretation. ○ **Case Study Discussions**: Engage students in real-world case studies to explore how remote sensing is applied in various fields (e.g., agriculture, disaster management, environmental monitoring). This could include exploring the role of remote sensing in monitoring climate change or deforestation. ○ **Interactive Questioning**: Use clicker systems or polling apps to gauge student understanding and encourage in-class participation. <hr>**2. Hands-On Practical Sessions** • **Strategy**: Provide students with practical experience in data acquisition, processing, and analysis using remote sensing software and tools. • **Teaching Methods**: ○ **Fieldwork and Data Collection**: Where possible, organize field trips or activities where students use real sensors (e.g., drones, UAVs) or access real satellite data. Students can collect ground truth data to compare with remote sensing outputs. ○ **Remote Sensing Software Training**: Train students to use industry-standard software (e.g., ENVI, ERDAS Imagine, ArcGIS, QGIS) for data processing, classification, and analysis. Ensure students get hands-on experience in manipulating imagery, applying image correction techniques, and performing classifications. ○ **Practical Image Interpretation**: Involve students in exercises where they manually interpret remote sensing images, identifying land cover types or monitoring changes over time. <hr>**3. Problem-Based Learning (PBL)** • **Strategy**: Encourage critical thinking and problem-solving skills by presenting real-world problems that require remote sensing solutions. • **Teaching Methods**: ○ **Scenario-Based Learning**: Provide students with scenarios (e.g., identifying deforestation, monitoring urban growth, disaster management) and ask them to solve problems using remote sensing data. This could involve tasks like analyzing a satellite image for vegetation index or detecting land use changes over time. ○ **Project-Based Learning**: Have students work on group projects where they apply remote sensing tools and data to address specific challenges, such as mapping the impact of a flood or identifying agricultural land use patterns. ○ **Research-Oriented Projects**: Encourage students to conduct research using available satellite imagery or remote sensing datasets, with the aim of solving a problem or answering a specific question. <hr>**4. Flipped Classroom** • **Strategy**: Use the flipped classroom approach to allow students to learn foundational content outside of class, which frees up in-class time for practical applications and problem-solving. • **Teaching Methods**: ○ **Pre-Class Learning Materials**: Provide recorded lectures, readings, and instructional videos covering the theory of remote sensing, sensor technologies, and data

processing before class. Tools like Coursera, YouTube, or instructor-created resources can be useful.

○ **Interactive In-Class Activities**: Use class time for applying the pre-class material through group exercises, problem-solving tasks, and hands-on projects, such as interpreting satellite images or conducting spatial analysis with remote sensing software.

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5. Collaborative Learning and Group Projects

- **Strategy**: Foster teamwork and peer learning by incorporating group activities that simulate real-world remote sensing projects.
- **Teaching Methods**:

○ **Team-Based Projects**: Assign group tasks where students must collaborate to analyze remote sensing data and produce a report or presentation on their findings. Projects could include land cover classification, environmental monitoring, or disaster damage assessment.

○ **Peer Review and Feedback**: Encourage students to review each other's work and provide constructive feedback. This can help refine their analysis and improve collaboration skills.

○ **Cross-Disciplinary Collaboration**: Involve students from different backgrounds (e.g., geography, environmental science, engineering) in group projects, allowing them to approach remote sensing applications from various perspectives.

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6. Use of Digital Tools and Online Learning Platforms

- **Strategy**: Incorporate digital tools and online resources to facilitate learning and enhance student engagement with remote sensing content.
- **Teaching Methods**:

○ **Online Tutorials and Webinars**: Provide access to online tutorials and webinars on remote sensing techniques, software usage, and emerging technologies. These resources can be used as supplemental learning tools.

○ **Remote Sensing Data Repositories**: Introduce students to online platforms like NASA Earth Observing System Data and Information System (EOSDIS), Google Earth Engine, and USGS Earth Explorer to access and analyze real remote sensing data.

○ **Virtual Field Trips**: Use virtual tools such as Google Earth or 3D mapping software to simulate field visits and demonstrate how remote sensing data is applied to real-world scenarios.

Student Workload (SWL)

الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	BASIC CONCEPTS OF REMOTE SENSING& GIS Introduction, Electromagnetic Energy, Principles of Remote Sensing,
Week 2	BASIC CONCEPTS OF REMOTE SENSING& GIS Introduction, Electromagnetic Energy, Principles of Remote Sensing,
Week 3	BASIC CONCEPTS OF REMOTE SENSING& GIS Introduction, Electromagnetic Energy, Principles of Remote Sensing,
Week 4	BASIC CONCEPTS OF REMOTE SENSING& GIS Passive/ Active Remote Sensing , Remote Sensing Platforms
Week 5	BASIC CONCEPTS OF REMOTE SENSING& GIS Passive/ Active Remote Sensing , Remote Sensing Platforms
Week 6	BASIC CONCEPTS OF REMOTE SENSING& GIS Airborne and Space-borne Remote Sensing, Ideal Remote Sensing System,
Week 7	BASIC CONCEPTS OF REMOTE SENSING& GIS Airborne and Space-borne Remote Sensing, Ideal Remote Sensing System,
Week 8	BASIC CONCEPTS OF REMOTE SENSING& GIS , Characteristics of Real Remote Sensing Systems , Advantages and Disadvantages of Remote Sensing
Week 9	BASIC CONCEPTS OF REMOTE SENSING& GIS , Characteristics of Real Remote Sensing Systems , Advantages and Disadvantages of Remote Sensing
Week 10	ELECTROMAGNATC RADIATION (EMR) SPECTRUM Electromagnetic energy , Electro-Magnetic Radiation (EMR) spectrum

Week 11	ELECTROMAGNATC RADIATION (EMR) SPECTRUM Electromagnetic energy , Electro-Magnetic Radiation (EMR) spectrum
Week 12	ELECTROMAGNATC RADIATION (EMR) SPECTRUM Electromagnetic energy , Electro-Magnetic Radiation (EMR) spectrum
Week 13	ELECTROMAGNATC RADIATION (EMR) SPECTRUM , Energy sources and radiation principles , Remote sensing using electromagnetic radiation
Week 14	ELECTROMAGNATC RADIATION (EMR) SPECTRUM , Energy sources and radiation principles , Remote sensing using electromagnetic radiation
Week 15	ENERGY INTERACTIONS IN THE ATMOSPHERE Composition of the atmosphere , Energy Interactions, Scattering , Absorption , Sensor selection for remote sensing
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Introduction to Geographic Information Systems GIS Definition of GIS, GIS applications, Geospatial data, data for GIS applications
Week 2	Introduction to Geographic Information Systems GIS Definition of GIS, GIS applications, Geospatial data, data for GIS applications
Week 3	Introduction to Geographic Information Systems GIS digital representation of geospatial data, Vector representation of data and raster representation of data.
Week 4	Introduction to Geographic Information Systems GIS digital representation of geospatial data, Vector representation of data and raster representation of data.
Week 5	Introduction to Geographic Information Systems GIS digital representation of geospatial data, Vector representation of data and raster representation of data.
Week 6	Introduction to Geographic Information Systems GIS digital representation of geospatial data, Vector representation of data and raster representation of data.
Week 7	Arc-Catalog & Arc-Map Geo-databases, Catalog tree, Metadata Raster files,
Week 8	Arc-Catalog & Arc-Map Geo-databases, Catalog tree, Metadata Raster files,
Week 9	**Arc-Catalog & Arc-Map** Map documents, Globe documents, and layer files. Starting Arc-Map
Week 10	Arc-Catalog & Arc-Map Map documents, Globe documents, and layer files. Starting Arc-Map

Week 11	Arc-Catalog & Arc-Map
Week 12	Opening an existing map document, Adding data, Moving around the map,
Week 13	Arc-Catalog & Arc-Map
Week 14	Opening an existing map document, Adding data, Moving around the map,
Week 15	**Presentation**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		No
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

<table>
<tr><td colspan="6">Module Information
معلومات المادة الدراسية</td></tr>
<tr><td>Module Title</td><td colspan="3">Computer Application (Python) 1</td><td colspan="2">Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="3">Core</td><td colspan="2" rowspan="4">☒ Theory
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☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
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<tr><td>ECTS Credits</td><td colspan="3">4</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="3">100</td></tr>
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<tr><td colspan="2">Administering Department</td><td>Type Dept. Code</td><td>College</td><td colspan="2">Type College Code</td></tr>
<tr><td>Module Leader</td><td colspan="2">Name</td><td>e-mail</td><td colspan="2">E-mail</td></tr>
<tr><td colspan="2">Module Leader’s Acad. Title</td><td>Professor</td><td colspan="2">Module Leader’s Qualification</td><td>Ph.D.</td></tr>
<tr><td>Module Tutor</td><td colspan="2">Name (if available)</td><td>e-mail</td><td colspan="2">E-mail</td></tr>
<tr><td colspan="2">Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td colspan="2">E-mail</td></tr>
<tr><td colspan="2">Scientific Committee Approval Date</td><td></td><td>Version Number</td><td colspan="2">1.0</td></tr>
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<tr><td colspan="4">Relation with other Modules
العلاقة مع المواد الدراسية الأخرى</td></tr>
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<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
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<tr><td colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</td></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>The objective is to equip individuals with the knowledge and skills to effectively use Python as a powerful programming language for various purposes. The objective is to provide individuals with the knowledge and skills to effectively use the Python programming language for various computational tasks and software development. Python is a popular programming language known for its simplicity, versatility, and readability. And to equip individuals with the skills to develop, automate, and solve problems using Python. Python's versatility and extensive library ecosystem make it suitable for a wide range of applications, including data analysis, web development, scientific computing, artificial intelligence, and automation. By mastering Python, individuals can leverage its power and flexibility to create robust and efficient computer applications.</td></tr>
<tr><td>Module Learning</td><td>1. Understand the Basics of Python Programming</td></tr>
</table>

Outcomes مخرجات التعلم للمادة الدراسية	• **Learning Outcome**: Understand the basic syntax, data types, and structures in Python programming. ○ **Indicator**: Students will be able to explain and apply Python's core syntax, including variables, operators, loops, conditionals, and basic data types (strings, lists, tuples, dictionaries, sets). ○ **Key Concepts**: Variables, data types, expressions, control flow (if-else, loops). <hr>**2. Develop Problem-Solving Skills Using Python** • **Learning Outcome**: Apply Python programming techniques to solve computational problems. ○ **Indicator**: Students will demonstrate the ability to break down real-world problems into smaller components and implement solutions using Python. ○ **Key Concepts**: Problem decomposition, algorithm development, debugging, and testing. <hr>**3. Master Functions and Modular Programming** • **Learning Outcome**: Understand the concepts of functions, modules, and libraries in Python for modular programming. ○ **Indicator**: Students will be able to create reusable functions, organize code into modules, and import and use Python libraries. ○ **Key Concepts**: Functions, parameters, return values, Python libraries, importing modules. <hr>**4. Work with Data Structures in Python** • **Learning Outcome**: Use Python's built-in data structures to store and manipulate data efficiently. ○ **Indicator**: Students will be able to apply lists, dictionaries, sets, and tuples for solving problems, and understand their use cases. ○ **Key Concepts**: Lists, dictionaries, sets, tuples, list comprehensions, data manipulation. <hr>**5. Implement Object-Oriented Programming (OOP) Concepts** • **Learning Outcome**: Understand and apply Object-Oriented Programming principles in Python. ○ **Indicator**: Students will be able to design and implement classes and objects, and use inheritance, polymorphism, and encapsulation in Python. ○ **Key Concepts**: Classes, objects, methods, inheritance, polymorphism, encapsulation. <hr>**6. Perform File Handling and Data Persistence** • **Learning Outcome**: Use Python for reading, writing, and manipulating files (text, CSV, JSON). ○ **Indicator**: Students will demonstrate the ability to open, read, write, and parse various file formats to store and retrieve data. ○ **Key Concepts**: File I/O (input/output), text files, CSV, JSON, data persistence. <hr>**7. Utilize Libraries for Data Analysis**

	• Learning Outcome: Apply Python libraries for data manipulation, analysis, and visualization. ○ Indicator: Students will be able to use libraries like NumPy, Pandas, and Matplotlib to perform data analysis, data cleaning, and visualization. ○ Key Concepts: NumPy, Pandas, Matplotlib, data manipulation, data visualization. **8. Develop Interactive and GUI Applications** • **Learning Outcome**: Build basic graphical user interface (GUI) applications using Python. ○ **Indicator**: Students will be able to design and implement simple GUI applications using libraries such as Tkinter. ○ **Key Concepts**: Tkinter, event-driven programming, widgets, GUI layout. **9. Work with APIs and Web Scraping** • **Learning Outcome**: Understand how to interact with external APIs and scrape web data using Python. ○ **Indicator**: Students will demonstrate the ability to request data from web APIs (e.g., REST API), parse the returned data, and scrape web pages using libraries like requests and BeautifulSoup. ○ **Key Concepts**: APIs, web scraping, requests, BeautifulSoup, JSON parsing. **10. Implement Basic Algorithms and Problem-Solving Techniques** • **Learning Outcome**: Understand and implement basic algorithms in Python (sorting, searching, recursion). ○ **Indicator**: Students will be able to implement common algorithms and understand their time complexity. ○ **Key Concepts**: Sorting algorithms (e.g., bubble sort, merge sort), searching algorithms (e.g., binary search), recursion. **11. Debug and Optimize Python Code** • **Learning Outcome**: Develop debugging and code optimization skills to improve Python programs. ○ **Indicator**: Students will be able to use debugging tools, analyze error messages, and optimize Python code for performance. ○ **Key Concepts**: Debugging techniques, optimization, time complexity, profiling. **12. Understand Python's Application in Real-World Domains** • **Learning Outcome**: Understand the use of Python in various domains such as web development, data science, and automation. ○ **Indicator**: Students will be able to explain how Python is used in different industries and domains, and apply it to build basic applications. ○ **Key Concepts**: Web development (Flask, Django), data science (Jupyter Notebooks), automation scripts.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Python Programming** • **Overview of Python**: ○ History and evolution of Python.

	○ Why Python is popular: readability, versatility, and community support. ○ Python versions and installation. • **Python Development Environment**: ○ Setting up a Python development environment (IDEs: PyCharm, VS Code, Jupyter). ○ Python shell vs. script-based programming. • **Basic Syntax**: ○ Writing and executing Python scripts. ○ Comments, indentation, and syntax rules. • **Hello World Program**: ○ Introduction to basic output using print(). --- **2. Data Types and Variables** • **Variables and Constants**: ○ Declaring and initializing variables. ○ Data type conversion (casting). • **Primitive Data Types**: ○ Integers, floating-point numbers, strings, booleans. • **Basic Input/Output**: ○ Reading input from the user with input(). ○ Formatting output (string interpolation, f-strings, and format method). • **Type Checking**: ○ Using type() and isinstance() functions to check types. --- **3. Control Flow and Conditional Statements** • **If-Else Statements**: ○ Simple conditionals: if, elif, else. ○ Nested conditions and logical operators (and, or, not). • **Comparison Operators**: ○ Operators such as ==, !=, <, >, <=, >=. • **Switch Case Alternative**: ○ Using dictionaries or match-case (Python 3.10+). • **Error Handling (Optional)**: ○ Introduction to try, except blocks for exception handling. --- **4. Loops and Iteration** • **For Loops**: ○ Looping through sequences (lists, strings, ranges). ○ Iterating over dictionaries and sets. • **While Loops**: ○ Conditional loops and using break and continue. • **Comprehensions**: ○ List comprehensions for efficient iteration and transformations. • **Nested Loops**: ○ Iterating over multidimensional data structures like lists of lists. --- **5. Functions and Modular Programming** • **Defining Functions**: ○ Syntax for defining functions using def.

	○ Function parameters, return values, and default arguments. • **Variable Scope**: ○ Local, global, and nonlocal variables. • **Lambda Functions**: ○ Anonymous functions using lambda. • **Recursion**: ○ Introduction to recursive functions and base case. • **Docstrings**: ○ Writing documentation for functions using triple quotes. **6. Data Structures in Python** • **Lists**: ○ Creating, accessing, and modifying lists. ○ List slicing, methods (append(), remove(), pop()). • **Tuples**: ○ Immutable sequences and their use cases. • **Dictionaries**: ○ Key-value pairs, dictionary operations (get(), keys(), values()). ○ Iterating over dictionaries. • **Sets**: ○ Set operations (union(), intersection(), difference()). • **String Manipulation**: ○ Working with strings: slicing, methods (join(), replace(), split()). • **Advanced Data Structures (Optional)**: ○ Stacks, queues, and linked lists. **7. Object-Oriented Programming (OOP)** • **Introduction to OOP**: ○ Object-oriented concepts: classes, objects, methods, attributes. • **Defining Classes and Objects**: ○ Syntax for creating classes and instantiating objects. • **Instance and Class Methods**: ○ Difference between instance and class methods. • **Inheritance**: ○ Creating subclasses, method overriding, and super(). • **Polymorphism and Encapsulation**: ○ Method overloading, and information hiding using private methods. • **Constructor (__init__)**: ○ Using constructors to initialize class attributes. • **Magic Methods**: ○ Introduction to magic methods like __str__, __repr__, __len__. **8. File Handling** • **Opening and Closing Files**: ○ Using open(), file modes (r, w, a, etc.), and closing files with close(). • **Reading and Writing Files**: ○ Reading text files (read(), readline(), readlines()). ○ Writing to files (write(), writelines()). • **Working with File Paths**:

- ○ Using the os and pathlib modules for file manipulation.
- **File Handling with CSV and JSON**:
  - ○ Reading and writing CSV files using the csv module.
  - ○ Parsing and writing JSON data using json module.

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9. Introduction to Libraries and Modules

- **Importing Libraries**:
  - ○ Using the import statement and aliasing (import numpy as np).
- **Standard Python Libraries**:
  - ○ Exploring commonly used libraries like math, random, datetime, os, sys.
- **Third-Party Libraries**:
  - ○ Introduction to popular third-party libraries like NumPy, Pandas, Matplotlib.
  - ○ Installing libraries using pip.

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10. Data Analysis and Visualization

- **NumPy**:
  - ○ Arrays, array operations, and basic mathematical functions.
- **Pandas**:
  - ○ Creating and manipulating DataFrames, reading data from CSV files, data aggregation.
- **Matplotlib**:
  - ○ Basic plotting techniques, creating line graphs, bar charts, histograms.
  - ○ Customizing plots with titles, labels, and legends.
- **Seaborn (Optional)**:
  - ○ Advanced visualization techniques for statistical data.

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11. Web Development with Python (Optional)

- **Introduction to Web Development Frameworks**:
  - ○ Overview of Flask or Django for building web applications.
- **Basic Flask Application**:
  - ○ Setting up a simple web server using Flask.
  - ○ Routing, templates, and handling user requests.
- **Database Connectivity**:
  - ○ Connecting to databases (SQLite, MySQL) using Python.
- **APIs**:
  - ○ Introduction to building RESTful APIs using Flask or FastAPI.

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12. Automation and Scripting

- **Automating Tasks**:
  - ○ Using Python to automate repetitive tasks (e.g., file management, web scraping).
- **Web Scraping with BeautifulSoup**:
  - ○ Extracting data from HTML pages using BeautifulSoup and requests.
- **Regular Expressions**:
  - ○ Using the re module for pattern matching in text data.

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13. Testing and Debugging

- **Debugging Techniques**:
  - ○ Using the pdb debugger, print statements, and error handling.

	• **Unit Testing**: ○ Introduction to unittest framework for writing tests. ○ Writing simple test cases for functions and methods. --- **14. Advanced Python Topics (Optional)** • **Decorators**: ○ Understanding and using decorators to modify functions. • **Generators**: ○ Introduction to generators for memory-efficient iteration. • **Context Managers**: ○ Using with statements for resource management. --- **15. Final Projects and Applications** • **Capstone Project**: ○ Encourage students to work on a final project where they apply the Python skills learned to build a complete application (e.g., a web scraper, automation script, or simple game). • **Project Presentation**: ○ Students present their projects, explaining the design, implementation, and challenges faced.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures and Demonstrations** • **Objective**: Provide theoretical knowledge and demonstrate key concepts through live coding. • **Strategy**: ○ Use **live coding** to demonstrate Python syntax and programming principles. ○ Present **concepts with real-world examples**, showing how Python is used in various industries (e.g., web development, data science, automation). ○ Highlight key libraries and tools in Python, explaining their uses with real-time examples. ○ Engage students with **question-and-answer sessions** to clarify doubts immediately. ○ **Visual aids** like flowcharts, diagrams, and code snippets to explain complex topics (e.g., OOP principles, recursion). --- **2. Hands-On Programming Practice** • **Objective**: Allow students to actively apply learned concepts by writing and debugging Python code. • **Strategy**: ○ **Weekly coding exercises**: Assign coding tasks and small projects to reinforce each topic. For instance, after learning about loops, students could implement a simple number guessing game or a text-based calculator. ○ **Guided practice** in the classroom where students write code during the lesson with the instructor's support, ensuring immediate feedback and guidance.

	○ **Challenge problems** that encourage problem-solving and creative thinking, such as algorithms or data structure tasks, to develop critical thinking and mastery of Python syntax. ○ **Collaborative coding**: Pair programming and small group coding tasks to encourage peer-to-peer learning. --- **3. Project-Based Learning** • **Objective**: Apply Python knowledge in real-world scenarios through larger, more complex projects. • **Strategy**: ○ Assign **small to medium-sized projects** that align with the students' interests (e.g., building a web scraper, developing a simple application with a graphical user interface (GUI), or performing data analysis). ○ Guide students through the **project lifecycle**: problem definition, design, coding, testing, and debugging. ○ Encourage **team-based projects** to mimic real-world work environments, improving collaboration skills and fostering peer learning. ○ Provide clear **project milestones** with deadlines to break down larger tasks into manageable parts (e.g., writing the code for one function at a time). --- **4. Flipped Classroom and Self-Directed Learning** • **Objective**: Empower students to learn concepts outside the classroom, freeing up class time for deeper discussions and practice. • **Strategy**: ○ Assign **pre-recorded video tutorials** or **reading material** on basic concepts (e.g., Python syntax, variables, control flow) for students to review before class. ○ Use **interactive Python platforms** (e.g., Jupyter Notebooks, Google Colab) for hands-on coding assignments and exercises that students can complete at their own pace. ○ Encourage **self-assessment and reflection** on completed tasks, helping students identify areas of improvement. ○ Provide access to additional **online resources** and **coding challenges** (e.g., LeetCode, HackerRank) to promote continuous self-learning. --- **5. Peer Learning and Collaborative Activities** • **Objective**: Foster collaboration and knowledge-sharing among students to reinforce learning. • **Strategy**: ○ **Pair Programming**: Pair students together to work on coding tasks, encouraging active collaboration and immediate feedback. ○ **Group Discussions**: Organize discussions or problem-solving sessions around specific programming concepts (e.g., sorting algorithms or object-oriented programming). ○ **Code Reviews**: Encourage students to review and critique each other's code, providing constructive feedback and suggestions for improvements. ○ **Discussion forums** (e.g., Slack, Microsoft Teams, or a course-specific forum): Use them to share resources, ask questions, and collaborate outside of class time. --- **6. Problem-Solving and Algorithmic Thinking** • **Objective**: Develop problem-solving skills through algorithmic thinking and

	computational logic. • **Strategy**: ○ Integrate **problem-solving sessions** where students break down problems into smaller tasks and then write Python code to solve them. ○ Use **puzzles and coding challenges** in each class to stimulate critical thinking (e.g., designing algorithms for common problems like searching, sorting, or string manipulation). ○ Focus on **algorithmic efficiency** by encouraging students to consider time complexity and space complexity. ○ Promote the practice of **writing pseudocode** or drawing flowcharts before implementing the solution in Python, helping students structure their approach to problems. --- **7. Use of Integrated Development Environments (IDEs) and Tools** • **Objective**: Familiarize students with industry-standard tools for coding, debugging, and project management. • **Strategy**: ○ **IDE Training**: Introduce students to Python IDEs like **PyCharm, VS Code**, and **Jupyter Notebooks** to make the coding experience more efficient and professional. ○ Encourage students to use **version control tools** like **Git** and **GitHub** for project management and collaborative work. ○ Teach students how to use **debugging tools** (e.g., pdb for Python) and **unit testing frameworks** (e.g., unittest or pytest) to ensure their code works correctly and is optimized. --- **8. Assessment and Feedback** • **Objective**: Assess students' understanding of Python concepts and provide constructive feedback to guide their learning. • **Strategy**: ○ **Formative Assessment**: Conduct **quizzes** and **short coding exercises** at the beginning or end of each lesson to test immediate understanding and reinforce concepts. ○ **Peer Review**: Use peer assessments for coding assignments and projects to encourage collaboration and critical thinking. ○ Provide **frequent, personalized feedback** on assignments, code quality, and error handling, helping students identify strengths and areas for improvement. ○ **Summative Assessment**: End-of-course exams or project submissions that require students to demonstrate their proficiency in Python programming and problem-solving. --- **9. Industry Relevance and Guest Lectures** • **Objective**: Provide insights into the real-world application of Python and inspire students with industry experiences. • **Strategy**: ○ Organize **guest lectures** or webinars from professionals working in fields that heavily utilize Python (e.g., web development, data science, or automation). ○ Encourage students to participate in **Python-related competitions** or **hackathons** to experience problem-solving in real-world scenarios. ○ Highlight **case studies** and **industry use cases** (e.g., Python for web scraping, machine learning, or automation). --- **10. Encouraging a Growth Mindset**

	• **Objective**: Foster a mindset of continuous learning, resilience, and adaptability in the face of challenges. • **Strategy**: ○ Promote **trial and error** in coding, emphasizing that mistakes are an essential part of learning. ○ Celebrate small wins and **gradual improvement**, such as successfully debugging an error or completing a challenging exercise. ○ Encourage students to **set personal goals** for learning Python and challenge themselves with more advanced topics as they progress.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Introduction to the Python language

Week 2	Download and install Python
Week 3	Download and install Python
Week 4	Python syntax
Week 5	Python syntax
Week 6	Python keywords and identifiers
Week 7	Python comments
Week 8	Python variables
Week 9	Python data types
Week 10	Python Methods
Week 11	Python Methods
Week 12	Connect with Python
Week 13	Python Classes and Objects
Week 14	Python libraries
Week 15	Installing Python librarie
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

Week	Material Covered
Week 1	N/A
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts		Yes
Recommended Texts		No
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية			
Module Title	**Cadastral Surveying 1**	**Module Delivery**	
Module Type	**Core**	☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 305**		
ECTS Credits	**5**		
SWL (hr/sem)	**125**		
Module Level	1	**Semester of Delivery**	1
Administering Department	Type Dept. Code	**College**	Type College Code
Module Leader	Name	**e-mail**	E-mail
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)	**e-mail**	E-mail
Peer Reviewer Name	Name	**e-mail**	E-mail
Scientific Committee Approval Date		**Version Number**	1.0

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective of studying cadastral surveying is to equip individuals with the knowledge and skills necessary to accurately establish, define, and manage property boundaries and cadastral information. This knowledge enables them to perform cadastral surveys, contribute to land administration systems, resolve boundary disputes, support land development projects, and ensure the integrity and reliability of property ownership records. Overall, the objective of studying cadastral topics is to equip individuals with the knowledge and skills necessary to establish, manage, and utilize cadastral systems. Cadastral systems play a crucial role in land administration, property rights, and land management, providing the foundation for secure land tenure, spatial planning, and sustainable development.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Principles of Cadastral Surveying** • **Learning Outcome**: Demonstrate a clear understanding of the principles, history, and objectives of cadastral surveying. ○ **Indicator**: Students will explain the fundamental concepts, legal framework, and purposes of cadastral surveying, including land ownership, boundary definition, and land use planning. **2. Apply Legal and Regulatory Frameworks in Cadastral Surveying** • **Learning Outcome**: Understand and apply the legal and regulatory frameworks governing cadastral surveys. ○ **Indicator**: Students will be able to identify relevant laws, regulations, and policies governing land tenure, property rights, and land registration systems in cadastral surveys. **3. Perform Cadastral Survey Measurements and Techniques** • **Learning Outcome**: Conduct cadastral surveys using appropriate measurement techniques and equipment. ○ **Indicator**: Students will demonstrate the ability to perform boundary measurements using traditional and modern surveying tools (e.g., total stations, GPS, and electronic distance measurement devices), ensuring accuracy and reliability. **4. Interpret Cadastral Survey Data and Documentation** • **Learning Outcome**: Interpret and produce accurate cadastral survey documentation and maps. ○ **Indicator**: Students will be able to interpret survey data, create legal and technical documents, and prepare cadastral maps that accurately represent land boundaries and property divisions. **5. Understand Land Registration and Titling Systems**

	• **Learning Outcome**: Comprehend the process of land registration and property titling. ○ **Indicator**: Students will explain how cadastral surveys contribute to land registration systems, and how land titles and ownership are managed through government authorities. **6. Apply Cadastral Surveying in Land Development and Planning** • **Learning Outcome**: Use cadastral survey data in land development, urban planning, and land-use management. ○ **Indicator**: Students will demonstrate the ability to use cadastral survey information to contribute to land development projects, including subdivisions, zoning, and land-use decisions. **7. Analyze and Solve Cadastral Surveying Problems** • **Learning Outcome**: Analyze and solve real-world cadastral surveying problems using appropriate surveying techniques. ○ **Indicator**: Students will apply critical thinking and problem-solving skills to resolve boundary disputes, property conflicts, and other issues related to land surveying. **8. Understand the Role of Technology in Cadastral Surveying** • **Learning Outcome**: Understand the impact and application of modern technology in cadastral surveying. ○ **Indicator**: Students will demonstrate familiarity with GPS, GIS, and other advanced technologies in cadastral surveying, and how these tools improve the accuracy, efficiency, and legal integrity of survey results. **9. Ensure Professional and Ethical Practices in Cadastral Surveying** • **Learning Outcome**: Apply ethical and professional standards to cadastral surveying practices. ○ **Indicator**: Students will understand the ethical responsibilities of cadastral surveyors and how to adhere to professional standards in the field, including privacy, accuracy, and impartiality in surveying practice. **10. Communicate Cadastral Surveying Findings Effectively** • **Learning Outcome**: Communicate survey findings, interpretations, and recommendations clearly to clients, authorities, and stakeholders. ○ **Indicator**: Students will demonstrate the ability to prepare clear, concise, and accurate reports, maps, and presentations for diverse audiences, including landowners, government officials, and developers.
Indicative Contents المحتويات الإرشادية	**Introduction to Cadastral Surveying** • **Definition and Purpose**: ○ Overview of cadastral surveying and its role in land management. ○ Importance of cadastral surveys in property rights, land ownership, and land-use planning. • **History of Cadastral Systems**: ○ Evolution of land surveying and the development of cadastral systems. • **Types of Surveys**: ○ Different types of cadastral surveys (boundary surveys, subdivision surveys, retracement surveys, etc.).

	• **Cadastral Surveying vs. Other Types of Surveying**: ○ Comparison with other survey types (topographic, engineering, etc.). --- **2. Legal and Regulatory Framework** • **Legal Basis of Cadastral Surveying**: ○ Land ownership rights, title deeds, and property boundaries. • **National and International Land Laws**: ○ Overview of land tenure systems, land laws, and international standards. • **Land Registration Systems**: ○ Principles of land registration and the role of cadastral surveys in supporting land titles. • **Surveying Acts and Standards**: ○ Relevant surveying regulations, codes of practice, and industry standards. • **Boundary Disputes and Legal Implications**: ○ Common legal issues in cadastral surveying, including resolving boundary conflicts. --- **3. Cadastral Surveying Techniques** • **Measurement Techniques**: ○ Traditional methods (tape and chain measurements). ○ Modern instruments (total stations, electronic distance measurement (EDM), and GPS/GNSS). • **Types of Cadastral Surveys**: ○ **Boundary Surveys**: Defining and marking property boundaries. ○ **Subdivision Surveys**: Dividing land into parcels or lots. ○ **Retracement Surveys**: Verifying and reestablishing previously surveyed boundaries. • **Field Surveying Methods**: ○ Setting up survey stations, using theodolites and levels, and collecting data. ○ The role of reference points and monuments in cadastral surveying. • **Data Collection and Error Management**: ○ Collecting survey data accurately and minimizing errors in measurements. --- **4. Cadastral Mapping and Documentation** • **Cadastral Mapping**: ○ Types of cadastral maps: property maps, parcel maps, and subdivision plans. ○ The importance of accuracy and clarity in cadastral maps. • **Survey Plan Preparation**: ○ Drawing legal survey plans and land parcel boundaries. ○ Symbols, notations, and other conventions used in cadastral survey plans. • **Land Ownership and Property Documentation**: ○ Recording survey results in legal documents and databases. • **Survey Reports**: ○ Creating technical and legal reports that accompany cadastral surveys. --- **5. Technology in Cadastral Surveying** • **Global Positioning Systems (GPS)**: ○ Use of GPS technology for boundary and location surveys. ○ Advantages and limitations of GPS in cadastral surveying.

	• **Geographic Information Systems (GIS)**: ○ Role of GIS in managing and analyzing cadastral data. ○ Integration of GIS with cadastral maps and land registries. • **Remote Sensing**: ○ Use of satellite imagery and aerial photography in cadastral surveying. ○ Applications of remote sensing for large-scale land surveys and boundary determinations. • **Electronic Surveying Instruments**: ○ Modern surveying tools like total stations, robotic instruments, and data loggers. • **Software for Cadastral Surveying**: ○ Surveying software for data collection, mapping, and processing (e.g., AutoCAD, MicroStation, ArcGIS). --- **6. Land Registration and Titling Systems** • **Land Ownership and Title Systems**: ○ Understanding land tenure and title systems. ○ Types of land titles: freehold, leasehold, and customary land ownership. • **Process of Land Registration**: ○ Steps involved in registering land ownership, title issuance, and the role of cadastral surveys. • **Cadastral Systems Around the World**: ○ Different land registration systems in various countries (e.g., Torrens System, deed registration system). • **Cadastral Surveying in Land Reform**: ○ Role of cadastral surveying in land redistribution and land reform programs. • **Challenges in Land Registration**: ○ Legal, technical, and social challenges in land registration and titling. --- **7. Boundary Disputes and Resolutions** • **Boundary Identification**: ○ Methods for determining the correct boundaries of land parcels. • **Resolving Boundary Disputes**: ○ Procedures for resolving boundary conflicts, including legal and technical approaches. • **Surveyor’s Role in Boundary Disputes**: ○ Ethical considerations and responsibilities of surveyors in dispute resolution. • **Case Studies in Boundary Disputes**: ○ Real-world examples of cadastral disputes and their resolution through surveying and legal processes. --- **8. Cadastral Surveying and Land Development** • **Role of Cadastral Surveys in Urban Planning**: ○ Cadastral surveys for land subdivision and urban zoning. ○ Integrating cadastral surveys with city planning and infrastructure development. • **Land Development and Subdivision**: ○ Surveying for property subdivision and land development projects. • **Environmental Considerations in Cadastral Surveys**:

	○ Impact of cadastral surveys on environmental planning and conservation efforts. • **Planning for Infrastructure**: ○ How cadastral surveys contribute to the planning and implementation of infrastructure like roads, utilities, and public services. --- **9. Professional Practices in Cadastral Surveying** • **Ethics and Professionalism**: ○ Ethical issues and professional standards in cadastral surveying. • **Surveying for Government and Private Sector**: ○ The role of cadastral surveyors in both public (government) and private sector projects. • **Surveyor's Liability**: ○ Legal liability for errors, omissions, and negligence in cadastral surveys. • **Continuing Professional Development**: ○ Importance of professional certifications, education, and lifelong learning for cadastral surveyors. --- **10. Future Trends in Cadastral Surveying** • **Emerging Technologies**: ○ Future innovations in surveying technology, such as LiDAR, UAVs (drones), and autonomous surveying systems. • **Cadastral Surveying in the Digital Age**: ○ The move toward digital cadastral systems and online land registries. • **Automation and Artificial Intelligence**: ○ The potential for automation and AI in data processing and boundary dispute resolution. • **Global Trends and Challenges**: ○ Emerging trends in cadastral surveying related to climate change, population growth, and urbanization.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**Interactive Lectures and Demonstrations** • **Objective**: Deliver foundational knowledge and demonstrate surveying methods. • **Strategy**: ○ Use **live demonstrations** of cadastral survey techniques (e.g., boundary marking, GPS-based measurements) to reinforce theoretical concepts. ○ **Case Studies**: Present case studies of real-world cadastral surveys, such as boundary disputes or land registration systems, to show how surveying principles are applied in practice. ○ Use **visual aids** like maps, aerial photos, and survey plans to demonstrate concepts such as boundary delineation and land ownership. ○ **Interactive Q&A**: Encourage active participation from students by asking questions about legal implications and technical challenges they may face during cadastral surveys.

	2. Hands-On Practical Sessions • **Objective**: Equip students with the practical skills needed for cadastral surveying. • **Strategy**: ○ Organize **field trips** or outdoor practical sessions where students perform boundary surveys and use surveying instruments like total stations, GPS, and theodolites. ○ Set up **surveying exercises** on real properties, allowing students to apply measurement techniques and produce survey reports. ○ **Simulation Software**: Use software tools like AutoCAD, ArcGIS, or MicroStation for simulating cadastral mapping and land registration tasks, allowing students to practice creating survey maps and legal documents. **3. Problem-Based Learning (PBL)** • **Objective**: Develop critical thinking and problem-solving skills through real-world challenges. • **Strategy**: ○ Present students with **real-life surveying problems**, such as boundary disputes, and have them work in groups to analyze and propose solutions. ○ Use **boundary conflict scenarios** to have students assess legal and technical aspects and create survey plans that resolve the disputes. ○ Assign **case studies** related to cadastral surveying, such as subdivision surveys, to test their understanding of both technical and legal principles. **4. Collaborative Learning and Peer Review** • **Objective**: Encourage teamwork and peer feedback to reinforce learning. • **Strategy**: ○ **Group projects**: Organize students into small groups to complete a cadastral survey project, including fieldwork, mapping, and report writing. This promotes teamwork and the exchange of ideas. ○ **Peer reviews**: After each project or survey task, have students review each other's work, providing feedback on the quality of survey measurements, accuracy of boundary definitions, and the quality of survey reports. ○ **Group discussions**: Hold class discussions on surveying principles, ethical practices, and legal responsibilities, allowing students to learn from one another. **5. Flipped Classroom Approach** • **Objective**: Maximize in-class time for discussions, application, and problem-solving by having students learn foundational concepts beforehand. • **Strategy**: ○ Assign **pre-class readings** or video tutorials on topics such as land registration systems, boundary law, or surveying techniques. ○ Use **interactive online platforms** like quizzes, forums, or discussion boards where students can discuss legal or technical topics before coming to class. ○ In-class time should be dedicated to applying knowledge through group exercises, hands-on tasks, or simulations. **6. Use of Technology and Digital Tools** • **Objective**: Familiarize students with the tools and software used in modern cadastral surveying.

	• **Strategy**: o **GPS and GIS Training**: Provide training sessions on using **GPS technology**, **GIS software** (e.g., ArcGIS, QGIS), and **surveying tools** such as total stations or drones to perform cadastral surveys and map properties. o Introduce **surveying software** like AutoCAD and MicroStation for creating survey plans and legal documents. o Use **3D modeling tools** or **virtual reality simulations** to create virtual surveying environments where students can practice boundary measurement and surveying tasks. o Use **online databases and mapping platforms** to simulate land registration processes and cadastral data management. **7. Guest Lectures and Industry Interaction** • **Objective**: Provide real-world insights and professional perspectives to students. • **Strategy**: o Invite **experienced cadastral surveyors** or legal professionals to speak about current trends, challenges, and ethical issues in cadastral surveying. o Organize **site visits** to ongoing cadastral survey projects or land registration offices, where students can observe professionals in action. o **Industry partnerships**: Collaborate with land management authorities or surveying companies to provide students with real-world survey data for analysis and mapping exercises. **8. Structured Assessments and Feedback** • **Objective**: Assess student progress and provide constructive feedback to guide their learning. • **Strategy**: o Implement **formative assessments** throughout the course, such as quizzes, peer-reviewed assignments, or practical surveying tasks, to track progress. o Provide **immediate feedback** after field exercises and projects, focusing on both technical accuracy and adherence to legal and ethical standards. o Use **summative assessments** (e.g., final exams or major project submissions) to test comprehensive knowledge of cadastral surveying concepts, legal frameworks, and technical skills. **9. Ethics and Professionalism in Cadastral Surveying** • **Objective**: Instill professional conduct and ethical responsibility in students. • **Strategy**: o **Role-playing scenarios**: Engage students in role-playing activities that focus on ethical decision-making, such as resolving boundary disputes or handling conflicts of interest during a survey. o Discuss the **ethical responsibilities** of cadastral surveyors in relation to accuracy, impartiality, confidentiality, and legal compliance. o Explore case studies involving ethical dilemmas, where students discuss and propose solutions based on professional and legal standards. **10. Real-World Applications and Capstone Project** • **Objective**: Provide students with an opportunity to apply all learned skills in a final project that simulates real-world cadastral surveying.

	• **Strategy**: ○ Assign a **capstone project** where students conduct a full cadastral survey, including legal research, boundary analysis, fieldwork, and map production. ○ The project could involve creating a comprehensive survey report, addressing boundary disputes, and designing land registration documents for a fictional or real property. ○ **Mentorship**: Pair students with industry professionals to guide them through the process of completing the capstone project, ensuring they receive expert feedback.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**125**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	0	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Introduction
Week 2	Definition of cadastral area
Week 3	Compute the regular area

Week 4	Compute the irregular area
Week 5	Compute the irregular area
Week 6	Intersection I, traversing
Week 7	Intersection I, traversing
Week 8	Intersection II using analytical Engineering
Week 9	Intersection II using analytical Engineering
Week 10	Application of intersection II
Week 11	Application of intersection II
Week 12	Application of intersection II
Week 13	Road intersection, area division
Week 14	Road intersection, area division
Week 15	Intersection III
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	**Introduction**
Week 2	Example for forward computation
Week 3	Example for compute the regular area
Week 4	Example for compute the irregular area
Week 5	Example for compute the irregular area
Week 6	Example for intersection I, traversing
Week 7	Example for intersection I, traversing
Week 8	Example for intersection II using analytical Engineering
Week 9	Example for intersection II using analytical Engineering
Week 10	Example for application of intersection II
Week 11	Example for application of intersection II
Week 12	Example for application of intersection II
Week 13	Example for road intersection , area division
Week 14	Example for road intersection , area division
Week 15	Example intersection III

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

<table>
<tr><th colspan="4">Module Information
معلومات المادة الدراسية</th></tr>
<tr><td>Module Title</td><td colspan="2">Analytical Engineering</td><td>Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="2">Core</td><td rowspan="5">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="2">SUT 306</td></tr>
<tr><td>ECTS Credits</td><td colspan="2">4</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="2">100</td></tr>
</table>

Module Level		**Semester of Delivery**	1
Administering Department		**College**	Type College Code
Module Leader		**e-mail**	E-mail
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)	**e-mail**	E-mail
Peer Reviewer Name	Name	**e-mail**	E-mail
Scientific Committee Approval Date		**Version Number**	1.0

Relation with other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Objectives	The objective of studying "Engineering Analysis" topics is to provide individuals with the

أهداف المادة الدراسية	knowledge and skills to analyze and solve engineering problems using mathematical and scientific methods. Engineering analysis involves the application of mathematical principles, physical laws, and computational techniques to understand and predict the behavior of engineering systems. Overall, the objective of studying engineering analysis topics is to equip individuals with the analytical and problem-solving skills necessary to analyze and understand engineering systems. By applying mathematical and scientific methods, engineers can make informed decisions, optimize designs, and ensure the safe and efficient operation of engineering projects
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Fundamentals of Analytical Engineering** • **Learning Outcome: Demonstrate a comprehensive understanding of the fundamental principles of analytical engineering and its role in solving engineering problems.** ○ **Indicator: Students will be able to explain the role of analytical methods in engineering, describe key concepts, and identify various types of analytical models used in engineering problems.** **2. Apply Mathematical Models to Engineering Problems** • **Learning Outcome: Develop and apply mathematical models to solve engineering problems in different domains.** ○ **Indicator: Students will create mathematical models using techniques such as differential equations, linear algebra, and optimization to solve real-world engineering problems (e.g., stress analysis, fluid dynamics, thermodynamics).** **3. Analyze Engineering Systems Using Computational Tools** • **Learning Outcome: Use appropriate computational tools and software to analyze engineering systems and processes.** ○ **Indicator: Students will apply engineering analysis software (e.g., MATLAB, COMSOL, ANSYS) to simulate and analyze engineering systems and processes, interpreting the results to inform design decisions.** **4. Apply Statistical and Numerical Methods in Engineering Analysis** • **Learning Outcome: Use statistical and numerical methods to perform data analysis and solve engineering problems.** ○ **Indicator: Students will use techniques like regression analysis, Monte Carlo simulations, and finite element analysis (FEA) to analyze engineering data and solve complex problems, including uncertainty modeling and risk analysis.** **5. Understand the Principles of System Dynamics and Simulation** • **Learning Outcome: Understand and apply the principles of system dynamics and simulation modeling in engineering design and analysis.** ○ **Indicator: Students will demonstrate an understanding of system dynamics, including feedback loops and time-dependent behavior, and apply simulation tools to model complex engineering systems (e.g., mechanical systems, electrical circuits,**

	or supply chains). --- **6. Interpret and Validate Analytical Results** • **Learning Outcome: Interpret and validate the results of analytical models and simulations in the context of engineering design.** ○ **Indicator: Students will critically evaluate the validity of the results obtained from analytical methods, ensuring that models and simulations reflect real-world behavior and meet engineering requirements.** --- **7. Apply Engineering Principles to Optimize Solutions** • **Learning Outcome: Use optimization techniques to design and improve engineering systems and processes.** ○ **Indicator: Students will apply optimization techniques (e.g., linear programming, genetic algorithms) to engineering problems to optimize performance, reduce costs, and enhance efficiency in system design and operations.** --- **8. Communicate Analytical Findings and Recommendations Effectively** • **Learning Outcome: Communicate the results of engineering analysis effectively in both written and oral formats.** ○ **Indicator: Students will prepare clear, concise reports and deliver presentations that communicate the findings of their analytical work, including model assumptions, methodologies, results, and recommendations.** --- **9. Understand Ethical and Professional Issues in Analytical Engineering** • **Learning Outcome: Recognize the ethical and professional implications of engineering analysis in real-world applications.** ○ **Indicator: Students will identify and analyze ethical considerations related to the use of analytical methods in engineering, such as safety, sustainability, and environmental impacts.** --- **10. Work Collaboratively on Analytical Engineering Projects** • **Learning Outcome: Work effectively in teams to conduct engineering analysis and solve complex problems.** ○ **Indicator: Students will collaborate with peers in interdisciplinary teams to apply analytical methods to real-world engineering projects, demonstrating effective communication, problem-solving, and decision-making skills.** --- **11. Develop and Apply Engineering Design Alternatives** • **Learning Outcome: Develop and assess alternative solutions to engineering problems through analytical methods.** ○ **Indicator: Students will use analytical techniques to generate, evaluate, and compare alternative solutions to engineering challenges, considering trade-offs in**

	terms of performance, cost, and feasibility. --- **12. Integrate Theory and Practice in Engineering Problem Solving** • **Learning Outcome: Integrate theoretical knowledge with practical experience to solve complex engineering problems.** ○ **Indicator: Students will demonstrate the ability to apply engineering theories, principles, and computational methods in real-world settings, integrating theoretical and practical aspects to develop effective solutions.**
Indicative Contents المحتويات الإرشادية	**1. Introduction to Analytical Engineering** • **Definition and Scope**: ○ Overview of analytical engineering and its role in problem-solving. ○ Comparison between analytical and empirical methods in engineering. • **Applications of Analytical Engineering**: ○ Real-world examples in mechanical, civil, electrical, and aerospace engineering. ○ The role of analytical techniques in optimization, design, and simulation. --- **2. Mathematical Fundamentals for Engineering Analysis** • **Basic Mathematics for Engineering**: ○ Linear algebra, matrices, and determinants. ○ Differential equations (ordinary and partial). ○ Integration and differentiation techniques in engineering contexts. • **Numerical Methods**: ○ Solving algebraic and transcendental equations (e.g., Newton-Raphson method). ○ Numerical integration and differentiation. ○ Interpolation methods and curve fitting. --- **3. Mathematical Modeling in Engineering** • **Creating Mathematical Models**: ○ Formulating real-world engineering problems as mathematical models. ○ Translating physical systems into mathematical equations. ○ Boundary conditions and initial conditions in system modeling. • **Types of Mathematical Models**: ○ Static and dynamic models. ○ Lumped and distributed parameter models. ○ Linear and nonlinear models. --- **4. Engineering Mechanics and Analytical Methods** • **Statics and Dynamics**:

	○ Force analysis, equilibrium equations, and free body diagrams. ○ Kinematic and kinetic analysis of rigid bodies. • **Strength of Materials**: ○ Stress, strain, and deformation analysis. ○ Beam bending, torsion, and axial loading. ○ Analytical methods for structural analysis. • **Fluid Mechanics**: ○ Flow equations (Navier-Stokes equations, Bernoulli's equation). ○ Pressure distribution, fluid statics, and dynamics. ○ Computational Fluid Dynamics (CFD) principles. --- **5. Computational Tools for Engineering Analysis** • **Software Tools**: ○ Introduction to popular engineering analysis software (e.g., MATLAB, COMSOL, ANSYS). ○ Numerical solvers and their application in real engineering problems. • **Finite Element Analysis (FEA)**: ○ Principles and application of FEA in structural and thermal analysis. ○ Creating FEA models for solid mechanics, fluid flow, and heat transfer. • **Computational Fluid Dynamics (CFD)**: ○ Basics of CFD simulation: meshing, boundary conditions, and solvers. ○ Applications of CFD in engineering fields such as aerodynamics, heat transfer, and chemical engineering. --- **6. Optimization in Engineering** • **Introduction to Optimization**: ○ Basic concepts in optimization: objective functions, constraints, and decision variables. ○ Types of optimization problems: linear, nonlinear, discrete, and continuous. • **Methods of Optimization**: ○ Analytical methods (e.g., gradient descent, Lagrange multipliers). ○ Numerical optimization techniques: simplex method, genetic algorithms, and simulated annealing. • **Engineering Design Optimization**: ○ Structural design optimization (e.g., minimizing weight subject to strength constraints). ○ Process optimization in manufacturing, energy systems, and resource management. --- **7. System Dynamics and Simulation** • **Principles of System Dynamics**: ○ Feedback loops, dynamic systems, and stability analysis. ○ Time-domain and frequency-domain analysis techniques. • **Modeling Dynamic Systems**:

- Modeling mechanical, electrical, and thermal systems using differential equations.
- Solving dynamic systems using numerical methods.

- **Simulation Techniques**:
  - Monte Carlo simulations and probabilistic modeling.
  - Discrete-event simulation and system performance prediction.

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8. Statistical and Probabilistic Methods in Engineering Analysis

- **Probability Theory in Engineering**:
  - Random variables, distributions, and expected values.
  - Applications in reliability analysis, risk assessment, and quality control.
- **Statistical Methods**:
  - Hypothesis testing, regression analysis, and design of experiments (DOE).
  - Statistical process control and quality management techniques.
- **Reliability Engineering**:
  - Failure analysis, fault tree analysis, and reliability block diagrams.

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9. Advanced Analytical Engineering Topics

- **Multiphysics Modeling**:
  - Coupling mechanical, thermal, fluid, and electrical domains in a single analysis.
  - Applications in MEMS (Micro-Electro-Mechanical Systems) and embedded systems.
- **Nonlinear and Time-Dependent Problems**:
  - Solution techniques for nonlinear differential equations.
  - Stability analysis in time-dependent systems.
- **Multiscale Modeling**:
  - Approaches for solving problems across different scales (microscopic to macroscopic).
  - Applications in material science, nanotechnology, and complex systems.

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10. Practical Applications in Analytical Engineering

- **Case Studies in Engineering Design**:
  - Practical examples of analytical techniques in the design of mechanical, civil, electrical, and aerospace systems.
  - Problem-solving approaches for optimization in real-world engineering challenges.
- **Engineering Analysis for Sustainability**:
  - Applying analytical methods to sustainable design, energy efficiency, and resource management.
  - Environmental impact analysis using computational models.
- **Ethical and Professional Considerations**:
  - Ethical issues in using analytical methods for engineering design.

	○ Ensuring safety, reliability, and accountability in engineering analysis. --- **11. Communication of Analytical Results** • **Effective Reporting**: ○ Communicating complex analytical results to stakeholders in engineering projects. ○ Preparing technical reports, presentations, and visualizations of analytical findings. • **Collaboration in Engineering Teams**: ○ Working in multidisciplinary teams to apply analytical methods to solve engineering problems. ○ Understanding the role of engineers, analysts, and designers in the solution process. --- **12. Emerging Trends and Technologies in Analytical Engineering** • **Artificial Intelligence and Machine Learning**: ○ Applications of AI/ML in engineering design and optimization (e.g., surrogate models, design automation). • **Big Data and Engineering Analysis**: ○ Leveraging big data for predictive maintenance, real-time system optimization, and process improvements. • **Smart Materials and Structures**: ○ Modeling and analyzing smart materials, adaptive structures, and sensors in engineering systems.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures and Discussions** • **Objective**: Engage students actively in learning foundational theories, models, and strategies related to teaching. • **Strategy**: ○ Present key educational theories (e.g., constructivism, behaviorism, and cognitivism) through **interactive lectures**. ○ Incorporate **class discussions** where students can relate theory to their own experiences and explore how different strategies work in practice. ○ Encourage **questioning and critical thinking** throughout the lecture to keep students engaged and help them develop a deeper understanding of educational principles. ---

2. Case Studies and Real-Life Applications

- **Objective**: Help students connect teaching theories with real-world educational settings.
- **Strategy**:
  - Present **case studies** based on diverse educational contexts (e.g., K-12, higher education, online learning) that illustrate different teaching challenges and strategies.
  - Ask students to analyze the case studies in groups, identifying key teaching strategies used and evaluating their effectiveness.
  - Have students present their findings and discuss how they would approach similar situations in their own teaching practice.

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3. Active Learning Strategies

- **Objective**: Demonstrate how to engage students in learning through active participation.
- **Strategy**:
  - Implement active learning techniques like **think-pair-share**, **peer teaching**, and **problem-based learning** during class.
  - Encourage students to create and implement their own **active learning activities**, such as group discussions, role-playing, and collaborative problem-solving exercises.
  - Provide opportunities for students to experience both **learner and teacher roles**, allowing them to better understand the dynamics of active learning.

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4. Collaborative Learning

- **Objective**: Foster teamwork and collaborative skills by engaging students in group work and cooperative learning tasks.
- **Strategy**:
  - Organize **group projects** where students create lesson plans, teaching materials, or learning activities, incorporating the strategies discussed in class.
  - Facilitate **peer review** and **feedback** sessions, where students evaluate each other’s work and provide constructive suggestions for improvement.
  - Use **group discussions** to explore the benefits and challenges of collaborative learning and how to effectively manage group dynamics in a classroom setting.

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5. Simulation and Role-Playing

- **Objective**: Provide hands-on experience with teaching strategies through simulation and role-playing.
- **Strategy**:
  - Organize **teaching simulations** where students take turns teaching a class

segment to their peers, using the strategies they have learned.

○ Have students simulate various classroom scenarios, such as managing disruptive behavior, delivering a lesson using a specific strategy, or designing an assessment.

○ Provide **feedback** after each simulation, focusing on the effectiveness of the teaching strategy, engagement techniques, and classroom management.

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6. Reflective Practice and Self-Assessment

- **Objective**: Encourage students to critically reflect on their own learning and teaching practices.

- **Strategy**:

○ Ask students to keep a **teaching journal** or portfolio, where they document their reflections on the strategies they are learning and how they would apply them in their own teaching.

○ Use **self-assessment rubrics** for students to evaluate their own teaching practices or the effectiveness of the strategies they have implemented.

○ Incorporate **peer assessments** where students evaluate each other's lesson plans, activities, or teaching strategies, offering constructive feedback.

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7. Technology-Enhanced Learning

- **Objective**: Introduce students to digital tools and resources for effective teaching.

- **Strategy**:

○ Explore **educational technologies** such as learning management systems (LMS), virtual classrooms, and multimedia tools (e.g., videos, podcasts) to enhance teaching and learning.

○ Incorporate **online teaching modules** or **blended learning** experiences to demonstrate the effectiveness of different online teaching strategies.

○ Encourage students to design **technology-based lesson plans** and implement tools like quizzes, discussion boards, and online assessments to engage remote or hybrid learners.

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8. Differentiated Instruction

- **Objective**: Teach students how to tailor their teaching strategies to meet the diverse needs of learners.

- **Strategy**:

○ Introduce the concept of **differentiated instruction**, explaining how to adjust content, processes, and assessments to accommodate varying student abilities and learning styles.

○ Have students design **differentiated lessons** based on hypothetical learner profiles, considering factors such as readiness, interests, and learning preferences.

	○ Simulate **inclusive teaching environments** where students need to consider strategies for working with diverse learners, including those with disabilities, language barriers, and cultural differences. --- **9. Classroom Management and Motivation** • **Objective**: Equip students with strategies for maintaining an effective and positive learning environment. • **Strategy**: ○ Discuss key **classroom management techniques** (e.g., setting expectations, establishing routines, and positive reinforcement) to prevent disruptions and foster engagement. ○ Use **role-playing** exercises to practice managing classroom behavior and motivating students. ○ Discuss **motivational theories** (e.g., intrinsic vs. extrinsic motivation, self-determination theory) and how these can be applied to create a supportive, inspiring classroom atmosphere. --- **10. Assessment for Learning** • **Objective**: Enable students to design assessments that measure and support learning effectively. • **Strategy**: ○ Introduce different **assessment types**, such as formative and summative assessments, diagnostic assessments, and authentic assessments (e.g., projects, portfolios). ○ Have students design **assessment rubrics** and create valid, reliable assessment tools for evaluating student performance. ○ Discuss how to use **assessment data** to inform teaching strategies and provide constructive feedback to students. --- **11. Professional Development and Lifelong Learning** • **Objective**: Encourage a mindset of continuous improvement and development as an educator. • **Strategy**: ○ Introduce **professional development resources** for teachers (e.g., conferences, journals, online courses) and discuss how they can enhance teaching practice. ○ Have students create a **personal professional development plan**, identifying areas for growth and strategies for continuous learning. ○ Encourage students to engage in **peer learning communities**, whether in-person or online, to share insights and improve teaching effectiveness collectively. --- **12. Evaluation and Feedback** • **Objective**: Teach students how to evaluate their teaching strategies and improve based

	on feedback. • **Strategy**: ○ Use **self-evaluation** and **peer evaluations** to assess the effectiveness of the strategies implemented in class. ○ Introduce the concept of **formative feedback**, where students regularly receive constructive feedback on their teaching and can make adjustments accordingly. ○ Encourage a **growth mindset**, emphasizing that teaching is a process of continuous improvement through regular feedback and reflection.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل		**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Demonstrates knowledge about ordinary differential equations, liner differential equations,

	homogeneous linear equations of the second order, general solution. Basis initial value problem, homogeneous linear differential equations of arbitrary order n, equations of order with constant coefficients, non-homogeneous equations solving by the method of undetermined coefficient.
Week 2	Demonstrates knowledge about ordinary differential equations, liner differential equations, homogeneous linear equations of the second order, general solution. Basis initial value problem, homogeneous linear differential equations of arbitrary order n, equations of order with constant coefficients, non-homogeneous equations solving by the method of undetermined coefficient.
Week 3	Uses correctly the applications of O.D.E of undetermined coefficient method in: beam & column, beam-column, beam on elastic foundation, modeling: forced oscillation (dynamics analysis).
Week 4	Uses correctly the applications of O.D.E of undetermined coefficient method in: beam & column, beam-column, beam on elastic foundation, modeling: forced oscillation (dynamics analysis).
Week 5	Uses correctly the applications of O.D.E of undetermined coefficient method in: beam & column, beam-column, beam on elastic foundation, modeling: forced oscillation (dynamics analysis).
Week 6	Able to identify and implement singular function: unit step function, unit impulse function, unit moment function.
Week 7	Correctly execute the applications of O.D.E of integration method in beams
Week 8	Correctly execute the applications of O.D.E of integration method in beams
Week 9	Correctly execute Fourier series, Euler formulas, Fourier series for any period (2L), odd and even functions, Half – rang expansion, applications of Fourier series in construction engineering
Week 10	Correctly execute Fourier series, Euler formulas, Fourier series for any period (2L), odd and even functions, Half – rang expansion, applications of Fourier series in construction engineering
Week 11	Correctly execute Fourier series, Euler formulas, Fourier series for any period (2L), odd and even functions, Half – rang expansion, applications of Fourier series in construction engineering
Week 12	Demonstrates knowledge and correctly execute Partial differential equations, one dimensional wave equation, free longitudinal vibration of beam, free transverse vibration of beam, one dimensional heat equation, consolidation equation, two dimensional Laplace equation.
Week 13	Demonstrates knowledge and correctly execute Partial differential equations, one dimensional wave equation, free longitudinal vibration of beam, free transverse vibration of beam, one dimensional heat equation, consolidation equation, two dimensional Laplace equation.
Week 14	Demonstrates knowledge and correctly execute Partial differential equations, one dimensional wave equation, free longitudinal vibration of beam, free transverse vibration of beam, one dimensional heat equation, consolidation equation, two dimensional Laplace equation.

Week 15	Demonstrates knowledge and correctly execute Partial differential equations, one dimensional wave equation, free longitudinal vibration of beam, free transverse vibration of beam, one dimensional heat equation, consolidation equation, two dimensional Laplace equation.

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

Week	Material Covered
Week 1	N/A
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts		Yes
Recommended Texts		Yes
Websites		

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors

	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	GEODESY 1		**Module Delivery**	
Module Type	**Core**		☒ **Theory**	
Module Code	**SUT 307**		☒ **Lecture**	
ECTS Credits	**3**		☒ **Lab**	
SWL (hr/sem)	**75**		☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Level			**Semester of Delivery**	1
Administering Department			**College**	Type College Code
Module Leader			**e-mail**	E-mail
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)		**e-mail**	E-mail
Peer Reviewer Name	Name		**e-mail**	E-mail
Scientific Committee Approval Date			**Version Number**	1.0

<table>
<tr><th colspan="4">Relation with other Modules
العلاقة مع المواد الدراسية الأخرى</th></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</th></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>The objective is to provide individuals with the knowledge and skills necessary to understand and analyze the Earth's shape, size, and gravitational field. Geodesy is the science that deals with the measurement and representation of the Earth's surface, its gravity field, and its orientation in space. Overall, the objective of studying geodesy topics is to equip individuals with the knowledge and skills to accurately measure, represent, and understand Earth's shape, gravity field, and spatial positioning. Geodesy plays a crucial role in various applications, including navigation, mapping, geosciences, and geospatial sciences.</td></tr>
<tr><td>Module Learning Outcomes

مخرجات التعلم للمادة الدراسية</td><td>1. Understand the Fundamentals of Geodesy
• Learning Outcome: Demonstrate a comprehensive understanding of the basic principles and concepts of geodesy, including the Earth's shape, size, and gravitational field.
○ Indicator: Students will be able to explain the Earth's physical properties (e.g., geoid, ellipsoid) and describe how geodesy relates to other geospatial sciences.
<hr>2. Apply Geodetic Datums and Coordinate Systems
• Learning Outcome: Understand and apply various geodetic datums, reference systems, and coordinate systems used in geospatial measurements.
○ Indicator: Students will be able to convert between different geodetic coordinate systems (e.g., geodetic, Cartesian, UTM) and understand the use of global positioning systems (GPS) in geodesy.
<hr>3. Perform Geodetic Measurements and Surveys
• Learning Outcome: Demonstrate proficiency in using geodetic measurement techniques, including leveling, triangulation, and GPS, for accurate surveying and mapping.
○ Indicator: Students will be able to conduct field surveys using appropriate geodetic equipment and techniques, and accurately measure distances, angles, and elevations.
<hr>4. Understand Geodetic Errors and Adjustments
• Learning Outcome: Identify and manage sources of error in geodetic</td></tr>
</table>

	measurements and apply adjustment techniques to improve the accuracy of survey data. ○ **Indicator: Students will be able to calculate and mitigate common errors in geodetic measurements, including instrumental, observational, and environmental errors, and apply adjustment methods like least squares to refine data.** --- **5. Apply Modern Geodetic Technologies** • **Learning Outcome: Utilize modern geodetic technologies such as GPS, satellite-based systems, and remote sensing for geospatial analysis and monitoring.** ○ **Indicator: Students will demonstrate how to use GPS data for precise location determination and apply remote sensing technologies for geospatial mapping and analysis.** --- **6. Understand the Earth's Gravitational Field and Geoid** • **Learning Outcome: Comprehend the Earth's gravitational field, geoid, and the significance of geoid undulations in accurate height measurements.** ○ **Indicator: Students will explain the concepts of geoid, ellipsoid, and gravity anomalies and describe how these affect geodetic height determination and positioning.** --- **7. Analyze Geodetic Data for Mapping and Navigation** • **Learning Outcome: Analyze geodetic data to support the creation of accurate maps, navigation systems, and geospatial models.** ○ **Indicator: Students will be able to process geodetic data for map production, land boundary determination, and navigation applications, including error analysis.** --- **8. Understand Global Positioning Systems (GPS) and GNSS** • **Learning Outcome: Gain in-depth knowledge of Global Navigation Satellite Systems (GNSS) and their application in geodesy for positioning, surveying, and monitoring.** ○ **Indicator: Students will be able to explain how GPS and other GNSS systems work, and how they are used in geodesy for precise location determination, including concepts such as differential GPS (DGPS) and real-time kinematic (RTK) systems.** --- **9. Apply Geodetic Techniques to Environmental and Geophysical Studies** • **Learning Outcome: Apply geodetic techniques to environmental monitoring, natural hazard analysis, and geophysical investigations.** ○ **Indicator: Students will demonstrate how geodetic measurements are used in monitoring tectonic plate movements, subsidence, sea level rise, and other environmental and geophysical phenomena.** ---

	10. Interpret and Present Geodetic Data • **Learning Outcome: Present geodetic analysis results and data effectively to a range of audiences using appropriate visualizations and reporting techniques.** ○ **Indicator: Students will be able to create accurate visual representations of geodetic data, including maps, charts, and 3D models, and communicate the findings in clear, professional reports.** **11. Understand the Legal and Ethical Implications of Geodesy** • **Learning Outcome: Recognize the legal and ethical issues associated with geodetic surveys, including land ownership, privacy, and environmental impacts.** ○ **Indicator: Students will be able to discuss the legal aspects of geodesy, including issues related to surveying land boundaries, rights of way, and privacy in the context of GPS and satellite data collection.** **12. Integrate Geodesy with Other Disciplines** • **Learning Outcome: Integrate geodesy with other geospatial disciplines such as cartography, GIS (Geographic Information Systems), and remote sensing.** ○ **Indicator: Students will demonstrate an understanding of how geodesy supports GIS, remote sensing, and cartography in creating accurate geospatial data for various applications, from urban planning to environmental management.**
Indicative Contents المحتويات الإرشادية	**Introduction to Geodesy** • **Definition and Scope of Geodesy**: ○ Overview of geodesy as the science of measuring and understanding Earth's geometric shape, orientation, and gravitational field. ○ Historical development of geodesy and its importance in navigation, surveying, and Earth sciences. • **Applications of Geodesy**: ○ Uses in mapping, land surveying, navigation, satellite positioning, and environmental monitoring. **2. The Earth’s Shape and Size** • **Ellipsoid and Geoid**: ○ The concept of the reference ellipsoid as a model of Earth’s shape. ○ The geoid as the equipotential surface of Earth's gravity field and its relationship to the ellipsoid. • **Earth’s Dimensions**: ○ Determination of Earth's size, radius, and circumference using geodetic methods. • **Geodetic and Astronomical Coordinates**: ○ Conversion between astronomical and geodetic coordinates.

3. Geodetic Datums and Coordinate Systems

- **Geodetic Datums**:
  - Definition and role of geodetic datums in geodesy.
  - Common geodetic datums (e.g., WGS84, NAD83, ED50) and their application in different regions.
- **Coordinate Systems**:
  - Introduction to global (e.g., GPS-based) and local coordinate systems.
  - UTM (Universal Transverse Mercator) and local geodetic coordinate systems.
- **Datum Transformations**:
  - Methods of transforming coordinates from one datum to another.

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4. Geodetic Measurement Techniques

- **Surveying and Measurement Methods**:
  - Basic geodetic measurement methods: angular measurement, distance measurement, and elevation measurement.
  - Use of **total stations**, **theodolites**, **levels**, and **tape** in traditional geodetic surveys.
- **Triangulation and Trilateration**:
  - Principles and applications of triangulation and trilateration in geodesy.
  - Methods for establishing control points and networks.
- **Geodetic Leveling**:
  - Differential leveling techniques to determine height differences over large areas.
  - Accuracy considerations and corrections in leveling measurements.

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5. Global Navigation Satellite Systems (GNSS)

- **Overview of GNSS**:
  - Introduction to satellite navigation systems such as GPS, GLONASS, Galileo, and BeiDou.
  - Working principles of GNSS systems: satellite orbits, signal propagation, and receivers.
- **GNSS Positioning Techniques**:
  - **Code-based** and **carrier-phase** positioning techniques.
  - Real-time kinematic (RTK) positioning and differential GNSS (DGPS).
- **GNSS Error Sources**:
  - Understanding errors in GNSS data: multipath, atmospheric delays, satellite geometry, and clock errors.
  - Techniques to mitigate errors in GNSS measurements.

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6. Geoid and Gravity Field

- **Gravitational Field of the Earth**:
  - The Earth's gravitational anomalies and how they affect geodesic measurements.
  - The relationship between the Earth's gravity field and the geoid.
- **Geoid Determination**:
  - Techniques for determining the geoid through gravimetric surveys and satellite altimetry.
  - The role of the geoid in precise height determination.
- **Gravity Measurements**:
  - Methods and equipment used in gravity surveys (e.g., gravimeters).
  - Applications of gravity measurements in geodesy and geophysics.

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7. Geodetic Surveying Equipment and Techniques

- **Traditional Surveying Instruments**:
  - Theodolites, levels, and total stations used in terrestrial geodetic surveys.
  - Electronic Distance Measurement (EDM) and its principles.
- **Modern Surveying Instruments**:
  - The role of GPS receivers, GNSS instruments, and other electronic tools in geodesy.
- **Data Collection and Processing**:
  - Methods for collecting and processing geodetic data in the field.
  - Use of software tools for data analysis and adjustment (e.g., AutoCAD, Leica Geo Office).

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8. Geodetic Data Adjustments and Error Analysis

- **Error Sources in Geodesy**:
  - Types of errors in geodetic measurements: instrumental, observational, and environmental.
- **Least Squares Adjustment**:
  - Introduction to the least squares method for adjusting geodetic networks.
  - Applications in triangulation and leveling networks.
- **Error Propagation and Precision**:
  - Methods for estimating the accuracy and precision of geodetic measurements.

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9. Geodesy in Mapping and Cartography

- **Geodetic Data in Cartography**:
  - How geodetic data is used to produce accurate maps and charts.
- **Map Projections**:
  - Different map projections (e.g., Mercator, Lambert Conformal Conic) and their application in geodesy.
  - Distortions and corrections in map projections.
- **Topographic and Cadastral Surveys**:

	○ Applications of geodesy in topographic mapping and land surveying. --- **10. Remote Sensing and Geodesy** • **Remote Sensing Technologies**: ○ The role of remote sensing in geodesy, including the use of satellite imagery, LiDAR, and radar. • **Integration of Remote Sensing and Geodesy**: ○ Using remote sensing data to enhance geodetic measurements and geospatial modeling. • **Applications in Monitoring**: ○ Use of geodesy and remote sensing in monitoring land subsidence, sea level rise, and tectonic plate movements. --- **11. Geodesy for Environmental and Engineering Applications** • **Geodesy in Environmental Monitoring**: ○ Application of geodetic techniques for tracking changes in Earth's surface (e.g., land subsidence, coastal erosion). • **Geodesy in Engineering Projects**: ○ The role of geodesy in large infrastructure projects (e.g., dam construction, tunneling, highway design). • **Monitoring Natural Disasters**: ○ Using geodesy to monitor earthquakes, volcanic activity, and landslides. --- **12. Future Trends and Innovations in Geodesy** • **Advancements in Geodesy**: ○ The role of emerging technologies like autonomous systems, UAVs (drones), and machine learning in advancing geodesy. • **Space Geodesy**: ○ The increasing role of satellite-based geodesy (e.g., GPS, GLONASS, Galileo) and space-based Earth observation systems. • **Geodesy and Climate Change**: ○ The application of geodesy in studying climate change impacts, such as sea level rise and glacial melting. --- **13. Practical Applications and Case Studies** • **Case Studies in Geodesy**: ○ Real-world applications of geodesy in surveying, environmental monitoring, and geospatial analysis. ○ Review of case studies demonstrating the successful application of geodesy in various industries and research fields.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**Interactive Lectures** • **Objective**: Provide foundational knowledge on geodesy principles, theories, and techniques. • **Strategy**: ○ Deliver **interactive lectures** using visuals such as diagrams, animations, and videos to explain complex concepts like geoid, ellipsoid, and coordinate systems. ○ Integrate **real-time polling** or quizzes (e.g., using tools like Kahoot or Mentimeter) during lectures to test comprehension and encourage active participation. ○ Use **problem-solving exercises** during lectures to demonstrate the application of theories (e.g., geodetic coordinate transformations or error analysis). ○ Engage students in short discussions to connect the lecture material to real-world applications in surveying, mapping, and satellite systems. --- **2. Practical Demonstrations and Hands-On Activities** • **Objective**: Develop students' technical skills in geodetic measurement techniques and technology usage. • **Strategy**: ○ Conduct **laboratory sessions** where students use geodetic tools such as total stations, GPS receivers, and levels to measure distances, angles, and elevations. ○ Set up **field trips** to allow students to participate in actual geodetic surveys, observing real-world applications of triangulation, leveling, and GNSS. ○ Demonstrate the use of **software tools** (e.g., AutoCAD, ArcGIS) for geodetic data processing, creating maps, and adjusting survey data. Provide opportunities for students to complete hands-on exercises using these tools. --- **3. Problem-Based Learning (PBL)** • **Objective**: Encourage critical thinking and application of geodetic principles to solve real-world problems. • **Strategy**: ○ Present students with **real-world scenarios** such as a land boundary survey, environmental monitoring of subsidence, or GPS-based navigation challenges. ○ Assign **group projects** where students research, plan, and simulate geodetic surveys or mapping projects using GNSS and traditional geodetic methods. ○ Encourage students to explore **alternative methods** for solving geodetic

problems, fostering collaboration, critical thinking, and innovation.

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4. Case Studies and Real-World Applications

- **Objective**: Show how geodesy is applied in various fields and industries.
- **Strategy**:
  - Present **case studies** demonstrating the application of geodesy in fields such as environmental monitoring, civil engineering, agriculture, and disaster management.
  - Invite guest speakers from industries (e.g., surveying, urban planning, or remote sensing) to provide **insights into how geodesy is used in practice**.
  - Organize **site visits** to infrastructure projects or agencies that rely on geodesy for accurate mapping, such as land surveyors or satellite monitoring stations.

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5. Collaborative and Group Learning

- **Objective**: Develop teamwork, communication, and problem-solving skills.
- **Strategy**:
  - Use **group discussions** and activities to explore specific topics such as geodetic datum transformation, satellite systems, or geoid determination.
  - Facilitate **peer teaching** exercises where students explain key concepts (e.g., leveling methods, geodetic corrections) to each other, reinforcing their understanding.
  - Organize **team-based practical exercises** for data collection, analysis, and the presentation of results, where each group handles a different geodetic technique.

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6. Blended Learning and Digital Tools

- **Objective**: Enhance learning flexibility and integrate modern technologies into geodesy education.
- **Strategy**:
  - Combine **online resources** such as instructional videos, readings, and interactive simulations with in-person learning for a flexible, blended learning approach.
  - Use **online platforms** (e.g., Moodle, Blackboard) to provide learning materials, assignments, and forums for student discussions on topics like geodetic adjustment or satellite navigation systems.
  - Introduce **virtual labs or simulations** where students can virtually practice geodetic measurements or simulate GNSS-based positioning without requiring physical equipment.

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7. Flipped Classroom Approach

- **Objective**: Encourage independent learning and deeper understanding of geodetic concepts.

- **Strategy**:

  - Assign students preparatory work such as watching videos or reading articles about specific geodesy topics (e.g., GNSS technology, the geoid, or coordinate systems) before class.

  - Use **in-class time** for solving practical problems, case discussions, and hands-on activities where students apply their understanding.

  - Promote **active engagement** during class through collaborative exercises or by addressing misconceptions and questions raised by students from their preparatory work.

---

8. Fieldwork and Practical Surveys

- **Objective**: Provide students with real-world surveying and geodetic measurement experience.

- **Strategy**:

  - Organize **fieldwork trips** where students can perform geodetic surveys using a variety of instruments (e.g., theodolites, GNSS receivers, and levels) to measure angles, distances, and elevations.

  - Assign **data collection exercises**, where students work in groups to gather geodetic data in the field, then analyze and present the data back in class.

  - Conduct **geodetic mapping activities** in different terrains to assess how environmental conditions affect measurement techniques (e.g., surveying in mountainous regions or near large bodies of water).

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9. Assessment and Feedback

- **Objective**: Assess student learning, providing opportunities for reflection and improvement.

- **Strategy**:

  - Use **formative assessments** such as quizzes, problem sets, and practical exercises to monitor student progress and provide continuous feedback on their understanding.

  - Provide **summative assessments** that require students to analyze and apply geodetic techniques in a comprehensive manner, such as solving complex survey problems, producing a geodetic report, or designing a GPS-based survey project.

  - Offer detailed **feedback** on both the technical aspects of geodetic measurements and the clarity of students' explanations, interpretations, and data presentation.

---

10. Guest Lectures and Industry Collaboration

- **Objective**: Expose students to professional practices and innovations in geodesy.

- **Strategy**:

  - Invite **professionals and experts** from geodesy-related industries (e.g., surveying companies, GPS technology firms, or research institutions) to give guest lectures on

	the latest developments and applications of geodesy. ○ Provide opportunities for **industry collaboration** where students can participate in projects or internships related to geodesy, allowing them to apply their academic knowledge in professional settings. **11. Reflection and Self-Assessment** • **Objective**: Promote continuous learning and self-improvement. • **Strategy**: ○ Encourage students to maintain a **learning journal** where they reflect on their understanding of geodetic principles, practical skills, and challenges encountered during fieldwork and exercises. ○ Organize **self-assessment activities** where students review their performance in practical tasks, surveys, and assignments, identifying areas of strength and areas for improvement. ○ Use **peer review** processes where students assess each other's work on geodetic assignments, promoting collaborative learning and self-reflection.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل		**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**75**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All

Total assessment	100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Introduction: General basic information about geodetic science, astronomy, and the relationship of astronomical observations to geodetic calculations
Week 2	Introduction: General basic information about geodetic science, astronomy, and the relationship of astronomical observations to geodetic calculations
Week 3	Earth shapes (gyde, sphere, ellipse), types of support surfaces, heights calculated from the surface of the elliptical shape and heights measured from sea level and from the topographic surface
Week 4	Earth shapes (gyde, sphere, ellipse), types of support surfaces, heights calculated from the surface of the elliptical shape and heights measured from sea level and from the topographic surface
Week 5	Spherical coordinate systems (geographical and Cartesian coordinates) and the relationship between the two systems
Week 6	Spherical coordinate systems (geographical and Cartesian coordinates) and the relationship between the two systems
Week 7	Calculating the arc distance and angle on a spherical surface. Using the spherical triangle to find distances and angles on spherical surfaces
Week 8	Calculating the arc distance and angle on a spherical surface. Using the spherical triangle to find distances and angles on spherical surfaces
Week 9	Right-angled spherical triangle Use Napier's rule to solve a spherical triangle and find the missing elements for that triangle.
Week 10	Right-angled spherical triangle Use Napier's rule to solve a spherical triangle and find the missing elements for that triangle.
Week 11	General introduction to geodetic astronomy. Giving general definitions of astronomical terms. Types of astronomical observations used in the field of surveying.
Week 12	General introduction to geodetic astronomy. Giving general definitions of astronomical terms. Types of astronomical observations used in the field of surveying.
Week 13	Astronomical coordinate systems. Ways to find the locations of stars in the planetarium.
Week 14	Astronomical coordinate systems. Ways to find the locations of stars in the planetarium.

Week 15	PRESENTATION

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Displaying models of astronomical observations and geodetic calculations that were conducted on a survey project. And asking the students to prepare a report on geodetic science, astronomy, and the relationship of astronomical observations with geodetic calculations
Week 2	Displaying models of astronomical observations and geodetic calculations that were conducted on a survey project. And asking the students to prepare a report on geodetic science, astronomy, and the relationship of astronomical observations with geodetic calculations
Week 3	Presentation of figures showing the shapes of the Earth (the bony, spherical, and oval shapes) and the types of supporting surfaces, asking the students to design a comparison table between each of the forms of the Earth's surface
Week 4	Presentation of figures showing the shapes of the Earth (the bony, spherical, and oval shapes) and the types of supporting surfaces, asking the students to design a comparison table between each of the forms of the Earth's surface
Week 5	Solve problems about spherical coordinate systems (geographical and Cartesian coordinates) and the relationship between the two systems
Week 6	Solve problems about spherical coordinate systems (geographical and Cartesian coordinates) and the relationship between the two systems
Week 7	Solve problems about calculating the arc distance and angle on a spherical surface. Using the spherical triangle to find distances and angles on spherical surfaces
Week 8	Solve problems about calculating the arc distance and angle on a spherical surface. Using the spherical triangle to find distances and angles on spherical surfaces
Week 9	Solve problems about a spherical right-angled triangle, use Napier's rule to solve a spherical triangle and find the missing elements for that triangle.
Week 10	Solve problems about a spherical right-angled triangle, use Napier's rule to solve a spherical triangle and find the missing elements for that triangle.
Week 11	Using the theodolite device to monitor the height and direction of the sun at fixed intervals,

	and draw a curve of the relationship between the change in time and the amount of the sun's height, as well as drawing the curves of the relationship between the change in time and the change in the direction of the sun.
Week 12	Using the theodolite device to monitor the height and direction of the sun at fixed intervals, and draw a curve of the relationship between the change in time and the amount of the sun's height, as well as drawing the curves of the relationship between the change in time and the change in the direction of the sun.
Week 13	Solve problems about astronomical coordinate systems. Ways to find the locations of stars in the planetarium
Week 14	Solve problems about astronomical coordinate systems. Ways to find the locations of stars in the planetarium
Week 15	**PRESENTATION**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		Yes
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria

Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information

معلومات المادة الدراسية

Module Title	**Surveying Equipment's**	**Module Delivery**	
Module Type	**Core**	☒ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**SUT 308**		
ECTS Credits	**6**		
SWL (hr/sem)	**150**		
Module Level	1	**Semester of Delivery**	1
Administering Department	Type Dept. Code	**College**	Type College Code
Module Leader	Name	**e-mail**	E-mail
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)	**e-mail**	E-mail
Peer Reviewer Name	Name	**e-mail**	E-mail
Scientific Committee Approval Date		**Version Number**	1.0

Relation with other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	

Co-requisites module	None	Semester	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	**1. Understand the Different Types of Surveying Equipment** 7. **Objective**: Identify and describe various types of surveying equipment used in field and construction surveying, such as total stations, theodolites, levels, GPS systems, laser scanners, and measuring tapes. 8. **Key Learning Outcomes**: 9. Classify surveying instruments based on their function. 10. Understand the application of each tool in different surveying tasks. **2. Familiarity with Equipment Components and Functions** E. **Objective**: Understand the basic components, features, and functions of common surveying equipment. F. **Key Learning Outcomes**: G. Describe the parts of a total station and theodolite and their respective functions. H. Learn the principles of operation for electronic distance measurement (EDM) and angle measurement. **3. Proper Setup and Calibration of Surveying Equipment** E. **Objective**: Learn how to set up and calibrate surveying equipment for accurate data collection. F. **Key Learning Outcomes**: G. Demonstrate proper leveling and instrument calibration techniques. H. Adjust and align equipment to ensure accurate readings.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Identification and Understanding of Surveying Equipment** • **Learning Outcome**: **Identify and describe** the different types of surveying equipment used in various surveying tasks, such as total stations, theodolites, GPS systems, levels, and laser scanners. ○ **Indicator**: Students will be able to list the names, features, and functions of at least five types of surveying equipment. **2. Knowledge of Surveying Equipment Components** • **Learning Outcome**: **Understand the components and working principles** of common surveying instruments. ○ **Indicator**: Students will be able to explain how each component (e.g., prism, EDM, theodolite, or level) contributes to the operation of the equipment.

	3. Proficiency in Setting Up Surveying Equipment • **Learning Outcome**: **Demonstrate the ability to set up and calibrate** different surveying instruments for accurate measurements. ○ **Indicator**: Students will successfully complete setup and calibration of a total station or theodolite in a hands-on exercise, ensuring correct leveling and alignment. **4. Competence in Data Collection and Measurement** • **Learning Outcome**: **Accurately collect data** using different surveying equipment, including measuring angles, distances, and coordinates. ○ **Indicator**: Students will perform a survey using a total station and GPS device, correctly collecting distance, angle, and position data. **5. Application of Surveying Equipment in Real-World Scenarios** • **Learning Outcome**: **Apply the correct surveying equipment** for specific survey tasks in real-world settings, such as boundary surveys, topographic surveys, and construction layout. ○ **Indicator**: Students will demonstrate their ability to select and use appropriate equipment for a field task, such as measuring a site boundary or elevation. **6. Safety and Maintenance Procedures** • **Learning Outcome**: **Follow proper safety protocols** and understand the maintenance needs for the effective use of surveying equipment. ○ **Indicator**: Students will identify potential hazards when using surveying equipment and perform routine maintenance tasks, such as cleaning lenses and checking calibrations. **7. Interpretation and Analysis of Survey Data** • **Learning Outcome**: **Interpret and analyze** survey data collected from various instruments and apply it to generate practical outputs, such as maps or construction plans. ○ **Indicator**: Students will convert raw data from surveying equipment into meaningful outputs, such as plotting coordinates on a map or determining the elevation of a site. **8. Troubleshooting Surveying Equipment** • **Learning Outcome**: **Diagnose and troubleshoot common issues** encountered with surveying equipment during data collection. ○ **Indicator**: Students will be able to identify common problems with survey instruments (e.g., misalignment or error in measurements) and take corrective action.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Surveying and Surveying Equipment** • **Overview of Surveying**: ○ Definition and importance of surveying in construction, mapping, and land development. ○ Different branches of surveying (e.g., land surveying, construction surveying, geodetic surveying). • **Surveying Equipment**: ○ Types of equipment used in surveying. ○ Historical evolution of surveying instruments.

	2. Types of Surveying Equipment • **Total Stations**: ○ Working principles (Electronic Distance Measurement, EDM). ○ Components: telescope, electronic display, and measuring devices. ○ Uses: angle and distance measurement, setting out. • **Theodolites**: ○ Functionality and components: horizontal and vertical circles, micrometer, and vernier scales. ○ Types: transit theodolite, digital theodolite. ○ Applications in angle measurement. • **Levels**: ○ Types: optical levels, laser levels, digital levels. ○ Uses: measuring elevation, checking horizontal planes. ○ Principles of leveling (line of sight, bubble level). • **GPS (Global Positioning Systems)**: ○ Working principles: GNSS (Global Navigation Satellite System) basics. ○ Equipment: RTK (Real-Time Kinematic) and Static GPS. ○ Uses: site location, geodetic surveys, mapping. • **Measuring Tapes and Chains**: ○ Manual and digital tapes. ○ Uses: basic distance measurements in land surveying. --- **3. Surveying Equipment Components and Functions** • **Electronic Distance Measurement (EDM)**: ○ Principles of EDM. ○ Measurement of distances using electromagnetic waves. • **Optical Systems**: ○ Role of lenses, telescopes, and magnification in surveying instruments. • **Electronics and Displays**: ○ Digital readings and data recording. • **Prisms and Reflectors**: ○ Function in total stations and GPS surveys. --- **4. Setting Up Surveying Equipment** • **Instrument Setup**: ○ Stationing and leveling the instrument. ○ Ensuring proper alignment (horizontal and vertical). ○ Setup procedures for different equipment (e.g., theodolite, total station). • **Calibration**: ○ Importance of calibration for accuracy. ○ Methods for calibrating instruments. ○ Checking and adjusting optical and electronic systems. --- **5. Measurement Techniques and Data Collection** • **Measuring Angles and Distances**: ○ Angle measurement using theodolites and total stations. ○ Distance measurement with total stations and GPS devices. • **Coordinate Systems**: ○ Horizontal and vertical coordinate systems.

	○ The importance of datum in surveying. • **Field Surveying Methods**: ○ Traversing: open and closed traverses. ○ Differential leveling. ○ Triangulation and trilateration methods. --- **6. Surveying Data Interpretation and Analysis** • **Data Collection Techniques**: ○ Recording data (manual vs. digital). ○ Use of field notebooks, digital loggers, and survey software. • **Data Processing**: ○ Converting measurements into coordinates. ○ Plotting survey data on maps or CAD systems. • **Error Analysis**: ○ Identifying sources of errors (instrumental, observational, systematic). ○ Techniques for minimizing errors. --- **7. Troubleshooting Surveying Equipment** • **Common Equipment Issues**: ○ Misalignment, calibration issues, and other common faults. ○ Error messages and how to address them. • **Troubleshooting Techniques**: ○ Diagnosing problems with measurements and instrument function. ○ Steps to reset or recalibrate equipment. --- **8. Surveying Applications** • **Field Applications**: ○ Practical use cases in construction, land development, road layout, etc. • **Mapping and GIS**: ○ Integration of surveying data with Geographic Information Systems (GIS). • **Site Layout and Design**: ○ Using surveying equipment for construction staking and site design. ○ Determining boundaries, leveling, and elevation control. • **Automation in Surveying**: ○ Robotic total stations. ○ Autonomous survey vehicles and drones.

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	**1. Interactive Lectures and Demonstrations** • **Strategy**: Deliver engaging lectures that introduce surveying concepts and equipment. Use multimedia tools, including images, videos, and diagrams, to demonstrate how different equipment functions. • **Teaching Methods**: ○ **Visual aids**: Use 3D models, animations, and videos to explain the working principles of surveying instruments.

	○ **Live demonstrations**: Conduct live demonstrations of equipment setup, calibration, and measurement processes in the classroom or lab. ○ **Guest lectures**: Invite professionals from the field (e.g., land surveyors, civil engineers) to share their expertise and real-world applications of surveying equipment. **2. Hands-On Practical Training** • **Strategy**: Provide students with practical, hands-on experiences using surveying equipment in a controlled environment (laboratory or field). • **Teaching Methods**: ○ **Field exercises**: Organize field trips where students can work with real surveying instruments (total stations, GPS devices, levels) to collect data. ○ **Simulations**: Use survey software and virtual simulation tools to mimic the use of surveying equipment, especially when field trips are not feasible. ○ **Practice sessions**: Allocate time for students to practice setting up and using equipment independently or in small groups, with instructors providing guidance. **3. Collaborative Learning and Group Work** • **Strategy**: Promote collaborative learning by organizing group activities where students can work together to complete tasks involving surveying equipment. • **Teaching Methods**: ○ **Group projects**: Assign projects that require students to plan and execute a survey, analyze data, and present results. This can simulate real-world surveying scenarios. ○ **Peer-to-peer teaching**: Encourage students to explain concepts to each other, helping reinforce their own understanding while building teamwork skills. ○ **Problem-solving tasks**: Provide group challenges such as troubleshooting errors in survey setups or interpreting unclear data from field measurements. **4. Problem-Based Learning (PBL)** • **Strategy**: Use problem-based learning to encourage critical thinking and practical application of surveying techniques. Present students with real-world surveying problems that they need to solve using the equipment. • **Teaching Methods**: ○ **Case studies**: Present case studies of surveying projects (e.g., land subdivision or construction layout), and ask students to analyze and propose solutions using the equipment and data they collect. ○ **Scenarios**: Provide a scenario where students must design and carry out a survey, making decisions about which equipment to use, how to troubleshoot issues, and how to analyze the results. ○ **Field troubleshooting**: Set up simulated issues in the field, such as incorrect instrument calibration, and have students identify and correct the problems. •

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7

Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation
تقييم المادة الدراسية

As		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	0	10% (10)	Continuous	All
	Report	5	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

Week	Material Covered
Week 1	Lidar
Week 2	Lidar data
Week 3	General definition
Week 4	Lidar
Week 5	How work Lidar
Week 6	How work Lidar
Week 7	Surveying using lidar
Week 8	Surveying using lidar
Week 9	Lidar application
Week 10	Lidar application
Week 11	Lidar coordinate system
Week 12	Lidar coordinate system
Week 13	How user lidar data
Week 14	How user lidar data
Week 15	How user lidar data
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Introduction
Week 2	Ex. About coordinate system
Week 3	Ex. About coordinate system
Week 4	How can use GPS inst.
Week 5	Observation using GPS
Week 6	GPS inst. pages
Week 7	NAV. page
Week 8	Position Page
Week 9	Map page
Week 10	Compose page
Week 11	Setting psge
Week 12	Traverse observation using GPS
Week 13	Traverse observation using GPS
Week 14	Traverse observation using GPS
Week 15	Traverse observation using GPS

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية			
Module Title	**Global Position System**	**Module Delivery**	
Module Type	**Core**	☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 309**		
ECTS Credits	**4**		
SWL (hr/sem)	**100**		
Module Level	1	**Semester of Delivery**	1
Administering Department	Type Dept. Code	**College**	Type College Code

Module Leader	Name	**e-mail**	E-mail
Module Leader's Acad. Title	Mohammed Tareq Khaleel	**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)	**e-mail**	E-mail
Peer Reviewer Name	Name	**e-mail**	E-mail
Scientific Committee Approval Date		**Version Number**	1.0

Relation with other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Objectives أهداف المادة الدراسية	The objective of studying "Global Positioning System (GPS)" topics is to provide individuals with an understanding of the principles, operation, and applications of GPS technology. GPS is a satellite-based navigation system that enables users to determine their precise location, velocity, and time anywhere on or near the Earth's surface. The objective is to provide individuals with the knowledge and skills necessary to understand, utilize, and benefit from GPS technology. This knowledge enables them to accurately determine positions, navigate efficiently, conduct precise surveys, and leverage GPS for various applications in diverse fields.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Principles of GPS Technology** • **Learning Outcome**: Understand the fundamental principles of the Global Positioning System (GPS), including its components and how it operates. ○ **Indicator**: Students will be able to explain how GPS works, including the roles of satellites, receivers, and ground control stations. ○ **Key Concepts**: Satellite constellations, signal propagation, trilateration. **2. Identify the Components of GPS** • **Learning Outcome**: Identify and describe the key components of the GPS system and how they contribute to accurate positioning. ○ **Indicator**: Students will identify the roles of GPS satellites, ground control stations, and receivers in the system. ○ **Key Concepts**: GPS satellites, signal transmission, and reception. **3. Analyze GPS Signal Structure** • **Learning Outcome**: Analyze the structure of GPS signals and understand how the signals are used to determine position. ○ **Indicator**: Students will explain how GPS signals carry time-stamped information and how the receiver calculates distance based on signal travel time. ○ **Key Concepts**: Signal modulation, pseudo range, and time synchronization.

	4. Perform Basic GPS Measurements • **Learning Outcome**: Demonstrate the ability to use GPS equipment to measure positions and distances accurately. ○ **Indicator**: Students will successfully set up and operate a GPS receiver to collect data in the field. ○ **Key Skills**: Collecting position data, measuring distances, recording waypoints. **5. Understand GPS Accuracy and Sources of Error** • **Learning Outcome**: Understand the factors that affect GPS accuracy and how to mitigate errors in positioning data. ○ **Indicator**: Students will identify sources of error in GPS measurements, such as satellite geometry, signal interference, and atmospheric conditions, and describe methods to improve accuracy. ○ **Key Concepts**: Dilution of Precision (DOP), multipath error, ionospheric and tropospheric effects. **6. Apply Differential GPS (DGPS) for Improved Accuracy** • **Learning Outcome**: Understand and apply the principles of Differential GPS (DGPS) to enhance positioning accuracy. ○ **Indicator**: Students will describe how DGPS works and use a DGPS system to improve position accuracy. ○ **Key Concepts**: Base stations, corrections, and real-time positioning.
Indicative Contents المحتويات الإرشادية	**1. Introduction to GPS** • **Overview of GPS**: ○ History and development of GPS. ○ Importance of GPS in modern navigation, surveying, and geospatial applications. • **Applications of GPS**: ○ Surveying, mapping, navigation, geodesy, agriculture, and environmental monitoring. ○ Emerging uses of GPS in various industries. **2. GPS System Components** • **Satellites**: ○ GPS satellite constellations (e.g., NAVSTAR). ○ Roles of satellites in GPS: orbit, positioning, and signal transmission. • **Ground Control Stations**: ○ Overview of ground control operations: monitoring and maintaining satellite health. ○ Satellite tracking and corrections. • **GPS Receivers**: ○ Types of GPS receivers: handheld, geodetic, differential, etc. ○ How receivers work: receiving signals, calculating position, and displaying data. **3. GPS Signal Structure** • **Signal Modulation**:

	○ The components of GPS signals: carrier waves, pseudoranges, codes, and the navigation message. ○ Types of GPS signals: C/A code (coarse/acquisition), P-code (precise), and L2C. • **Time Synchronization**: ○ How GPS signals are time-stamped and how time is used for positioning calculations. • **Signal Propagation**: ○ How GPS signals travel through the atmosphere, including ionospheric and tropospheric effects. --- **4. Working Principles of GPS** • **Trilateration**: ○ How positions are calculated using the distances from multiple satellites. ○ The concept of range measurement and time-of-flight of GPS signals. • **Coordinate Systems**: ○ Geodetic coordinates (latitude, longitude, and altitude). ○ The role of reference frames such as WGS84 (World Geodetic System 1984). • **Accuracy and Precision**: ○ The concept of positional accuracy and factors that affect it (e.g., satellite geometry, signal interference). --- **5. Sources of Error in GPS** • **Satellite Geometry**: ○ Dilution of Precision (DOP) and its impact on accuracy. ○ The effect of satellite positioning on measurement quality. • **Atmospheric Effects**: ○ Ionospheric and tropospheric delays and how they influence GPS accuracy. • **Multipath Errors**: ○ The impact of reflected signals from buildings, terrain, or other objects. • **Receiver and Signal Quality**: ○ Issues with receiver calibration, signal blockage, and interference. --- **6. Differential GPS (DGPS)** • **Concept of DGPS**: ○ How DGPS improves GPS accuracy by using correction signals from a fixed base station. • **DGPS Components**: ○ The role of base stations, reference stations, and correction data. • **Real-Time DGPS**: ○ How DGPS is used for high-precision applications like land surveying and geodesy. ○ Integration with real-time kinematic (RTK) positioning. --- **7. GPS Data Collection and Measurement** • **Field Data Collection**: ○ Setting up GPS receivers for data collection in the field. ○ Using GPS for various surveying tasks: waypoints, route tracking, and area measurements.

	• **Post-Processing GPS Data**: ○ Transferring and processing GPS data on computers or GIS software. ○ Data correction, conversion to coordinates, and analysis of results. **8. GPS Accuracy and Performance** • **Factors Affecting Accuracy**: ○ Number of visible satellites, satellite geometry, signal quality, and environmental factors. • **Accuracy Assessment**: ○ Methods for evaluating and improving GPS accuracy: using multiple frequencies (L1, L2) and post-processing techniques. • **GPS Error Correction**: ○ Correcting GPS data through software and processing techniques.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures and Discussions** • **Strategy**: Provide clear, engaging lectures that introduce the theoretical foundations of GPS. Use multimedia and interactive tools to help visualize complex concepts. • **Teaching Methods**: ○ **Visual Aids**: Use diagrams, animations, and videos to demonstrate how GPS signals travel, satellite orbits, and the concept of trilateration. ○ **Class Discussions**: Engage students in discussions about the uses and limitations of GPS technology, as well as its impact on various industries (e.g., navigation, surveying, agriculture). ○ **Real-World Examples**: Present case studies of how GPS is used in different fields, such as autonomous vehicles, land surveying, and precision agriculture. **2. Hands-On Practical Training** • **Strategy**: Offer hands-on sessions where students can use GPS receivers, perform measurements, and analyze GPS data. • **Teaching Methods**: ○ **Field Exercises**: Organize practical sessions where students use GPS devices to collect real-time data, such as measuring distances, waypoints, and areas. ○ **Data Collection in the Field**: Allow students to collect GPS data for specific tasks (e.g., mapping, surveying), and later analyze it in the classroom using software tools. ○ **Simulations**: For situations where fieldwork isn't feasible, use GPS simulation software that mimics real GPS data collection processes. **3. Problem-Based Learning (PBL)** • **Strategy**: Encourage critical thinking and application of GPS concepts by having students work on real-world problems. • **Teaching Methods**: ○ **Case Studies**: Provide complex, real-world case studies where students must analyze and interpret GPS data to solve problems, such as mapping land boundaries, optimizing routes for navigation, or planning a construction site survey.

	○ **Scenario-Based Tasks**: Create scenarios where students must troubleshoot common GPS issues (e.g., signal interference, low satellite visibility) and apply corrections using real-time or post-processed GPS data. ○ **Group Problem-Solving**: Organize group projects where students need to design a survey, collect GPS data, and present their findings, mimicking a professional GPS project. --- **4. Flipped Classroom** • **Strategy**: Utilize the flipped classroom model to allow students to learn the theoretical concepts before class, so they can apply them during practical sessions. • **Teaching Methods**: ○ **Pre-Class Learning**: Assign students to watch videos or read materials related to GPS basics (e.g., signal structure, trilateration, and types of GPS receivers). ○ **Interactive In-Class Activities**: Use class time for problem-solving activities, hands-on practice with GPS equipment, and discussions about the pre-assigned material. ○ **Assessment via Online Quizzes**: Use quizzes or reflection tasks after each pre-class module to ensure that students understand the foundational concepts before engaging in practical work. --- **5. Collaborative Learning and Group Projects** • **Strategy**: Promote teamwork through collaborative learning activities that allow students to share knowledge and solve complex GPS-related tasks together. • **Teaching Methods**: ○ **Group Surveys**: Assign group projects where students use GPS equipment to conduct surveys, collect data, and present the results. Encourage students to divide roles such as data collection, data analysis, and presentation. ○ **Peer Review**: Have students critique each other's work, especially in data collection and analysis, to foster collaboration and improve understanding. ○ **Group Discussions**: Encourage discussion among students on how to troubleshoot common GPS issues, such as poor satellite coverage or multipath errors.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية				
	Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning**

As					Outcome
Formative assessment	Quizzes	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	Midterm Exam	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

Week	Material Covered
Week 1	GPS Campus
Week 2	GPS Campus
Week 3	Exporting / Correcting Data
Week 4	Exporting / Correcting Data
Week 5	Create Campus Map
Week 6	Create Campus Map
Week 7	Presentations
Week 8	Presentations
Week 9	GPS Project
Week 10	GPS Project
Week 11	GPS Project
Week 12	GPS Project
Week 13	GPS Project
Week 14	GPS Project
Week 15	Presentations
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

Week	Material Covered
Week 1	N/A
Week 2	
Week 3	
Week 4	

Week 5	
Week 6	
Week 7	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**REMOTE SENSING**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 310**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level		1	**Semester of Delivery**		1
Administering Department		Type Dept. Code	**College**	Type College Code	
Module Leader	Name		**e-mail**	E-mail	
Module Leader's Acad. Title		Professor	**Module Leader's Qualification**		Ph.D.
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name		Name	**e-mail**	E-mail	
Scientific Committee Approval Date			**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective of studying remote sensing is to equip individuals with the knowledge and skills necessary to effectively acquire, process, analyze, and interpret remote sensing data. This knowledge enables them to extract valuable information about the Earth's surface, monitor changes, and make informed decisions in various fields that require geospatial information. Overall, the objective of studying remote sensing topics is to equip individuals with the knowledge and skills to effectively acquire, interpret, and analyze remote sensing data. By understanding remote sensing principles, sensor technologies, image interpretation techniques, and applications, individuals can leverage remote sensing data for various purposes, including environmental monitoring, resource management, land use planning, and disaster response.

	Remote sensing plays a vital role in supporting informed decision-making and providing valuable insights about
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Principles of Remote Sensing** • **Learning Outcome**: Understand the fundamental principles of remote sensing, including the physics of electromagnetic radiation and how it interacts with Earth's surface. ○ **Indicator**: Students will be able to explain the basic principles of remote sensing, including the electromagnetic spectrum, sensors, and how different wavelengths are used to capture surface information. ○ **Key Concepts**: Electromagnetic spectrum, remote sensing platforms (satellites, aircraft), active vs passive sensing. --- **2. Identify Different Remote Sensing Platforms and Sensors** • **Learning Outcome**: Identify and describe various remote sensing platforms and sensors used for Earth observation. ○ **Indicator**: Students will be able to list and describe different platforms (e.g., satellites, drones, aircraft) and sensors (e.g., optical, radar, LiDAR) used for remote sensing applications. ○ **Key Concepts**: Satellite systems (e.g., Landsat, MODIS), sensor types (e.g., multispectral, hyperspectral, radar), spatial, spectral, and temporal resolution. --- **3. Analyze Remote Sensing Data** • **Learning Outcome**: Analyze remote sensing data to extract useful information about the Earth's surface. ○ **Indicator**: Students will demonstrate the ability to process and interpret remote sensing images, identifying land cover, vegetation, and other features. ○ **Key Concepts**: Image preprocessing, classification techniques (supervised, unsupervised), image interpretation. --- **4. Apply Remote Sensing for Environmental Monitoring** • **Learning Outcome**: Apply remote sensing techniques for environmental monitoring and resource management. ○ **Indicator**: Students will apply remote sensing data to monitor environmental changes such as deforestation, urbanization, and changes in land use. ○ **Key Concepts**: Vegetation indices (e.g., NDVI), land use/land cover change detection, environmental monitoring (e.g., forest health, water bodies). --- **5. Interpret Remote Sensing Images for Land Use and Land Cover Mapping** • **Learning Outcome**: Interpret remote sensing images for land use and land cover classification and mapping. ○ **Indicator**: Students will demonstrate the ability to classify land cover types (e.g., forest, water, urban) using remote sensing data and create maps for decision-making. ○ **Key Concepts**: Land use classification, supervised vs unsupervised classification, accuracy assessment. --- **6. Understand the Role of Remote Sensing in Disaster Management** • **Learning Outcome**: Understand the role of remote sensing in disaster management, including natural disasters such as floods, wildfires, and earthquakes. ○ **Indicator**: Students will describe how remote sensing is used to assess and respond to natural disasters, including damage assessment and recovery efforts.

	○ **Key Concepts**: Damage assessment, disaster response, real-time monitoring. **7. Utilize Geographic Information Systems (GIS) with Remote Sensing Data** • **Learning Outcome**: Integrate remote sensing data with GIS for spatial analysis and decision-making. ○ **Indicator**: Students will demonstrate how to combine remote sensing imagery with GIS software to perform spatial analysis, create maps, and generate reports. ○ **Key Concepts**: GIS integration, spatial analysis, geospatial data visualization. **8. Evaluate the Accuracy and Quality of Remote Sensing Data** • **Learning Outcome**: Evaluate the accuracy and quality of remote sensing data and images for different applications. ○ **Indicator**: Students will assess the quality of remote sensing data using accuracy metrics and validation techniques, ensuring its suitability for specific applications. ○ **Key Concepts**: Accuracy assessment, confusion matrix, validation, ground truthing. **9. Understand and Apply Remote Sensing in Agriculture** • **Learning Outcome**: Understand and apply remote sensing technologies for precision agriculture. ○ **Indicator**: Students will explain how remote sensing is used to monitor crop health, soil moisture, and other agricultural parameters, and how to interpret these for agricultural management. ○ **Key Concepts**: Crop monitoring, soil moisture, precision agriculture, yield prediction.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Remote Sensing** • **Overview and History of Remote Sensing**: ○ Origins and evolution of remote sensing technologies. ○ Key milestones in the development of remote sensing tools. • **Basic Principles**: ○ Electromagnetic radiation and its interaction with Earth's surface. ○ Passive vs. active remote sensing. ○ Remote sensing terminology: spatial, spectral, radiometric, and temporal resolution. **2. Remote Sensing Platforms and Sensors** • **Platform Types**: ○ Satellite-based platforms (e.g., geostationary, polar orbiting). ○ Airborne platforms (e.g., UAVs, aircraft). ○ Ground-based and terrestrial remote sensing. • **Sensor Types**: ○ Optical (visible, infrared, thermal). ○ Microwave (radar, synthetic aperture radar - SAR). ○ LiDAR (Light Detection and Ranging). ○ Hyperspectral and multispectral sensors. ○ Advantages and limitations of each sensor type.

	3. The Electromagnetic Spectrum • **Electromagnetic Spectrum Basics**: ○ Wavelength, frequency, and energy relationship. ○ Key regions of the electromagnetic spectrum: UV, visible, near-infrared, thermal infrared, microwave, and radar. • **Remote Sensing in Different Bands**: ○ How different wavelengths are used to detect various features (e.g., vegetation, water, soil). • **Interaction of Electromagnetic Radiation with the Earth's Surface**: ○ Reflection, absorption, and transmission. ○ Spectral signatures of different materials (e.g., vegetation, water bodies, urban areas). **4. Remote Sensing Data Acquisition and Processing** • **Data Acquisition**: ○ How remote sensing data is collected from satellites, aircraft, and drones. ○ The role of ground control points and calibration. • **Preprocessing Techniques**: ○ Geometric correction (orthorectification, map projection). ○ Radiometric correction (sensor calibration, atmospheric correction). ○ Image enhancement techniques (contrast stretching, filtering). • **Data Formats and Storage**: ○ Common remote sensing data formats (e.g., GeoTIFF, HDF, NetCDF). ○ Data compression and storage considerations. **5. Remote Sensing Image Interpretation** • **Image Interpretation Techniques**: ○ Visual interpretation: Identifying patterns and features in imagery. ○ Digital image processing: Quantitative analysis of pixel values. • **Image Classification**: ○ Supervised classification (e.g., maximum likelihood, decision trees). ○ Unsupervised classification (e.g., K-means clustering, ISODATA). ○ Accuracy assessment of classification results (confusion matrix, kappa coefficient). • **Change Detection**: ○ Methods for detecting changes over time using multi-temporal images. ○ Applications in monitoring deforestation, urban expansion, and climate change. **6. Geographic Information Systems (GIS) and Remote Sensing Integration** • **GIS Integration with Remote Sensing**: ○ Combining remote sensing data with GIS for spatial analysis and visualization. ○ Coordinate systems, map projections, and georeferencing. • **Applications of GIS-Remote Sensing Integration**: ○ Land use/land cover mapping, natural resource management, and urban planning. ○ 3D modeling and visualization using remote sensing data.

	7. Applications of Remote Sensing • **Environmental Monitoring**: ○ Vegetation and forest monitoring (e.g., NDVI, biomass estimation). ○ Water quality and hydrological studies (e.g., water bodies, wetlands, flood mapping). ○ Soil moisture and drought monitoring. • **Disaster Management**: ○ Monitoring and assessing the impacts of natural disasters (e.g., wildfires, floods, earthquakes). ○ Emergency response and recovery using remote sensing data. • **Agriculture**: ○ Precision farming and crop health monitoring (e.g., crop yield prediction, pest and disease detection). ○ Use of remote sensing in irrigation management and soil analysis. • **Urban and Regional Planning**: ○ Land use/land cover classification and urban expansion monitoring. ○ Infrastructure planning and transportation networks. • **Climate Change Studies**: ○ Monitoring global warming, melting ice caps, and sea level rise. ○ Analysis of urban heat islands and other climate-related phenomena.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures and Discussions** • **Strategy**: Deliver engaging lectures that introduce key concepts in remote sensing while promoting active participation and critical thinking. • **Teaching Methods**: ○ **Multimedia and Visual Aids**: Use diagrams, animations, and videos to illustrate complex remote sensing concepts such as electromagnetic radiation, sensor types, and image interpretation. ○ **Case Study Discussions**: Engage students in real-world case studies to explore how remote sensing is applied in various fields (e.g., agriculture, disaster management, environmental monitoring). This could include exploring the role of remote sensing in monitoring climate change or deforestation. ○ **Interactive Questioning**: Use clicker systems or polling apps to gauge student understanding and encourage in-class participation. --- **2. Hands-On Practical Sessions** • **Strategy**: Provide students with practical experience in data acquisition, processing, and analysis using remote sensing software and tools. • **Teaching Methods**: ○ **Fieldwork and Data Collection**: Where possible, organize field trips or activities where students use real sensors (e.g., drones, UAVs) or access real satellite data. Students can collect ground truth data to compare with remote sensing outputs. ○ **Remote Sensing Software Training**: Train students to use industry-standard

	software (e.g., ENVI, ERDAS Imagine, ArcGIS, QGIS) for data processing, classification, and analysis. Ensure students get hands-on experience in manipulating imagery, applying image correction techniques, and performing classifications. ○ **Practical Image Interpretation**: Involve students in exercises where they manually interpret remote sensing images, identifying land cover types or monitoring changes over time. <hr>**3. Problem-Based Learning (PBL)** • **Strategy**: Encourage critical thinking and problem-solving skills by presenting real-world problems that require remote sensing solutions. • **Teaching Methods**: ○ **Scenario-Based Learning**: Provide students with scenarios (e.g., identifying deforestation, monitoring urban growth, disaster management) and ask them to solve problems using remote sensing data. This could involve tasks like analyzing a satellite image for vegetation index or detecting land use changes over time. ○ **Project-Based Learning**: Have students work on group projects where they apply remote sensing tools and data to address specific challenges, such as mapping the impact of a flood or identifying agricultural land use patterns. ○ **Research-Oriented Projects**: Encourage students to conduct research using available satellite imagery or remote sensing datasets, with the aim of solving a problem or answering a specific question. <hr>**4. Flipped Classroom** • **Strategy**: Use the flipped classroom approach to allow students to learn foundational content outside of class, which frees up in-class time for practical applications and problem-solving. • **Teaching Methods**: ○ **Pre-Class Learning Materials**: Provide recorded lectures, readings, and instructional videos covering the theory of remote sensing, sensor technologies, and data processing before class. Tools like Coursera, YouTube, or instructor-created resources can be useful. ○ **Interactive In-Class Activities**: Use class time for applying the pre-class material through group exercises, problem-solving tasks, and hands-on projects, such as interpreting satellite images or conducting spatial analysis with remote sensing software. <hr>**5. Collaborative Learning and Group Projects** • **Strategy**: Foster teamwork and peer learning by incorporating group activities that simulate real-world remote sensing projects. • **Teaching Methods**: ○ **Team-Based Projects**: Assign group tasks where students must collaborate to analyze remote sensing data and produce a report or presentation on their findings. Projects could include land cover classification, environmental monitoring, or disaster damage assessment. ○ **Peer Review and Feedback**: Encourage students to review each other's work and provide constructive feedback. This can help refine their analysis and improve collaboration skills. ○ **Cross-Disciplinary Collaboration**: Involve students from different backgrounds (e.g., geography, environmental science, engineering) in group projects, allowing them to approach remote sensing applications from various perspectives.

	6. Use of Digital Tools and Online Learning Platforms • **Strategy**: Incorporate digital tools and online resources to facilitate learning and enhance student engagement with remote sensing content. • **Teaching Methods**: ○ **Online Tutorials and Webinars**: Provide access to online tutorials and webinars on remote sensing techniques, software usage, and emerging technologies. These resources can be used as supplemental learning tools. ○ **Remote Sensing Data Repositories**: Introduce students to online platforms like NASA Earth Observing System Data and Information System (EOSDIS), Google Earth Engine, and USGS Earth Explorer to access and analyze real remote sensing data. ○ **Virtual Field Trips**: Use virtual tools such as Google Earth or 3D mapping software to simulate field visits and demonstrate how remote sensing data is applied to real-world scenarios.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

Week	Material Covered
Week 1	ENERGY INTERACTIONS WITH EARTH SURFACE FEATURE Energy Interaction , Reflection , Diffuse and Specular Reflection , Spectral Reflectance Curves .
Week 2	SPECTRAL REFLECTANCE CURVES Spectral Reflectance Curve for Vegetation , Spectral Reflectance of Soil , Spectral Reflectance for Water , Spectral Reflectance of Some Natural Features .
Week 3	SATELLITES AND ORBITS Characteristics of satellite orbits , Geosynchronous orbit , Polar (or Near Polar) orbits , Sun-synchronous orbits , Remote sensing application
Week 4	SATELLITES AND ORBITS Characteristics of satellite orbits , Geosynchronous orbit , Polar (or Near Polar) orbits , Sun-synchronous orbits , Remote sensing application
Week 5	REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MONITORING
Week 6	REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MONITORING
Week 7	REMOTE SENSING AND GIS APPLICATIONS IN WATERSHED MANAGEMENT
Week 8	REMOTE SENSING AND GIS APPLICATIONS IN IRRIGATION MANAGEMENT
Week 9	REMOTE SENSING AND GIS APPLICATIONS IN IRRIGATION MANAGEMENT
Week 10	REMOTE SENSING AND GIS APPLICATIONS IN RAIN FALL-RUNOFF MODELLING
Week 11	REMOTE SENSING AND GIS APPLICATIONS IN RAIN FALL-RUNOFF MODELLING
Week 12	REMOTE SENSING AND GIS APPLICATIONS IN RAIN FALL-RUNOFF MODELLING
Week 13	REMOTE SENSING AND GIS APPLICATIONS IN RAIN FALL-RUNOFF MODELLING
Week 14	REMOTE SENSING AND GIS APPLICATIONS IN RAIN FALL-RUNOFF MODELLING
Week 15	REMOTE SENSING AND GIS APPLICATIONS IN RAIN FALL-RUNOFF MODELLING
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

Week	Material Covered
Week 1	Arc-Catalog & Arc-Map Displaying a layer, Identifying a feature, Adding graphics, and Laying out a map
Week 2	Arc-Catalog & Arc-Map Displaying a layer, Identifying a feature, Adding graphics, and Laying out a map
Week 3	Introduction to Geographic Information Systems GIS digital representation of geospatial data, Vector representation of data and raster representation of data.
Week 4	Using GIS with Global Positioning System GPS

	Introduction to GPS and Coordinate systems
Week 5	Using GIS with Global Positioning System GPS Introduction to GPS and Coordinate systems
Week 6	Using GIS with Global Positioning System GPS Introduction to GPS and Coordinate systems
Week 7	Editing & Tables in GIS Editor tool and Working with tables
Week 8	Editing & Tables in GIS Editor tool and Working with tables
Week 9	**ymbology and Labelling** **Symbolizing Points, Symbolizing Polygons, Categories, Graduated Color, and Labeling Features**
Week 10	ymbology and Labelling Symbolizing Points, Symbolizing Polygons, Categories, Graduated Color, and Labeling Features
Week 11	ymbology and Labelling Symbolizing Points, Symbolizing Polygons, Categories, Graduated Color, and Labeling Features
Week 12	Toolbox Analysis tools, Conversion tools, and Statistics and Modeling.
Week 13	Toolbox Analysis tools, Conversion tools, and Statistics and Modeling.
Week 14	Layout Map layout, and Project
Week 15	**Presentation**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		No
Recommended Texts		No
Websites		

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية			
Module Title	**Advanced Python Language**	**Module Delivery**	
Module Type	**Support**	☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 311**		
ECTS Credits	**4**		
SWL (hr/sem)	**100**		
Module Level	1	**Semester of Delivery**	1
Administering Department	Type Dept. Code	**College**	Type College Code
Module Leader	Name	**e-mail**	E-mail
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)	**e-mail**	E-mail
Peer Reviewer Name	Name	**e-mail**	E-mail
Scientific Committee Approval Date		**Version Number**	1.0

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective is to equip individuals with the knowledge and skills to effectively use Python as a powerful programming language for various purposes. The objective is to provide individuals with the knowledge and skills to effectively use the Python programming language for various computational tasks and software development. Python is a popular programming language known for its simplicity, versatility, and readability. And to equip individuals with the skills to develop, automate, and solve problems using Python. Python's versatility and extensive library ecosystem make it suitable for a wide range of applications, including data analysis, web development, scientific computing, artificial intelligence, and automation. By mastering Python, individuals can leverage its power and flexibility to create robust and efficient computer applications.
Module Learning	**1. Understand the Basics of Python Programming**

Outcomes مخرجات التعلم للمادة الدراسية	• **Learning Outcome**: Understand the basic syntax, data types, and structures in Python programming. ○ **Indicator**: Students will be able to explain and apply Python's core syntax, including variables, operators, loops, conditionals, and basic data types (strings, lists, tuples, dictionaries, sets). ○ **Key Concepts**: Variables, data types, expressions, control flow (if-else, loops). --- **2. Develop Problem-Solving Skills Using Python** • **Learning Outcome**: Apply Python programming techniques to solve computational problems. ○ **Indicator**: Students will demonstrate the ability to break down real-world problems into smaller components and implement solutions using Python. ○ **Key Concepts**: Problem decomposition, algorithm development, debugging, and testing. --- **3. Master Functions and Modular Programming** • **Learning Outcome**: Understand the concepts of functions, modules, and libraries in Python for modular programming. ○ **Indicator**: Students will be able to create reusable functions, organize code into modules, and import and use Python libraries. ○ **Key Concepts**: Functions, parameters, return values, Python libraries, importing modules. --- **4. Work with Data Structures in Python** • **Learning Outcome**: Use Python's built-in data structures to store and manipulate data efficiently. ○ **Indicator**: Students will be able to apply lists, dictionaries, sets, and tuples for solving problems, and understand their use cases. ○ **Key Concepts**: Lists, dictionaries, sets, tuples, list comprehensions, data manipulation. --- **5. Implement Object-Oriented Programming (OOP) Concepts** • **Learning Outcome**: Understand and apply Object-Oriented Programming principles in Python. ○ **Indicator**: Students will be able to design and implement classes and objects, and use inheritance, polymorphism, and encapsulation in Python. ○ **Key Concepts**: Classes, objects, methods, inheritance, polymorphism, encapsulation. --- **6. Perform File Handling and Data Persistence** • **Learning Outcome**: Use Python for reading, writing, and manipulating files (text, CSV, JSON). ○ **Indicator**: Students will demonstrate the ability to open, read, write, and parse various file formats to store and retrieve data. ○ **Key Concepts**: File I/O (input/output), text files, CSV, JSON, data persistence. --- **7. Utilize Libraries for Data Analysis**

	• **Learning Outcome**: Apply Python libraries for data manipulation, analysis, and visualization. ○ **Indicator**: Students will be able to use libraries like NumPy, Pandas, and Matplotlib to perform data analysis, data cleaning, and visualization. ○ **Key Concepts**: NumPy, Pandas, Matplotlib, data manipulation, data visualization. --- **8. Develop Interactive and GUI Applications** • **Learning Outcome**: Build basic graphical user interface (GUI) applications using Python. ○ **Indicator**: Students will be able to design and implement simple GUI applications using libraries such as Tkinter. ○ **Key Concepts**: Tkinter, event-driven programming, widgets, GUI layout. --- **9. Work with APIs and Web Scraping** • **Learning Outcome**: Understand how to interact with external APIs and scrape web data using Python. ○ **Indicator**: Students will demonstrate the ability to request data from web APIs (e.g., REST API), parse the returned data, and scrape web pages using libraries like requests and BeautifulSoup. ○ **Key Concepts**: APIs, web scraping, requests, BeautifulSoup, JSON parsing. --- **10. Implement Basic Algorithms and Problem-Solving Techniques** • **Learning Outcome**: Understand and implement basic algorithms in Python (sorting, searching, recursion). ○ **Indicator**: Students will be able to implement common algorithms and understand their time complexity. ○ **Key Concepts**: Sorting algorithms (e.g., bubble sort, merge sort), searching algorithms (e.g., binary search), recursion. --- **11. Debug and Optimize Python Code** • **Learning Outcome**: Develop debugging and code optimization skills to improve Python programs. ○ **Indicator**: Students will be able to use debugging tools, analyze error messages, and optimize Python code for performance. ○ **Key Concepts**: Debugging techniques, optimization, time complexity, profiling. --- **12. Understand Python's Application in Real-World Domains** • **Learning Outcome**: Understand the use of Python in various domains such as web development, data science, and automation. ○ **Indicator**: Students will be able to explain how Python is used in different industries and domains, and apply it to build basic applications. ○ **Key Concepts**: Web development (Flask, Django), data science (Jupyter Notebooks), automation scripts.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Python Programming** • **Overview of Python**: ○ History and evolution of Python.

- Why Python is popular: readability, versatility, and community support.
- Python versions and installation.

- **Python Development Environment**:
  - Setting up a Python development environment (IDEs: PyCharm, VS Code, Jupyter).
  - Python shell vs. script-based programming.
- **Basic Syntax**:
  - Writing and executing Python scripts.
  - Comments, indentation, and syntax rules.
- **Hello World Program**:
  - Introduction to basic output using print().

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2. Data Types and Variables

- **Variables and Constants**:
  - Declaring and initializing variables.
  - Data type conversion (casting).
- **Primitive Data Types**:
  - Integers, floating-point numbers, strings, booleans.
- **Basic Input/Output**:
  - Reading input from the user with input().
  - Formatting output (string interpolation, f-strings, and format method).
- **Type Checking**:
  - Using type() and isinstance() functions to check types.

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3. Control Flow and Conditional Statements

- **If-Else Statements**:
  - Simple conditionals: if, elif, else.
  - Nested conditions and logical operators (and, or, not).
- **Comparison Operators**:
  - Operators such as ==, !=, <, >, <=, >=.
- **Switch Case Alternative**:
  - Using dictionaries or match-case (Python 3.10+).
- **Error Handling (Optional)**:
  - Introduction to try, except blocks for exception handling.

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4. Loops and Iteration

- **For Loops**:
  - Looping through sequences (lists, strings, ranges).
  - Iterating over dictionaries and sets.
- **While Loops**:
  - Conditional loops and using break and continue.
- **Comprehensions**:
  - List comprehensions for efficient iteration and transformations.
- **Nested Loops**:
  - Iterating over multidimensional data structures like lists of lists.

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5. Functions and Modular Programming

- **Defining Functions**:
  - Syntax for defining functions using def.

- Function parameters, return values, and default arguments.
- **Variable Scope**:
  - Local, global, and nonlocal variables.
- **Lambda Functions**:
  - Anonymous functions using lambda.
- **Recursion**:
  - Introduction to recursive functions and base case.
- **Docstrings**:
  - Writing documentation for functions using triple quotes.

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6. Data Structures in Python

- **Lists**:
  - Creating, accessing, and modifying lists.
  - List slicing, methods (append(), remove(), pop()).
- **Tuples**:
  - Immutable sequences and their use cases.
- **Dictionaries**:
  - Key-value pairs, dictionary operations (get(), keys(), values()).
  - Iterating over dictionaries.
- **Sets**:
  - Set operations (union(), intersection(), difference()).
- **String Manipulation**:
  - Working with strings: slicing, methods (join(), replace(), split()).
- **Advanced Data Structures (Optional)**:
  - Stacks, queues, and linked lists.

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7. Object-Oriented Programming (OOP)

- **Introduction to OOP**:
  - Object-oriented concepts: classes, objects, methods, attributes.
- **Defining Classes and Objects**:
  - Syntax for creating classes and instantiating objects.
- **Instance and Class Methods**:
  - Difference between instance and class methods.
- **Inheritance**:
  - Creating subclasses, method overriding, and super().
- **Polymorphism and Encapsulation**:
  - Method overloading, and information hiding using private methods.
- **Constructor (__init__)**:
  - Using constructors to initialize class attributes.
- **Magic Methods**:
  - Introduction to magic methods like __str__, __repr__, __len__.

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8. File Handling

- **Opening and Closing Files**:
  - Using open(), file modes (r, w, a, etc.), and closing files with close().
- **Reading and Writing Files**:
  - Reading text files (read(), readline(), readlines()).
  - Writing to files (write(), writelines()).
- **Working with File Paths**:

	○ Using the os and pathlib modules for file manipulation. • **File Handling with CSV and JSON**: ○ Reading and writing CSV files using the csv module. ○ Parsing and writing JSON data using json module. **9. Introduction to Libraries and Modules** • **Importing Libraries**: ○ Using the import statement and aliasing (import numpy as np). • **Standard Python Libraries**: ○ Exploring commonly used libraries like math, random, datetime, os, sys. • **Third-Party Libraries**: ○ Introduction to popular third-party libraries like NumPy, Pandas, Matplotlib. ○ Installing libraries using pip. **10. Data Analysis and Visualization** • **NumPy**: ○ Arrays, array operations, and basic mathematical functions. • **Pandas**: ○ Creating and manipulating DataFrames, reading data from CSV files, data aggregation. • **Matplotlib**: ○ Basic plotting techniques, creating line graphs, bar charts, histograms. ○ Customizing plots with titles, labels, and legends. • **Seaborn (Optional)**: ○ Advanced visualization techniques for statistical data. **11. Web Development with Python (Optional)** • **Introduction to Web Development Frameworks**: ○ Overview of Flask or Django for building web applications. • **Basic Flask Application**: ○ Setting up a simple web server using Flask. ○ Routing, templates, and handling user requests. • **Database Connectivity**: ○ Connecting to databases (SQLite, MySQL) using Python. • **APIs**: ○ Introduction to building RESTful APIs using Flask or FastAPI. **12. Automation and Scripting** • **Automating Tasks**: ○ Using Python to automate repetitive tasks (e.g., file management, web scraping). • **Web Scraping with BeautifulSoup**: ○ Extracting data from HTML pages using BeautifulSoup and requests. • **Regular Expressions**: ○ Using the re module for pattern matching in text data. **13. Testing and Debugging** • **Debugging Techniques**: ○ Using the pdb debugger, print statements, and error handling.

	• **Unit Testing**: ○ Introduction to unittest framework for writing tests. ○ Writing simple test cases for functions and methods. **14. Advanced Python Topics (Optional)** • **Decorators**: ○ Understanding and using decorators to modify functions. • **Generators**: ○ Introduction to generators for memory-efficient iteration. • **Context Managers**: ○ Using with statements for resource management. **15. Final Projects and Applications** • **Capstone Project**: ○ Encourage students to work on a final project where they apply the Python skills learned to build a complete application (e.g., a web scraper, automation script, or simple game). • **Project Presentation**: ○ Students present their projects, explaining the design, implementation, and challenges faced.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures and Demonstrations** • **Objective**: Provide theoretical knowledge and demonstrate key concepts through live coding. • **Strategy**: ○ Use **live coding** to demonstrate Python syntax and programming principles. ○ Present **concepts with real-world examples**, showing how Python is used in various industries (e.g., web development, data science, automation). ○ Highlight key libraries and tools in Python, explaining their uses with real-time examples. ○ Engage students with **question-and-answer sessions** to clarify doubts immediately. ○ **Visual aids** like flowcharts, diagrams, and code snippets to explain complex topics (e.g., OOP principles, recursion). **2. Hands-On Programming Practice** • **Objective**: Allow students to actively apply learned concepts by writing and debugging Python code. • **Strategy**: ○ **Weekly coding exercises**: Assign coding tasks and small projects to reinforce each topic. For instance, after learning about loops, students could implement a simple number guessing game or a text-based calculator. ○ **Guided practice** in the classroom where students write code during the lesson with the instructor's support, ensuring immediate feedback and guidance.

	○ **Challenge problems** that encourage problem-solving and creative thinking, such as algorithms or data structure tasks, to develop critical thinking and mastery of Python syntax. ○ **Collaborative coding**: Pair programming and small group coding tasks to encourage peer-to-peer learning. <hr>**3. Project-Based Learning** • **Objective**: Apply Python knowledge in real-world scenarios through larger, more complex projects. • **Strategy**: ○ Assign **small to medium-sized projects** that align with the students' interests (e.g., building a web scraper, developing a simple application with a graphical user interface (GUI), or performing data analysis). ○ Guide students through the **project lifecycle**: problem definition, design, coding, testing, and debugging. ○ Encourage **team-based projects** to mimic real-world work environments, improving collaboration skills and fostering peer learning. ○ Provide clear **project milestones** with deadlines to break down larger tasks into manageable parts (e.g., writing the code for one function at a time). <hr>**4. Flipped Classroom and Self-Directed Learning** • **Objective**: Empower students to learn concepts outside the classroom, freeing up class time for deeper discussions and practice. • **Strategy**: ○ Assign **pre-recorded video tutorials** or **reading material** on basic concepts (e.g., Python syntax, variables, control flow) for students to review before class. ○ Use **interactive Python platforms** (e.g., Jupyter Notebooks, Google Colab) for hands-on coding assignments and exercises that students can complete at their own pace. ○ Encourage **self-assessment and reflection** on completed tasks, helping students identify areas of improvement. ○ Provide access to additional **online resources** and **coding challenges** (e.g., LeetCode, HackerRank) to promote continuous self-learning. <hr>**5. Peer Learning and Collaborative Activities** • **Objective**: Foster collaboration and knowledge-sharing among students to reinforce learning. • **Strategy**: ○ **Pair Programming**: Pair students together to work on coding tasks, encouraging active collaboration and immediate feedback. ○ **Group Discussions**: Organize discussions or problem-solving sessions around specific programming concepts (e.g., sorting algorithms or object-oriented programming). ○ **Code Reviews**: Encourage students to review and critique each other's code, providing constructive feedback and suggestions for improvements. ○ **Discussion forums** (e.g., Slack, Microsoft Teams, or a course-specific forum): Use them to share resources, ask questions, and collaborate outside of class time. <hr>**6. Problem-Solving and Algorithmic Thinking** • **Objective**: Develop problem-solving skills through algorithmic thinking and

computational logic.

- **Strategy**:
  - Integrate **problem-solving sessions** where students break down problems into smaller tasks and then write Python code to solve them.
  - Use **puzzles and coding challenges** in each class to stimulate critical thinking (e.g., designing algorithms for common problems like searching, sorting, or string manipulation).
  - Focus on **algorithmic efficiency** by encouraging students to consider time complexity and space complexity.
  - Promote the practice of **writing pseudocode** or drawing flowcharts before implementing the solution in Python, helping students structure their approach to problems.

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7. Use of Integrated Development Environments (IDEs) and Tools

- **Objective**: Familiarize students with industry-standard tools for coding, debugging, and project management.
- **Strategy**:
  - **IDE Training**: Introduce students to Python IDEs like **PyCharm, VS Code**, and **Jupyter Notebooks** to make the coding experience more efficient and professional.
  - Encourage students to use **version control tools** like **Git** and **GitHub** for project management and collaborative work.
  - Teach students how to use **debugging tools** (e.g., pdb for Python) and **unit testing frameworks** (e.g., unittest or pytest) to ensure their code works correctly and is optimized.

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8. Assessment and Feedback

- **Objective**: Assess students' understanding of Python concepts and provide constructive feedback to guide their learning.
- **Strategy**:
  - **Formative Assessment**: Conduct **quizzes** and **short coding exercises** at the beginning or end of each lesson to test immediate understanding and reinforce concepts.
  - **Peer Review**: Use peer assessments for coding assignments and projects to encourage collaboration and critical thinking.
  - Provide **frequent, personalized feedback** on assignments, code quality, and error handling, helping students identify strengths and areas for improvement.
  - **Summative Assessment**: End-of-course exams or project submissions that require students to demonstrate their proficiency in Python programming and problem-solving.

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9. Industry Relevance and Guest Lectures

- **Objective**: Provide insights into the real-world application of Python and inspire students with industry experiences.
- **Strategy**:
  - Organize **guest lectures** or webinars from professionals working in fields that heavily utilize Python (e.g., web development, data science, or automation).
  - Encourage students to participate in **Python-related competitions** or **hackathons** to experience problem-solving in real-world scenarios.
  - Highlight **case studies** and **industry use cases** (e.g., Python for web scraping, machine learning, or automation).

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10. Encouraging a Growth Mindset

	• **Objective**: Foster a mindset of continuous learning, resilience, and adaptability in the face of challenges. • **Strategy**: ○ Promote **trial and error** in coding, emphasizing that mistakes are an essential part of learning. ○ Celebrate small wins and **gradual improvement**, such as successfully debugging an error or completing a challenging exercise. ○ Encourage students to **set personal goals** for learning Python and challenge themselves with more advanced topics as they progress.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Python and Deep Learning

Week 2	Deep Learning
Week 3	Deep Learning
Week 4	Download and install Deep Learning
Week 5	Download and install Deep Learning
Week 6	Jupiter Library
Week 7	Python with Arcgis pro
Week 8	Copy the environment
Week 9	Application of RCNN
Week 10	Application of SSD
Week 11	Application of SSD
Week 12	Save the output
Week 13	Python – Modules
Week 14	Python user input
Week 15	Python user input
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

Week	**Material Covered**
Week 1	N/A
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

<table>
<tr><th colspan="8">Module Information
معلومات المادة الدراسية</th></tr>
<tr><td>Module Title</td><td colspan="3">FUNDAMENTAL OF CADASTRAL SURVEYING</td><td colspan="4">Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="3">Core</td><td colspan="4" rowspan="4">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="3">SUT 312</td></tr>
<tr><td>ECTS Credits</td><td colspan="3">5</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="3">125</td></tr>
<tr><td colspan="2">Module Level</td><td colspan="2">1</td><td colspan="3">Semester of Delivery</td><td>1</td></tr>
<tr><td colspan="2">Administering Department</td><td colspan="2">Type Dept. Code</td><td>College</td><td colspan="3">Type College Code</td></tr>
<tr><td>Module Leader</td><td colspan="3">Name</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td colspan="2">Module Leader’s Acad. Title</td><td colspan="2">Professor</td><td colspan="3">Module Leader’s Qualification</td><td>Ph.D.</td></tr>
<tr><td>Module Tutor</td><td colspan="3">Name (if available)</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td colspan="2">Peer Reviewer Name</td><td colspan="2">Name</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td colspan="2">Scientific Committee Approval Date</td><td colspan="2"></td><td colspan="2">Version Number</td><td colspan="2">1.0</td></tr>
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<table>
<tr><th colspan="4">Relation with other Modules
العلاقة مع المواد الدراسية الأخرى</th></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
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<table>
<tr><th colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</th></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>The objective of studying cadastral surveying is to equip individuals with the knowledge and skills necessary to accurately establish, define, and manage property boundaries and cadastral information. This knowledge enables them to perform cadastral surveys, contribute to land administration systems, resolve boundary disputes, support land development projects, and ensure the integrity and reliability of property ownership records. Overall, the objective of studying cadastral topics is to equip individuals with the knowledge and skills necessary to establish, manage, and utilize cadastral systems. Cadastral systems play a crucial role in land administration, property rights, and land management, providing the foundation for secure land tenure, spatial planning, and sustainable development.</td></tr>
<tr><td>Module Learning</td><td>1. Understand the Principles of Cadastral Surveying</td></tr>
</table>

Outcomes مخرجات التعلم للمادة الدراسية	• **Learning Outcome**: Demonstrate a clear understanding of the principles, history, and objectives of cadastral surveying. ○ **Indicator**: Students will explain the fundamental concepts, legal framework, and purposes of cadastral surveying, including land ownership, boundary definition, and land use planning. --- **2. Apply Legal and Regulatory Frameworks in Cadastral Surveying** • **Learning Outcome**: Understand and apply the legal and regulatory frameworks governing cadastral surveys. ○ **Indicator**: Students will be able to identify relevant laws, regulations, and policies governing land tenure, property rights, and land registration systems in cadastral surveys. --- **3. Perform Cadastral Survey Measurements and Techniques** • **Learning Outcome**: Conduct cadastral surveys using appropriate measurement techniques and equipment. ○ **Indicator**: Students will demonstrate the ability to perform boundary measurements using traditional and modern surveying tools (e.g., total stations, GPS, and electronic distance measurement devices), ensuring accuracy and reliability. --- **4. Interpret Cadastral Survey Data and Documentation** • **Learning Outcome**: Interpret and produce accurate cadastral survey documentation and maps. ○ **Indicator**: Students will be able to interpret survey data, create legal and technical documents, and prepare cadastral maps that accurately represent land boundaries and property divisions. --- **5. Understand Land Registration and Titling Systems** • **Learning Outcome**: Comprehend the process of land registration and property titling. ○ **Indicator**: Students will explain how cadastral surveys contribute to land registration systems, and how land titles and ownership are managed through government authorities. --- **6. Apply Cadastral Surveying in Land Development and Planning** • **Learning Outcome**: Use cadastral survey data in land development, urban planning, and land-use management. ○ **Indicator**: Students will demonstrate the ability to use cadastral survey information to contribute to land development projects, including subdivisions, zoning, and land-use decisions. --- **7. Analyze and Solve Cadastral Surveying Problems** • **Learning Outcome**: Analyze and solve real-world cadastral surveying problems using appropriate surveying techniques. ○ **Indicator**: Students will apply critical thinking and problem-solving skills to resolve boundary disputes, property conflicts, and other issues related to land surveying. --- **8. Understand the Role of Technology in Cadastral Surveying** • **Learning Outcome**: Understand the impact and application of modern technology in cadastral surveying.

	○ **Indicator**: Students will demonstrate familiarity with GPS, GIS, and other advanced technologies in cadastral surveying, and how these tools improve the accuracy, efficiency, and legal integrity of survey results. **9. Ensure Professional and Ethical Practices in Cadastral Surveying** • **Learning Outcome**: Apply ethical and professional standards to cadastral surveying practices. ○ **Indicator**: Students will understand the ethical responsibilities of cadastral surveyors and how to adhere to professional standards in the field, including privacy, accuracy, and impartiality in surveying practice. **10. Communicate Cadastral Surveying Findings Effectively** • **Learning Outcome**: Communicate survey findings, interpretations, and recommendations clearly to clients, authorities, and stakeholders. ○ **Indicator**: Students will demonstrate the ability to prepare clear, concise, and accurate reports, maps, and presentations for diverse audiences, including landowners, government officials, and developers.
Indicative Contents المحتويات الإرشادية	**Introduction to Cadastral Surveying** • **Definition and Purpose**: ○ Overview of cadastral surveying and its role in land management. ○ Importance of cadastral surveys in property rights, land ownership, and land-use planning. • **History of Cadastral Systems**: ○ Evolution of land surveying and the development of cadastral systems. • **Types of Surveys**: ○ Different types of cadastral surveys (boundary surveys, subdivision surveys, retracement surveys, etc.). • **Cadastral Surveying vs. Other Types of Surveying**: ○ Comparison with other survey types (topographic, engineering, etc.). **2. Legal and Regulatory Framework** • **Legal Basis of Cadastral Surveying**: ○ Land ownership rights, title deeds, and property boundaries. • **National and International Land Laws**: ○ Overview of land tenure systems, land laws, and international standards. • **Land Registration Systems**: ○ Principles of land registration and the role of cadastral surveys in supporting land titles. • **Surveying Acts and Standards**: ○ Relevant surveying regulations, codes of practice, and industry standards. • **Boundary Disputes and Legal Implications**: ○ Common legal issues in cadastral surveying, including resolving boundary conflicts. **3. Cadastral Surveying Techniques** • **Measurement Techniques**: ○ Traditional methods (tape and chain measurements). ○ Modern instruments (total stations, electronic distance measurement (EDM),

	and GPS/GNSS). • **Types of Cadastral Surveys**: ○ **Boundary Surveys**: Defining and marking property boundaries. ○ **Subdivision Surveys**: Dividing land into parcels or lots. ○ **Retracement Surveys**: Verifying and reestablishing previously surveyed boundaries. • **Field Surveying Methods**: ○ Setting up survey stations, using theodolites and levels, and collecting data. ○ The role of reference points and monuments in cadastral surveying. • **Data Collection and Error Management**: ○ Collecting survey data accurately and minimizing errors in measurements. <hr>**4. Cadastral Mapping and Documentation** • **Cadastral Mapping**: ○ Types of cadastral maps: property maps, parcel maps, and subdivision plans. ○ The importance of accuracy and clarity in cadastral maps. • **Survey Plan Preparation**: ○ Drawing legal survey plans and land parcel boundaries. ○ Symbols, notations, and other conventions used in cadastral survey plans. • **Land Ownership and Property Documentation**: ○ Recording survey results in legal documents and databases. • **Survey Reports**: ○ Creating technical and legal reports that accompany cadastral surveys. <hr>**5. Technology in Cadastral Surveying** • **Global Positioning Systems (GPS)**: ○ Use of GPS technology for boundary and location surveys. ○ Advantages and limitations of GPS in cadastral surveying. • **Geographic Information Systems (GIS)**: ○ Role of GIS in managing and analyzing cadastral data. ○ Integration of GIS with cadastral maps and land registries. • **Remote Sensing**: ○ Use of satellite imagery and aerial photography in cadastral surveying. ○ Applications of remote sensing for large-scale land surveys and boundary determinations. • **Electronic Surveying Instruments**: ○ Modern surveying tools like total stations, robotic instruments, and data loggers. • **Software for Cadastral Surveying**: ○ Surveying software for data collection, mapping, and processing (e.g., AutoCAD, MicroStation, ArcGIS). <hr>**6. Land Registration and Titling Systems** • **Land Ownership and Title Systems**: ○ Understanding land tenure and title systems. ○ Types of land titles: freehold, leasehold, and customary land ownership. • **Process of Land Registration**: ○ Steps involved in registering land ownership, title issuance, and the role of cadastral surveys.

	• **Cadastral Systems Around the World**: ○ Different land registration systems in various countries (e.g., Torrens System, deed registration system). • **Cadastral Surveying in Land Reform**: ○ Role of cadastral surveying in land redistribution and land reform programs. • **Challenges in Land Registration**: ○ Legal, technical, and social challenges in land registration and titling. --- **7. Boundary Disputes and Resolutions** • **Boundary Identification**: ○ Methods for determining the correct boundaries of land parcels. • **Resolving Boundary Disputes**: ○ Procedures for resolving boundary conflicts, including legal and technical approaches. • **Surveyor's Role in Boundary Disputes**: ○ Ethical considerations and responsibilities of surveyors in dispute resolution. • **Case Studies in Boundary Disputes**: ○ Real-world examples of cadastral disputes and their resolution through surveying and legal processes. --- **8. Cadastral Surveying and Land Development** • **Role of Cadastral Surveys in Urban Planning**: ○ Cadastral surveys for land subdivision and urban zoning. ○ Integrating cadastral surveys with city planning and infrastructure development. • **Land Development and Subdivision**: ○ Surveying for property subdivision and land development projects. • **Environmental Considerations in Cadastral Surveys**: ○ Impact of cadastral surveys on environmental planning and conservation efforts. • **Planning for Infrastructure**: ○ How cadastral surveys contribute to the planning and implementation of infrastructure like roads, utilities, and public services. --- **9. Professional Practices in Cadastral Surveying** • **Ethics and Professionalism**: ○ Ethical issues and professional standards in cadastral surveying. • **Surveying for Government and Private Sector**: ○ The role of cadastral surveyors in both public (government) and private sector projects. • **Surveyor's Liability**: ○ Legal liability for errors, omissions, and negligence in cadastral surveys. • **Continuing Professional Development**: ○ Importance of professional certifications, education, and lifelong learning for cadastral surveyors. --- **10. Future Trends in Cadastral Surveying** • **Emerging Technologies**: ○ Future innovations in surveying technology, such as LiDAR, UAVs (drones),

	and autonomous surveying systems. • **Cadastral Surveying in the Digital Age**: ○ The move toward digital cadastral systems and online land registries. • **Automation and Artificial Intelligence**: ○ The potential for automation and AI in data processing and boundary dispute resolution. • **Global Trends and Challenges**: ○ Emerging trends in cadastral surveying related to climate change, population growth, and urbanization.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**Interactive Lectures and Demonstrations** • **Objective**: Deliver foundational knowledge and demonstrate surveying methods. • **Strategy**: ○ Use **live demonstrations** of cadastral survey techniques (e.g., boundary marking, GPS-based measurements) to reinforce theoretical concepts. ○ **Case Studies**: Present case studies of real-world cadastral surveys, such as boundary disputes or land registration systems, to show how surveying principles are applied in practice. ○ Use **visual aids** like maps, aerial photos, and survey plans to demonstrate concepts such as boundary delineation and land ownership. ○ **Interactive Q&A**: Encourage active participation from students by asking questions about legal implications and technical challenges they may face during cadastral surveys. **2. Hands-On Practical Sessions** • **Objective**: Equip students with the practical skills needed for cadastral surveying. • **Strategy**: ○ Organize **field trips** or outdoor practical sessions where students perform boundary surveys and use surveying instruments like total stations, GPS, and theodolites. ○ Set up **surveying exercises** on real properties, allowing students to apply measurement techniques and produce survey reports. ○ **Simulation Software**: Use software tools like AutoCAD, ArcGIS, or MicroStation for simulating cadastral mapping and land registration tasks, allowing students to practice creating survey maps and legal documents. **3. Problem-Based Learning (PBL)** • **Objective**: Develop critical thinking and problem-solving skills through real-world challenges. • **Strategy**: ○ Present students with **real-life surveying problems**, such as boundary disputes, and have them work in groups to analyze and propose solutions. ○ Use **boundary conflict scenarios** to have students assess legal and technical aspects and create survey plans that resolve the disputes. ○ Assign **case studies** related to cadastral surveying, such as subdivision

	surveys, to test their understanding of both technical and legal principles. --- **4. Collaborative Learning and Peer Review** • **Objective**: Encourage teamwork and peer feedback to reinforce learning. • **Strategy**: ○ **Group projects**: Organize students into small groups to complete a cadastral survey project, including fieldwork, mapping, and report writing. This promotes teamwork and the exchange of ideas. ○ **Peer reviews**: After each project or survey task, have students review each other's work, providing feedback on the quality of survey measurements, accuracy of boundary definitions, and the quality of survey reports. ○ **Group discussions**: Hold class discussions on surveying principles, ethical practices, and legal responsibilities, allowing students to learn from one another. --- **5. Flipped Classroom Approach** • **Objective**: Maximize in-class time for discussions, application, and problem-solving by having students learn foundational concepts beforehand. • **Strategy**: ○ Assign **pre-class readings** or video tutorials on topics such as land registration systems, boundary law, or surveying techniques. ○ Use **interactive online platforms** like quizzes, forums, or discussion boards where students can discuss legal or technical topics before coming to class. ○ In-class time should be dedicated to applying knowledge through group exercises, hands-on tasks, or simulations. --- **6. Use of Technology and Digital Tools** • **Objective**: Familiarize students with the tools and software used in modern cadastral surveying. • **Strategy**: ○ **GPS and GIS Training**: Provide training sessions on using **GPS technology**, **GIS software** (e.g., ArcGIS, QGIS), and **surveying tools** such as total stations or drones to perform cadastral surveys and map properties. ○ Introduce **surveying software** like AutoCAD and MicroStation for creating survey plans and legal documents. ○ Use **3D modeling tools** or **virtual reality simulations** to create virtual surveying environments where students can practice boundary measurement and surveying tasks. ○ Use **online databases and mapping platforms** to simulate land registration processes and cadastral data management. --- **7. Guest Lectures and Industry Interaction** • **Objective**: Provide real-world insights and professional perspectives to students. • **Strategy**: ○ Invite **experienced cadastral surveyors** or legal professionals to speak about current trends, challenges, and ethical issues in cadastral surveying. ○ Organize **site visits** to ongoing cadastral survey projects or land registration offices, where students can observe professionals in action. ○ **Industry partnerships**: Collaborate with land management authorities or surveying companies to provide students with real-world survey data for analysis and mapping

	exercises. **8. Structured Assessments and Feedback** • **Objective**: Assess student progress and provide constructive feedback to guide their learning. • **Strategy**: ○ Implement **formative assessments** throughout the course, such as quizzes, peer-reviewed assignments, or practical surveying tasks, to track progress. ○ Provide **immediate feedback** after field exercises and projects, focusing on both technical accuracy and adherence to legal and ethical standards. ○ Use **summative assessments** (e.g., final exams or major project submissions) to test comprehensive knowledge of cadastral surveying concepts, legal frameworks, and technical skills. **9. Ethics and Professionalism in Cadastral Surveying** • **Objective**: Instill professional conduct and ethical responsibility in students. • **Strategy**: ○ **Role-playing scenarios**: Engage students in role-playing activities that focus on ethical decision-making, such as resolving boundary disputes or handling conflicts of interest during a survey. ○ Discuss the **ethical responsibilities** of cadastral surveyors in relation to accuracy, impartiality, confidentiality, and legal compliance. ○ Explore case studies involving ethical dilemmas, where students discuss and propose solutions based on professional and legal standards. **10. Real-World Applications and Capstone Project** • **Objective**: Provide students with an opportunity to apply all learned skills in a final project that simulates real-world cadastral surveying. • **Strategy**: ○ Assign a **capstone project** where students conduct a full cadastral survey, including legal research, boundary analysis, fieldwork, and map production. ○ The project could involve creating a comprehensive survey report, addressing boundary disputes, and designing land registration documents for a fictional or real property. ○ **Mentorship**: Pair students with industry professionals to guide them through the process of completing the capstone project, ensuring they receive expert feedback.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**125**		

Module Evaluation تقييم المادة الدراسية					
As		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	0	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	Midterm Exam	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Application of intersection
Week 2	Application of intersection
Week 3	Division area to different part
Week 4	Division area to different part
Week 5	Division area to same part
Week 6	Division area to same part
Week 7	Division area from inner point
Week 8	Convert the zigzag circumference to straight line
Week 9	Convert the zigzag circumference to straight line
Week 10	Intersection II using analytical Engineering
Week 11	Intersection II using analytical Engineering
Week 12	Intersection II using analytical Engineering
Week 13	Intersection II using analytical Engineering
Week 14	Intersection II using analytical Engineering
Week 15	Intersection II using analytical Engineering
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

Week	Material Covered
Week 1	Example for application of intersection
Week 2	Example for application of intersection
Week 3	Example for division area to different part
Week 4	Example for division area to different part
Week 5	Example for division area to same part
Week 6	Example for division area to same part
Week 7	Example for division area from inner point
Week 8	Example for division area from inner point
Week 9	Example for convert the zigzag circumference to straight line
Week 10	Example for convert the zigzag circumference to straight line
Week 11	Example for convert the zigzag circumference to straight line
Week 12	Example for project for division area
Week 13	Example for project for division area
Week 14	Example for project for division area
Week 15	Example for project for division area

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts		Yes
Recommended Texts		No
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	Geotechnic			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 313**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level				**Semester of Delivery**	1
Administering Department				**College**	Type College Code
Module Leader	Mohammed Tareq Khaleel			**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Lecturer			**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)			**e-mail**	E-mail
Peer Reviewer Name	Name			**e-mail**	E-mail
Scientific Committee Approval Date				**Version Number**	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective of studying "Geotechnics" topics is to provide individuals with the knowledge and skills necessary to understand and analyze the behavior of soils and rocks in engineering

	applications. Geotechnics is a branch of civil engineering that deals with the study of soil mechanics, rock mechanics, and their applications in geotechnical engineering projects. Overall, the objective of studying geotechnic topics is to equip individuals with the knowledge and skills necessary to analyze, design, and manage geotechnical aspects of engineering projects. By understanding the behavior of soil and rock materials, engineers can ensure the stability, safety, and sustainability of infrastructure and construction works.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Fundamentals of Geotechnics** • **Learning Outcome: Demonstrate an understanding of the fundamental principles of geotechnics, including soil mechanics, soil classification, and the behavior of soils under various conditions.** ○ **Indicator: Students will be able to explain the basic concepts of soil types, soil properties, and the role of geotechnics in civil engineering projects.** --- **2. Apply Soil Mechanics to Geotechnical Problems** • **Learning Outcome: Apply the principles of soil mechanics to analyze and solve geotechnical problems related to soil behavior under load.** ○ **Indicator: Students will be able to perform basic soil tests (e.g., grain size distribution, Atterberg limits) and interpret the results for practical applications like foundation design and slope stability analysis.** --- **3. Understand Soil Classification and Testing Methods** • **Learning Outcome: Understand and apply soil classification systems and testing methods used in geotechnical engineering to determine the properties of soils.** ○ **Indicator: Students will be able to classify different soil types based on standard testing methods (e.g., Unified Soil Classification System) and interpret test results (e.g., shear strength, compaction, permeability).** --- **4. Analyze Soil Behavior Under Load** • **Learning Outcome: Analyze the behavior of soils under various load conditions, including the principles of consolidation, settlement, and shear strength.** ○ **Indicator: Students will be able to calculate soil settlement due to applied loads and understand the influence of soil type, moisture content, and compaction on soil strength and stability.** --- **5. Design Geotechnical Structures and Foundations** • **Learning Outcome: Apply geotechnical knowledge to design foundations and other geotechnical structures, ensuring they are safe, stable, and cost-effective.** ○ **Indicator: Students will be able to design simple shallow and deep foundations (e.g., footings, piles) based on soil properties and loading conditions.** --- **6. Understand Slope Stability and Earth Retention Systems** • **Learning Outcome: Understand and assess the stability of slopes and earth retention systems (e.g., retaining walls, embankments).**

	○ **Indicator: Students will be able to evaluate the stability of slopes using limit equilibrium methods and design appropriate earth retention systems for specific site conditions.** --- **7. Use Geotechnical Software and Tools** • **Learning Outcome: Use geotechnical software and tools to model and analyze soil behavior, foundation performance, and other geotechnical design aspects.** ○ **Indicator: Students will be able to use industry-standard software (e.g., PLAXIS, GeoStudio) to perform geotechnical analyses such as settlement calculations, slope stability analysis, and foundation design.** --- **8. Conduct Geotechnical Site Investigations** • **Learning Outcome: Conduct geotechnical site investigations to collect soil samples and analyze field data for use in design and construction.** ○ **Indicator: Students will be able to plan and execute a basic site investigation, including drilling boreholes, performing in-situ tests (e.g., Standard Penetration Test), and interpreting the results for soil properties and design recommendations.** --- **9. Understand the Impact of Groundwater on Geotechnical Designs** • **Learning Outcome: Comprehend the effects of groundwater on soil behavior and geotechnical structures, including the principles of seepage, effective stress, and groundwater control in construction projects.** ○ **Indicator: Students will be able to assess the impact of groundwater on foundation design, slope stability, and soil settlement, and design drainage systems to mitigate groundwater-related issues.** --- **10. Integrate Geotechnical Principles with Other Civil Engineering Disciplines** • **Learning Outcome: Integrate geotechnical principles with other civil engineering disciplines such as structural engineering, transportation, and environmental engineering to deliver comprehensive design solutions.** ○ **Indicator: Students will be able to collaborate on multidisciplinary projects, ensuring that geotechnical considerations are integrated with structural and environmental aspects of design.** --- **11. Recognize Environmental and Sustainability Issues in Geotechnics** • **Learning Outcome: Understand and evaluate the environmental impact of geotechnical projects and incorporate sustainability principles in geotechnical design.** ○ **Indicator: Students will be able to identify environmental risks (e.g., soil contamination, groundwater pollution) and propose sustainable geotechnical solutions (e.g., green foundations, earth retention systems) that minimize environmental impact.** --- **12. Communicate Geotechnical Information Effectively**

	• **Learning Outcome: Communicate geotechnical analysis and design information clearly and professionally, both in written and oral formats.** ○ **Indicator: Students will be able to prepare detailed geotechnical reports and present their findings and recommendations to technical and non-technical stakeholders.**
Indicative Contents المحتويات الإرشادية	**1. Introduction to Geotechnics** • **Overview of Geotechnics**: ○ Definition and scope of geotechnics in civil engineering. ○ Importance of geotechnical engineering in infrastructure projects. • **Historical Development of Geotechnics**: ○ Key milestones in the development of geotechnical engineering principles and practices. • **Applications of Geotechnics**: ○ Examples of geotechnical applications such as foundation design, slope stability, and tunneling. --- **2. Soil Properties and Classification** • **Basic Soil Properties**: ○ Soil composition and structure: minerals, particles, and pore spaces. ○ Classification of soil: particle size, consistency limits (Atterberg limits), and compaction. • **Soil Classification Systems**: ○ Unified Soil Classification System (USCS). ○ AASHTO Soil Classification System. • **Soil Testing and Properties**: ○ Grain size distribution (sieve analysis). ○ Atterberg limits: Liquid limit, plastic limit, shrinkage limit. ○ Compaction tests (e.g., Proctor test, Standard and Modified Proctor tests). --- **3. Soil Mechanics and Behavior** • **Shear Strength of Soils**: ○ Mohr-Coulomb theory of shear strength. ○ Direct shear test, triaxial test, and unconfined compression test. • **Consolidation and Settlement**: ○ Principles of soil consolidation (Terzaghi's theory). ○ One-dimensional consolidation and settlement analysis. • **Permeability and Seepage**: ○ Darcy's Law and permeability tests (e.g., falling head and constant head permeability tests). ○ Soil seepage analysis and the effect of groundwater on soil behavior. ---

	4. Soil Stress and Effective Stress Principle • **Effective Stress**: ○ Definition and significance of effective stress in soils (Terzaghi's principle). • **Stress Distribution in Soils**: ○ Boussinesq's theory of stress distribution beneath loaded areas. ○ Influence of soil properties and external loading conditions. • **Vertical and Lateral Stress in Soils**: ○ Calculation of vertical stresses using point loads and uniform load distribution. ○ Stress distribution under different loading scenarios. <hr> **5. Geotechnical Site Investigation** • **Site Investigation Process**: ○ Importance of site investigations in geotechnical design. ○ Steps in site investigation: reconnaissance, soil sampling, field testing, and laboratory testing. • **Field Testing Methods**: ○ Standard Penetration Test (SPT), Cone Penetration Test (CPT), and vane shear test. ○ Borehole drilling and soil sampling methods. • **Laboratory Testing Methods**: ○ Testing of soil samples: compaction, permeability, consolidation, and shear strength tests. ○ Geotechnical laboratory equipment and procedures. <hr> **6. Foundation Design** • **Shallow Foundations**: ○ Types of shallow foundations: spread footings, slab-on-grade, and mat foundations. ○ Design principles for shallow foundations: bearing capacity, settlement analysis, and safety factors. ○ Load transfer mechanisms and design considerations for various soil types. • **Deep Foundations**: ○ Types of deep foundations: piles (end-bearing, friction, and combination piles). ○ Design of piles: pile load test, settlement prediction, and pile group analysis. • **Foundation Settlement**: ○ Methods for calculating settlement under different loading conditions. ○ Consolidation settlement in cohesive soils. ○ Immediate settlement in granular soils. <hr> **7. Slope Stability Analysis** • **Soil Mass Behavior in Slopes**:

- Types of slope failure: rotational failure, translational failure, and toppling.
- Factors affecting slope stability: soil properties, groundwater, and external forces.

- **Methods of Slope Stability Analysis**:
  - Limit equilibrium methods (e.g., Bishop's Method, Janbu Method).
  - Factor of safety and its interpretation.
- **Slope Stabilization**:
  - Methods of slope stabilization: drainage, reinforcement, retaining structures, and vegetation.

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8. Soil-Structure Interaction

- **Soil-Foundation Interaction**:
  - Interaction between soil and structural foundations under dynamic and static loads.
  - Effects of soil flexibility on the behavior of foundations.
- **Dynamic Soil Behavior**:
  - Soil response to dynamic loading: earthquakes, machine vibrations, and traffic loads.
  - Methods to evaluate soil dynamic properties and their influence on foundation design.

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9. Ground Improvement Techniques

- **Methods of Ground Improvement**:
  - Techniques for improving soil properties: soil compaction, vibrocompaction, soil stabilization, and grouting.
- **Ground Improvement for Foundations**:
  - Use of geosynthetics, soil nailing, and deep mixing techniques to improve soil behavior for construction purposes.
- **Geotechnical Aspects of Environmental Engineering**:
  - Applications in landfills, waste containment, and soil remediation.

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10. Earth Retention Systems

- **Retaining Walls**:
  - Types of retaining walls: gravity, cantilever, counterfort, anchored, and mechanically stabilized earth walls.
  - Design principles and stability considerations for retaining walls.
- **Sheet Piling and Soil Nailing**:
  - Use of sheet piles for lateral support and excavation safety.
  - Soil nailing for slope stabilization and excavation support.
- **Anchored Systems and Ground Anchors**:
  - Design and applications of ground anchors and tiebacks in retaining structures.

11. Geotechnical Risk and Safety Management

- **Geotechnical Hazards**:
  - Common geotechnical hazards: landslides, soil liquefaction, settlement, and foundation failure.
- **Risk Assessment in Geotechnical Design**:
  - Methods for assessing and managing risk in geotechnical engineering projects.
  - Reliability-based design and probabilistic methods for safety in geotechnical engineering.
- **Geotechnical Safety and Environmental Impact**:
  - Considerations for the safety of workers and the public in geotechnical projects.
  - Environmental considerations in geotechnical design, including erosion, groundwater contamination, and the impact of construction on local ecosystems.

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12. Modern Trends and Technologies in Geotechnics

- **Geotechnical Software and Tools**:
  - Introduction to modern software used in geotechnical analysis and design (e.g., PLAXIS, GeoStudio, Slope/W).
- **Geotechnical Data Acquisition**:
  - Use of remote sensing, drones, and geophysical methods (e.g., seismic, resistivity, and ground penetrating radar) in geotechnical investigations.
- **Sustainable Geotechnical Practices**:
  - Green geotechnics: minimizing environmental impact through the use of sustainable materials, techniques, and practices.

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13. Case Studies in Geotechnics

- **Real-World Case Studies**:
  - Review of significant geotechnical engineering projects (e.g., dams, tunnels, skyscrapers) and the challenges faced during their design and construction.
- **Lessons Learned from Geotechnical Failures**:
  - Analysis of major geotechnical failures, their causes, and the lessons learned for future projects.
- **Geotechnical Engineering in Developing Regions**:
  - Special challenges and opportunities for geotechnical engineering in developing countries, including issues of soil variability, construction materials, and resource limitations.

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم	
Strategies	**1. Lectures and Theoretical Instruction** • **Purpose**: Provide students with a solid understanding of core geotechnical principles, concepts, and theories. • **Approach**: ○ Use structured lectures to explain key concepts in soil mechanics, foundation design, and soil testing. ○ Include visual aids such as diagrams, animations, and videos to illustrate complex soil behaviors and testing methods. ○ Provide real-world examples and case studies to link theory to practice. --- **2. Practical Laboratory Sessions** • **Purpose**: Allow students to conduct hands-on experiments to deepen their understanding of soil properties and behavior. • **Approach**: ○ Organize laboratory experiments on soil classification (e.g., sieve analysis, Atterberg limits), shear strength, compaction, and consolidation tests. ○ Ensure students gain familiarity with lab equipment, protocols, and data interpretation. ○ Encourage students to analyze lab results and draw conclusions based on their observations, promoting problem-solving skills. --- **3. Field Visits and Site Investigations** • **Purpose**: Provide students with exposure to real-world geotechnical engineering projects and the site investigation process. • **Approach**: ○ Arrange site visits to construction projects, where students can observe geotechnical practices in action (e.g., soil sampling, borehole drilling, field tests like Standard Penetration Test (SPT)). ○ Engage students in discussions with professionals working in the field to learn about the challenges and techniques involved in site investigations. ○ Have students prepare reports or presentations on their observations, encouraging critical thinking and report-writing skills. --- **4. Problem-Based Learning (PBL)** • **Purpose**: Encourage students to apply theoretical knowledge to solve real-world geotechnical problems. • **Approach**:

	○ Present case studies or hypothetical scenarios that require students to analyze soil data, perform design calculations, or propose solutions to common geotechnical issues (e.g., foundation failure, slope stability). ○ Assign group-based projects to foster teamwork and collaboration, where students can work together to solve complex problems. ○ Provide structured guidance, but encourage independent problem-solving, fostering the development of critical thinking and practical skills. --- **5. Collaborative Learning and Group Work** • **Purpose**: Promote teamwork and communication skills while solving geotechnical problems. • **Approach**: ○ Assign group tasks such as designing a foundation system or conducting a slope stability analysis based on a set of parameters and site data. ○ Encourage peer-to-peer teaching, where students with a better understanding of specific topics can support others. ○ Use group discussions to assess different approaches to solving a problem, helping students learn diverse perspectives and solutions. --- **6. Use of Software Tools and Simulations** • **Purpose**: Familiarize students with industry-standard software used in geotechnical design and analysis. • **Approach**: ○ Provide training on geotechnical software (e.g., PLAXIS, GeoStudio, Slope/W) to help students perform complex analyses like settlement calculations, slope stability assessments, and foundation design. ○ Use simulations and virtual labs to demonstrate how changes in soil properties (e.g., shear strength, consolidation) can affect geotechnical design outcomes. ○ Encourage students to solve problems using these tools, with an emphasis on interpreting results and integrating them into their overall design process. --- **7. Interactive Workshops and Seminars** • **Purpose**: Facilitate in-depth discussion on complex topics and enhance students' understanding of the latest geotechnical trends. • **Approach**: ○ Organize workshops on specific geotechnical topics like advanced foundation design, soil-structure interaction, or geotechnical earthquake engineering. ○ Invite guest speakers and industry experts to present recent advancements in geotechnics and share real-world experiences with students.

	○ Encourage students to ask questions and participate in interactive discussions to deepen their understanding of current practices and emerging technologies. --- **8. Independent Study and Research Projects** • **Purpose**: Foster independent learning and critical research skills. • **Approach**: ○ Assign individual projects where students must research specific geotechnical issues or conduct a detailed study on topics such as soil behavior under dynamic loading or geotechnical site investigation methods. ○ Encourage students to review scientific papers, case studies, and technical reports to gather information and support their analysis. ○ Support students in developing their writing and presentation skills by requiring them to prepare research reports or presentations based on their findings. --- **9. Online Learning Resources and Self-Directed Learning** • **Purpose**: Supplement traditional teaching with online resources and encourage self-directed learning. • **Approach**: ○ Provide access to online resources such as recorded lectures, textbooks, research papers, and relevant websites. ○ Encourage students to use online geotechnical databases, simulation software, and forums to enhance their understanding and engage with global research trends. ○ Assign short self-assessment quizzes and reflective activities to help students track their progress and consolidate their learning. --- **10. Continuous Assessment and Feedback** • **Purpose**: Provide ongoing assessment and feedback to guide students in their learning journey. • **Approach**: ○ Use a combination of quizzes, assignments, and presentations to assess students' understanding of key geotechnical concepts. ○ Provide detailed feedback on assignments, laboratory reports, and project work, focusing on areas of improvement and encouraging students to apply feedback to future tasks. ○ Incorporate peer assessments, where students evaluate each other's work and provide constructive feedback, fostering a collaborative learning environment. --- **11. Industry Collaboration and Internships** • **Purpose**: Bridge the gap between academic learning and industry practice.

	• **Approach**: ○ Establish partnerships with geotechnical engineering firms to offer students internships or field placements, where they can gain practical experience working on live projects. ○ Organize networking events, job fairs, and guest lectures by professionals in the geotechnical field to help students connect with industry experts. ○ Encourage students to participate in industry conferences, workshops, or research collaborations to gain exposure to current geotechnical practices.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل		**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Basic engineering properties of soil

Week 2	Basic engineering properties of soil
Week 3	Soil investigation and classification
Week 4	Soil investigation and classification
Week 5	Soil condition in the field
Week 6	Soil condition in the field
Week 7	Soil for highway construction
Week 8	Soil for highway construction
Week 9	Soil stabilization, Introduction and background
Week 10	Soil stabilization, Introduction and background
Week 11	Introduction to rock mechanics
Week 12	Introduction to rock mechanics
Week 13	Index properties and rock classification
Week 14	Index properties and rock classification
Week 15	Strength and deformation property of rock

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

Week	**Material Covered**
Week 1	N/A
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		Yes

Websites	

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	GEODESY 2			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 314**				
ECTS Credits	**3**				
SWL (hr/sem)	75				
Module Level		**Semester of Delivery**		1	
Administering Department		**College**		Type College Code	
Module Leader	Mohammed Tareq Khaleel	**e-mail**		Mohammed.alsafaawe@ntu.edu.iq	
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**		Ph.D.	
Module Tutor	Name (if available)	**e-mail**		E-mail	
Peer Reviewer Name	Name	**e-mail**		E-mail	
Scientific Committee Approval Date		**Version Number**		1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Objectives أهداف المادة الدراسية	The objective is to provide individuals with the knowledge and skills necessary to understand and analyze the Earth's shape, size, and gravitational field. Geodesy is the science that deals with the measurement and representation of the Earth's surface, its gravity field, and its orientation in space. Overall, the objective of studying geodesy topics is to equip individuals with the knowledge and skills to accurately measure, represent, and understand Earth's shape, gravity field, and spatial positioning. Geodesy plays a crucial role in various applications, including navigation, mapping, geosciences, and geospatial sciences.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Fundamentals of Geodesy** • **Learning Outcome: Demonstrate a comprehensive understanding of the basic principles and concepts of geodesy, including the Earth's shape, size, and gravitational field.** ○ **Indicator: Students will be able to explain the Earth's physical properties (e.g., geoid, ellipsoid) and describe how geodesy relates to other geospatial sciences.** **2. Apply Geodetic Datums and Coordinate Systems** • **Learning Outcome: Understand and apply various geodetic datums, reference systems, and coordinate systems used in geospatial measurements.** ○ **Indicator: Students will be able to convert between different geodetic coordinate systems (e.g., geodetic, Cartesian, UTM) and understand the use of global positioning systems (GPS) in geodesy.** **3. Perform Geodetic Measurements and Surveys** • **Learning Outcome: Demonstrate proficiency in using geodetic measurement techniques, including leveling, triangulation, and GPS, for accurate surveying and mapping.** ○ **Indicator: Students will be able to conduct field surveys using appropriate geodetic equipment and techniques, and accurately measure distances, angles, and elevations.** **4. Understand Geodetic Errors and Adjustments** • **Learning Outcome: Identify and manage sources of error in geodetic measurements and apply adjustment techniques to improve the accuracy of survey data.** ○ **Indicator: Students will be able to calculate and mitigate common errors in geodetic measurements, including instrumental, observational, and environmental errors, and apply adjustment methods like least squares to refine data.** **5. Apply Modern Geodetic Technologies** • **Learning Outcome: Utilize modern geodetic technologies such as GPS, satellite-based systems, and remote sensing for geospatial analysis and monitoring.** ○ **Indicator: Students will demonstrate how to use GPS data for precise location determination and apply remote sensing technologies for geospatial mapping and analysis.**

	6. Understand the Earth's Gravitational Field and Geoid • **Learning Outcome: Comprehend the Earth's gravitational field, geoid, and the significance of geoid undulations in accurate height measurements.** ○ **Indicator: Students will explain the concepts of geoid, ellipsoid, and gravity anomalies and describe how these affect geodetic height determination and positioning.** **7. Analyze Geodetic Data for Mapping and Navigation** • **Learning Outcome: Analyze geodetic data to support the creation of accurate maps, navigation systems, and geospatial models.** ○ **Indicator: Students will be able to process geodetic data for map production, land boundary determination, and navigation applications, including error analysis.** **8. Understand Global Positioning Systems (GPS) and GNSS** • **Learning Outcome: Gain in-depth knowledge of Global Navigation Satellite Systems (GNSS) and their application in geodesy for positioning, surveying, and monitoring.** ○ **Indicator: Students will be able to explain how GPS and other GNSS systems work, and how they are used in geodesy for precise location determination, including concepts such as differential GPS (DGPS) and real-time kinematic (RTK) systems.** **9. Apply Geodetic Techniques to Environmental and Geophysical Studies** • **Learning Outcome: Apply geodetic techniques to environmental monitoring, natural hazard analysis, and geophysical investigations.** ○ **Indicator: Students will demonstrate how geodetic measurements are used in monitoring tectonic plate movements, subsidence, sea level rise, and other environmental and geophysical phenomena.** **10. Interpret and Present Geodetic Data** • **Learning Outcome: Present geodetic analysis results and data effectively to a range of audiences using appropriate visualizations and reporting techniques.** ○ **Indicator: Students will be able to create accurate visual representations of geodetic data, including maps, charts, and 3D models, and communicate the findings in clear, professional reports.** **11. Understand the Legal and Ethical Implications of Geodesy** • **Learning Outcome: Recognize the legal and ethical issues associated with geodetic surveys, including land ownership, privacy, and environmental impacts.** ○ **Indicator: Students will be able to discuss the legal aspects of geodesy, including issues related to surveying land boundaries, rights of way, and privacy in the**

	context of GPS and satellite data collection. --- **12. Integrate Geodesy with Other Disciplines** • **Learning Outcome: Integrate geodesy with other geospatial disciplines such as cartography, GIS (Geographic Information Systems), and remote sensing.** ○ **Indicator: Students will demonstrate an understanding of how geodesy supports GIS, remote sensing, and cartography in creating accurate geospatial data for various applications, from urban planning to environmental management.**
Indicative Contents المحتويات الإرشادية	**Introduction to Geodesy** • **Definition and Scope of Geodesy**: ○ Overview of geodesy as the science of measuring and understanding Earth's geometric shape, orientation, and gravitational field. ○ Historical development of geodesy and its importance in navigation, surveying, and Earth sciences. • **Applications of Geodesy**: ○ Uses in mapping, land surveying, navigation, satellite positioning, and environmental monitoring. --- **2. The Earth's Shape and Size** • **Ellipsoid and Geoid**: ○ The concept of the reference ellipsoid as a model of Earth's shape. ○ The geoid as the equipotential surface of Earth's gravity field and its relationship to the ellipsoid. • **Earth's Dimensions**: ○ Determination of Earth's size, radius, and circumference using geodetic methods. • **Geodetic and Astronomical Coordinates**: ○ Conversion between astronomical and geodetic coordinates. --- **3. Geodetic Datums and Coordinate Systems** • **Geodetic Datums**: ○ Definition and role of geodetic datums in geodesy. ○ Common geodetic datums (e.g., WGS84, NAD83, ED50) and their application in different regions. • **Coordinate Systems**: ○ Introduction to global (e.g., GPS-based) and local coordinate systems. ○ UTM (Universal Transverse Mercator) and local geodetic coordinate systems. • **Datum Transformations**: ○ Methods of transforming coordinates from one datum to another.

4. Geodetic Measurement Techniques

- **Surveying and Measurement Methods**:
  - Basic geodetic measurement methods: angular measurement, distance measurement, and elevation measurement.
  - Use of **total stations**, **theodolites**, **levels**, and **tape** in traditional geodetic surveys.
- **Triangulation and Trilateration**:
  - Principles and applications of triangulation and trilateration in geodesy.
  - Methods for establishing control points and networks.
- **Geodetic Leveling**:
  - Differential leveling techniques to determine height differences over large areas.
  - Accuracy considerations and corrections in leveling measurements.

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5. Global Navigation Satellite Systems (GNSS)

- **Overview of GNSS**:
  - Introduction to satellite navigation systems such as GPS, GLONASS, Galileo, and BeiDou.
  - Working principles of GNSS systems: satellite orbits, signal propagation, and receivers.
- **GNSS Positioning Techniques**:
  - **Code-based** and **carrier-phase** positioning techniques.
  - Real-time kinematic (RTK) positioning and differential GNSS (DGPS).
- **GNSS Error Sources**:
  - Understanding errors in GNSS data: multipath, atmospheric delays, satellite geometry, and clock errors.
  - Techniques to mitigate errors in GNSS measurements.

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6. Geoid and Gravity Field

- **Gravitational Field of the Earth**:
  - The Earth's gravitational anomalies and how they affect geodesic measurements.
  - The relationship between the Earth's gravity field and the geoid.
- **Geoid Determination**:
  - Techniques for determining the geoid through gravimetric surveys and satellite altimetry.
  - The role of the geoid in precise height determination.
- **Gravity Measurements**:
  - Methods and equipment used in gravity surveys (e.g., gravimeters).
  - Applications of gravity measurements in geodesy and geophysics.

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7. Geodetic Surveying Equipment and Techniques

- **Traditional Surveying Instruments**:
  - Theodolites, levels, and total stations used in terrestrial geodetic surveys.
  - Electronic Distance Measurement (EDM) and its principles.
- **Modern Surveying Instruments**:
  - The role of GPS receivers, GNSS instruments, and other electronic tools in geodesy.
- **Data Collection and Processing**:
  - Methods for collecting and processing geodetic data in the field.
  - Use of software tools for data analysis and adjustment (e.g., AutoCAD, Leica Geo Office).

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8. Geodetic Data Adjustments and Error Analysis

- **Error Sources in Geodesy**:
  - Types of errors in geodetic measurements: instrumental, observational, and environmental.
- **Least Squares Adjustment**:
  - Introduction to the least squares method for adjusting geodetic networks.
  - Applications in triangulation and leveling networks.
- **Error Propagation and Precision**:
  - Methods for estimating the accuracy and precision of geodetic measurements.

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9. Geodesy in Mapping and Cartography

- **Geodetic Data in Cartography**:
  - How geodetic data is used to produce accurate maps and charts.
- **Map Projections**:
  - Different map projections (e.g., Mercator, Lambert Conformal Conic) and their application in geodesy.
  - Distortions and corrections in map projections.
- **Topographic and Cadastral Surveys**:
  - Applications of geodesy in topographic mapping and land surveying.

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10. Remote Sensing and Geodesy

- **Remote Sensing Technologies**:
  - The role of remote sensing in geodesy, including the use of satellite imagery, LiDAR, and radar.
- **Integration of Remote Sensing and Geodesy**:
  - Using remote sensing data to enhance geodetic measurements and geospatial modeling.
- **Applications in Monitoring**:
  - Use of geodesy and remote sensing in monitoring land subsidence, sea level

	rise, and tectonic plate movements. --- **11. Geodesy for Environmental and Engineering Applications** • **Geodesy in Environmental Monitoring**: ○ Application of geodetic techniques for tracking changes in Earth's surface (e.g., land subsidence, coastal erosion). • **Geodesy in Engineering Projects**: ○ The role of geodesy in large infrastructure projects (e.g., dam construction, tunneling, highway design). • **Monitoring Natural Disasters**: ○ Using geodesy to monitor earthquakes, volcanic activity, and landslides. --- **12. Future Trends and Innovations in Geodesy** • **Advancements in Geodesy**: ○ The role of emerging technologies like autonomous systems, UAVs (drones), and machine learning in advancing geodesy. • **Space Geodesy**: ○ The increasing role of satellite-based geodesy (e.g., GPS, GLONASS, Galileo) and space-based Earth observation systems. • **Geodesy and Climate Change**: ○ The application of geodesy in studying climate change impacts, such as sea level rise and glacial melting. --- **13. Practical Applications and Case Studies** • **Case Studies in Geodesy**: ○ Real-world applications of geodesy in surveying, environmental monitoring, and geospatial analysis. ○ Review of case studies demonstrating the successful application of geodesy in various industries and research fields.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**Interactive Lectures** • **Objective**: Provide foundational knowledge on geodesy principles, theories, and techniques. • **Strategy**: ○ Deliver **interactive lectures** using visuals such as diagrams, animations, and

videos to explain complex concepts like geoid, ellipsoid, and coordinate systems.

o Integrate **real-time polling** or quizzes (e.g., using tools like Kahoot or Mentimeter) during lectures to test comprehension and encourage active participation.

o Use **problem-solving exercises** during lectures to demonstrate the application of theories (e.g., geodetic coordinate transformations or error analysis).

o Engage students in short discussions to connect the lecture material to real-world applications in surveying, mapping, and satellite systems.

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2. Practical Demonstrations and Hands-On Activities

- **Objective**: Develop students' technical skills in geodetic measurement techniques and technology usage.
- **Strategy**:

o Conduct **laboratory sessions** where students use geodetic tools such as total stations, GPS receivers, and levels to measure distances, angles, and elevations.

o Set up **field trips** to allow students to participate in actual geodetic surveys, observing real-world applications of triangulation, leveling, and GNSS.

o Demonstrate the use of **software tools** (e.g., AutoCAD, ArcGIS) for geodetic data processing, creating maps, and adjusting survey data. Provide opportunities for students to complete hands-on exercises using these tools.

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3. Problem-Based Learning (PBL)

- **Objective**: Encourage critical thinking and application of geodetic principles to solve real-world problems.
- **Strategy**:

o Present students with **real-world scenarios** such as a land boundary survey, environmental monitoring of subsidence, or GPS-based navigation challenges.

o Assign **group projects** where students research, plan, and simulate geodetic surveys or mapping projects using GNSS and traditional geodetic methods.

o Encourage students to explore **alternative methods** for solving geodetic problems, fostering collaboration, critical thinking, and innovation.

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4. Case Studies and Real-World Applications

- **Objective**: Show how geodesy is applied in various fields and industries.
- **Strategy**:

o Present **case studies** demonstrating the application of geodesy in fields such as environmental monitoring, civil engineering, agriculture, and disaster management.

o Invite guest speakers from industries (e.g., surveying, urban planning, or remote sensing) to provide **insights into how geodesy is used in practice**.

	○ Organize **site visits** to infrastructure projects or agencies that rely on geodesy for accurate mapping, such as land surveyors or satellite monitoring stations. --- **5. Collaborative and Group Learning** • **Objective**: Develop teamwork, communication, and problem-solving skills. • **Strategy**: ○ Use **group discussions** and activities to explore specific topics such as geodetic datum transformation, satellite systems, or geoid determination. ○ Facilitate **peer teaching** exercises where students explain key concepts (e.g., leveling methods, geodetic corrections) to each other, reinforcing their understanding. ○ Organize **team-based practical exercises** for data collection, analysis, and the presentation of results, where each group handles a different geodetic technique. --- **6. Blended Learning and Digital Tools** • **Objective**: Enhance learning flexibility and integrate modern technologies into geodesy education. • **Strategy**: ○ Combine **online resources** such as instructional videos, readings, and interactive simulations with in-person learning for a flexible, blended learning approach. ○ Use **online platforms** (e.g., Moodle, Blackboard) to provide learning materials, assignments, and forums for student discussions on topics like geodetic adjustment or satellite navigation systems. ○ Introduce **virtual labs or simulations** where students can virtually practice geodetic measurements or simulate GNSS-based positioning without requiring physical equipment. --- **7. Flipped Classroom Approach** • **Objective**: Encourage independent learning and deeper understanding of geodetic concepts. • **Strategy**: ○ Assign students preparatory work such as watching videos or reading articles about specific geodesy topics (e.g., GNSS technology, the geoid, or coordinate systems) before class. ○ Use **in-class time** for solving practical problems, case discussions, and hands-on activities where students apply their understanding. ○ Promote **active engagement** during class through collaborative exercises or by addressing misconceptions and questions raised by students from their preparatory work. --- **8. Fieldwork and Practical Surveys** • **Objective**: Provide students with real-world surveying and geodetic measurement

experience.

- **Strategy**:

  - Organize **fieldwork trips** where students can perform geodetic surveys using a variety of instruments (e.g., theodolites, GNSS receivers, and levels) to measure angles, distances, and elevations.

  - Assign **data collection exercises**, where students work in groups to gather geodetic data in the field, then analyze and present the data back in class.

  - Conduct **geodetic mapping activities** in different terrains to assess how environmental conditions affect measurement techniques (e.g., surveying in mountainous regions or near large bodies of water).

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9. Assessment and Feedback

- **Objective**: Assess student learning, providing opportunities for reflection and improvement.

- **Strategy**:

  - Use **formative assessments** such as quizzes, problem sets, and practical exercises to monitor student progress and provide continuous feedback on their understanding.

  - Provide **summative assessments** that require students to analyze and apply geodetic techniques in a comprehensive manner, such as solving complex survey problems, producing a geodetic report, or designing a GPS-based survey project.

  - Offer detailed **feedback** on both the technical aspects of geodetic measurements and the clarity of students' explanations, interpretations, and data presentation.

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10. Guest Lectures and Industry Collaboration

- **Objective**: Expose students to professional practices and innovations in geodesy.

- **Strategy**:

  - Invite **professionals and experts** from geodesy-related industries (e.g., surveying companies, GPS technology firms, or research institutions) to give guest lectures on the latest developments and applications of geodesy.

  - Provide opportunities for **industry collaboration** where students can participate in projects or internships related to geodesy, allowing them to apply their academic knowledge in professional settings.

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11. Reflection and Self-Assessment

- **Objective**: Promote continuous learning and self-improvement.

- **Strategy**:

  - Encourage students to maintain a **learning journal** where they reflect on their understanding of geodetic principles, practical skills, and challenges encountered during fieldwork and exercises.

	○ Organize **self-assessment activities** where students review their performance in practical tasks, surveys, and assignments, identifying areas of strength and areas for improvement. ○ Use **peer review** processes where students assess each other's work on geodetic assignments, promoting collaborative learning and self-reflection.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل		**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**75**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Astronomical triangle Laws used to find the elements of the astronomical triangle.
Week 2	Astronomical triangle Laws used to find the elements of the astronomical triangle.
Week 3	Methods: Equations used to find the height of a star and the circular direction of that star
Week 4	Methods: Equations used to find the height of a star and the circular direction of that star
Week 5	Finding the direction and locations of objects, points, and beams on the surface of the earth based on known star locations

	using observations and astronomical calculations
Week 6	Finding the direction and locations of objects, points, and beams on the surface of the earth based on known star locations using observations and astronomical calculations
Week 7	Give an overview of the reference shape of the Earth's ellipse, the elements of the ellipse and the equations used to find those elements. And study the types of surfaces of the oval references for the countries of the world
Week 8	Give an overview of the reference shape of the Earth's ellipse, the elements of the ellipse and the equations used to find those elements. And study the types of surfaces of the oval references for the countries of the world
Week 9	Geodetic coordinate systems on the ellipse (geographical and Cartesian geodetic coordinates) and the relationship between the two systems
Week 10	Geodetic coordinate systems on the ellipse (geographical and Cartesian geodetic coordinates) and the relationship between the two systems
Week 11	The radii of convexity on an ellipse
Week 12	The radii of convexity on an ellipse
Week 13	The relationship between geodetic and astronomical coordinate systems. Methods of calculating and extracting the elements of vertical deviation (ξ,η)
Week 14	The relationship between geodetic and astronomical coordinate systems. Methods of calculating and extracting the elements of vertical deviation (ξ,η)
Week 15	Using Laplace's equations and their applications in astronomical and geodetic surveys

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

Week	**Material Covered**
Week 1	Solve problems about finding the elements of the astronomical triangle
Week 2	Solve problems about finding the elements of the astronomical triangle
Week 3	Solve problems about finding the height of a star and the circular direction of that star
Week 4	Solve problems about finding the height of a star and the circular direction of that star
Week 5	Solving problems about finding the direction and locations of objects, points, and beams on the Earth's surface based on known star positions using astronomical observations and calculations
Week 6	Solving problems about finding the direction and locations of objects, points, and beams on the Earth's surface based on known star positions using astronomical observations and calculations
Week 7	Solve problems about finding the elements of the ellipse used as a reference for Iraq (Clark 1880) and the ellipse (WGS84
Week 8	Solve problems about finding the elements of the ellipse used as a reference for Iraq (Clark 1880) and the ellipse (WGS84
Week 9	Solve problems about geodetic coordinate systems on the ellipse (geographical and Cartesian geodetic coordinates) and the relationship between the two systems.
Week 10	Solve problems about geodetic coordinate systems on the ellipse (geographical and Cartesian geodetic

	coordinates) and the relationship between the two systems.
Week 11	Solve problems about the radii of convexity on an ellipse
Week 12	Solve problems about the radii of convexity on an ellipse
Week 13	Solve problems about the relationship between geodetic and astronomical coordinate systems. Methods of calculating and extracting the elements of vertical deviation (ξ,η
Week 14	Solve problems about the relationship between geodetic and astronomical coordinate systems. Methods of calculating and extracting the elements of vertical deviation (ξ,η
Week 15	Solve problems about the use of Laplace's equations and their applications in astronomical and geodetic surveys

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		Yes
Websites		

Grading Scheme
مخطط الدرجات

Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

<table>
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معلومات المادة الدراسية</th></tr>
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<tr><td>Module Leader</td><td colspan="2">Mohammed Tareq Khaleel</td><td>e-mail</td><td colspan="2">Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td colspan="2">Module Leader’s Acad. Title</td><td>Professor</td><td colspan="2">Module Leader’s Qualification</td><td>Ph.D.</td></tr>
<tr><td>Module Tutor</td><td colspan="2">Name (if available)</td><td>e-mail</td><td colspan="2">E-mail</td></tr>
<tr><td colspan="2">Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td colspan="2">E-mail</td></tr>
<tr><td colspan="2">Scientific Committee Approval Date</td><td></td><td>Version Number</td><td colspan="2">1.0</td></tr>
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<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
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Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective is to provide individuals with the knowledge and skills necessary to understand and contribute to the development and management of urban areas. Urban planning is a multidisciplinary field that focuses on creating sustainable, functional, and inclusive urban environments. The objective of urban planning is to create well-designed, sustainable, and functional urban environments that cater to the needs of communities and promote the overall well-being of residents. Urban planning involves the systematic organization and design of physical, social, and economic elements of cities and towns.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Analyze Urbanization Trends and Issues** • **Outcome:** Students will be able to critically analyze patterns and trends of urbanization, identifying their causes, consequences, and challenges at local, national, and global levels. • **Key Skills:** Data analysis, trend identification, and critical thinking in urban studies. **2. Apply Urban Planning Theories and Concepts** • **Outcome:** Students will be able to apply key urban planning theories, concepts, and frameworks to real-world urban issues and development scenarios. • **Key Skills:** Application of theoretical knowledge, strategic thinking, and problem-solving. **3. Design Sustainable Urban Spaces** • **Outcome:** Students will demonstrate the ability to design urban spaces that balance environmental, social, and economic sustainability, considering both short-term and long-term impacts. • **Key Skills:** Urban design, sustainability principles, and creative problem-solving. **4. Evaluate Infrastructure Planning and Development** • **Outcome:** Students will be able to assess the effectiveness and challenges of urban infrastructure planning, including transportation, housing, energy, and water systems. • **Key Skills:** Infrastructure analysis, systems thinking, and planning evaluation. **5. Address Social Equity and Inclusion** • **Outcome:** Students will be able to evaluate urban planning practices through the lens of social equity, identifying strategies to enhance inclusion, affordable housing, and access to essential services. • **Key Skills:** Social equity analysis, policy assessment, and community engagement. **6. Develop Urban Policies and Governance Frameworks** • **Outcome:** Students will be able to assess and develop urban policies that promote sustainable development and effective governance, considering local, regional, and national contexts. • **Key Skills:** Policy analysis, governance understanding, and regulatory framework development. **7. Integrate Technology in Urban Planning** • **Outcome:** Students will demonstrate an understanding of how technologies like Geographic Information Systems (GIS), smart city tools, and digital infrastructure contribute to modern urban planning practices. • **Key Skills:** Technology integration, digital literacy, and GIS skills. **8. Implement Transportation and Mobility Solutions**

	• **Outcome:** Students will be able to plan and implement urban mobility strategies that enhance transportation efficiency, reduce congestion, and promote sustainable travel options. • **Key Skills:** Transportation planning, mobility strategy development, and systems integration. **9. Promote Resilience and Climate Adaptation in Urban Areas** • **Outcome:** Students will be able to assess urban vulnerabilities to climate change and develop resilience strategies to mitigate environmental risks in urban settings. • **Key Skills:** Climate resilience planning, risk assessment, and environmental mitigation. **10. Examine the Ethical Dimensions of Urban Planning** • **Outcome:** Students will be able to recognize and address ethical dilemmas in urban planning, including issues related to fairness, justice, and accountability in decision-making processes. • **Key Skills:** Ethical analysis, professional integrity, and ethical decision-making. **11. Engage Stakeholders and Communities in the Planning Process** • **Outcome:** Students will be able to effectively engage diverse stakeholders, including local communities, in the urban planning process to ensure participation and transparency. • **Key Skills:** Public engagement, stakeholder management, and communication. **12. Conduct Urban Planning Research and Analysis** • **Outcome:** Students will develop the ability to conduct research on urban planning issues using qualitative and quantitative methods, synthesizing data to inform planning decisions. • **Key Skills:** Research methodology, data collection, analysis, and report writing. **13. Work Collaboratively on Urban Planning Projects** • **Outcome:** Students will demonstrate the ability to collaborate in interdisciplinary teams, integrating perspectives from urban design, policy, and engineering to solve complex urban problems. • **Key Skills:** Teamwork, collaboration, and interdisciplinary thinking. **14. Present Urban Planning Solutions Effectively** • **Outcome:** Students will be able to present urban planning proposals clearly and effectively to various stakeholders, including government officials, community groups, and investors. • **Key Skills:** Communication, presentation, and negotiation.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Urban Planning** • Definition, scope, and history of urban planning • Key urban planning principles and approaches • Urbanization and its global trends • The role of urban planners in shaping cities **2. Urban Planning Theories and Models** • Classical urban planning theories (e.g., the Garden City, the Radiant City) • Modern planning theories (e.g., new urbanism, sustainable urban development) • Theories of city growth and development (e.g., concentric zone theory, sector theory, multiple nuclei theory) • Comparative urban planning models (e.g., Western vs. Eastern, global south urbanism) **3. Urban Design and the Built Environment** • Principles of urban design (e.g., public space design, accessibility, scale)

- Urban aesthetics, form, and architecture
- Streetscape and public realm design
- Zoning and land-use planning (e.g., residential, commercial, industrial, mixed-use)
- Smart cities and technology-driven design

4. Sustainable Urban Development

- Principles of sustainability in urban planning
- Green urbanism and ecological urban design
- Climate change and environmental challenges in cities
- Low-carbon cities and urban energy efficiency
- Sustainable transportation systems (e.g., public transit, cycling infrastructure)

5. Urban Infrastructure and Services

- Urban transportation planning and mobility (e.g., roads, public transport, pedestrian systems)
- Water, waste, and energy management systems
- Housing and urban regeneration
- Urban sanitation and waste management
- Urban utilities and their integration into planning

6. Urban Governance and Policy

- Urban governance frameworks: local government vs. central government
- The role of urban policies in shaping cities (e.g., zoning laws, housing policies, environmental regulations)
- Planning systems and instruments (e.g., master planning, strategic planning, participatory planning)
- Public-private partnerships in urban development
- Conflict resolution and negotiation in urban planning

7. Social Equity and Inclusive Urban Planning

- Social justice and equity in urban planning
- Affordable housing and homelessness prevention
- Planning for marginalized communities (e.g., low-income, minorities, refugees)
- Community participation and public involvement in planning processes
- Access to public services and social infrastructure (e.g., healthcare, education, recreation)

8. Urban Economics and Land Use

- Economic drivers of urban development (e.g., real estate, employment, commerce)
- The role of land markets in urban growth
- Urban land use planning and policies
- Land value capture and taxation in urban areas
- Gentrification and urban renewal

9. Transportation Planning and Mobility

- Urban mobility challenges: congestion, air pollution, and mobility equity
- Transport infrastructure planning: road networks, public transit, cycling, and pedestrian infrastructure
- Sustainable transportation: green transport modes, electric vehicles, mobility as a service (MaaS)
- Urban transport governance and regulation
- Planning for resilient transportation systems in the face of climate change

10. Urban Resilience and Climate Adaptation

- Urban vulnerability to natural disasters (e.g., floods, earthquakes, heatwaves)

	• Building resilient cities: disaster risk reduction, preparedness, and recovery • Climate adaptation strategies for cities • Green infrastructure and nature-based solutions for urban resilience • The role of urban planning in disaster risk management **11. Urban Planning and Technology** • The role of Geographic Information Systems (GIS) in urban planning • Urban planning in the context of smart cities and IoT (Internet of Things) • Data-driven urban management: big data, urban sensors, and digital twins • Digital governance and e-planning tools • Innovations in urban planning technologies (e.g., autonomous vehicles, drone use in planning) **12. Ethics and Professionalism in Urban Planning** • Ethical challenges in urban planning practice • Professional codes of conduct for urban planners • Balancing private interests and public good in urban planning • Conflict of interest and accountability in planning decisions • The role of urban planners in advocating for social justice **13. Planning for Urban Health and Well-being** • The relationship between urban form and public health • Planning for healthy cities: green spaces, walkability, and pollution reduction • Mental health considerations in urban planning • Addressing urban food security and access to healthy food • Creating inclusive environments that promote well-being for all residents **14. Urban Planning Challenges and Future Directions** • The future of cities: megacities, shrinking cities, and urban sprawl • Urban planning in the Global South: informal settlements and slums • Urban planning in post-conflict and post-disaster settings • Innovations in urban planning for the future: autonomous cities, AI-driven planning, and sustainable urbanism • The role of urban planning in achieving the United Nations Sustainable Development Goals (SDGs)

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lectures and Seminars** • **Purpose:** To deliver foundational knowledge, introduce key concepts, theories, and frameworks of urban planning. • **Approach:** ○ Use **interactive lectures** to engage students with discussions, case studies, and real-life examples. ○ **Seminars** can be used to explore specific topics in-depth, allowing students to debate and present their views. ○ Encourage critical thinking by asking open-ended questions and using multimedia tools (e.g., videos, GIS data visualizations). **2. Case Studies**

	• **Purpose:** To link theory with practice by exploring real-world urban planning problems and solutions. • **Approach:** o Present **local and global case studies** of cities dealing with issues like congestion, climate change, housing crises, and social inequality. o Ask students to analyze and propose solutions based on learned theories and planning models. o Use **comparative case studies** to explore planning challenges in diverse urban contexts (e.g., developed vs. developing cities). o Encourage group work where students collaborate to analyze and present solutions for specific case studies. **3. Field Trips and Site Visits** • **Purpose:** To provide students with a tangible understanding of urban planning in practice. • **Approach:** o Organize visits to urban development projects, planning offices, or areas undergoing regeneration to observe firsthand the planning process. o Field trips can include visits to cities or neighborhoods that have implemented innovative urban design solutions or face significant planning challenges. o Encourage students to observe the interaction of social, economic, and environmental factors in urban settings. **4. Collaborative Learning and Group Work** • **Purpose:** To foster teamwork, problem-solving skills, and interdisciplinary thinking. • **Approach:** o Assign group projects where students work together on urban planning proposals (e.g., designing a sustainable neighborhood, creating a transport plan). o Encourage collaboration between students from diverse backgrounds, as urban planning often requires interdisciplinary work (e.g., urban design, transportation, policy). o Facilitate peer reviews and group critiques to refine ideas and approaches. **5. Problem-Based Learning (PBL)** • **Purpose:** To develop critical thinking, research skills, and the ability to apply knowledge to complex urban planning problems. • **Approach:** o Present students with **real-world urban planning challenges** (e.g., traffic congestion, affordable housing, environmental degradation) and ask them to develop practical solutions. o Students conduct research, evaluate planning strategies, and propose solutions, often in groups, with guidance from the instructor. o Use **simulations and role-play** exercises, where students take on the roles of different stakeholders in the planning process (e.g., city officials, developers, community members). **6. Workshops and Interactive Sessions** • **Purpose:** To enhance practical skills in urban design, policy analysis, and planning tools. • **Approach:** o Organize hands-on **workshops** on tools commonly used in urban planning, such as Geographic Information Systems (GIS), urban modeling software, or environmental impact assessment. o Have students work on creating zoning maps, transportation plans, or

	sustainable development proposals using these tools. o Introduce **design charrettes** (collaborative planning exercises) where students work intensively on design solutions for specific sites or issues. **7. Guest Lectures and Industry Speakers** • **Purpose:** To expose students to expert insights, contemporary issues, and innovations in urban planning. • **Approach:** o Invite guest speakers such as urban planners, architects, policy makers, or activists to share their expertise and experiences. o Use **panel discussions** to foster dialogue between experts and students, exploring various perspectives on urban planning topics (e.g., smart cities, affordable housing). o Guest speakers can also share their career paths and advice for entering the urban planning profession. **8. Technology Integration and Digital Learning** • **Purpose:** To familiarize students with the digital tools and technologies used in modern urban planning. • **Approach:** o Integrate **GIS** tools and urban planning software into coursework for spatial analysis, land-use planning, and transportation modeling. o Use **virtual field trips** or interactive simulations (e.g., urban planning games, online mapping tools) to engage students with city planning problems and solutions. o Incorporate **online learning platforms** for collaborative projects, discussions, and assignments. **9. Flipped Classroom** • **Purpose:** To encourage active learning and deeper engagement with course content. • **Approach:** o Provide students with **pre-recorded lectures, readings, or videos** to study at home. o Use class time for **active learning activities** such as discussions, case study analyses, group work, and problem-solving. o Encourage students to come prepared with questions and ideas for in-class activities. **10. Assessments and Critiques** • **Purpose:** To evaluate student progress and deepen understanding through constructive feedback. • **Approach:** o Use a combination of **formative assessments** (e.g., quizzes, essays, presentations) and **summative assessments** (e.g., exams, final projects). o Encourage regular **peer reviews** where students critique each other's work, providing constructive feedback on urban planning proposals. o Implement **oral presentations** to assess communication skills, where students present their planning proposals or research findings to the class or a panel of experts. **11. Role of Reflection and Personal Development** • **Purpose:** To help students reflect on their learning, connect theory with practice, and develop professional identity. • **Approach:** o Encourage students to maintain a **learning journal** or portfolio where they reflect on their learning experiences, challenges, and insights. o Incorporate opportunities for **self-assessment** and peer feedback, enabling

	students to track their own development and growth in urban planning. ○ Provide guidance on **career pathways** in urban planning and opportunities for professional development (e.g., internships, conferences, and networking). **12. Community Engagement and Service Learning** • **Purpose:** To connect students with local communities and provide hands-on experience in participatory planning. • **Approach:** ○ Organize **service-learning projects** where students work with local communities to address urban issues (e.g., neighborhood design, community health, or local transportation). ○ Collaborate with local planning agencies or NGOs to offer students real-world experience in community engagement, policy-making, or urban design projects.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**125**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	0	10% (10)	Continuous	All
	Report	5	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**

Week 1	Introduction to planning (types - stages - theories)
Week 2	Introduction to planning (types - stages - theories)
Week 3	Planning cycle (models - planning patterns)
Week 4	Planning cycle (models - planning patterns)
Week 5	basic design
Week 6	basic design
Week 7	Survey work for basic design
Week 8	Survey work for basic design
Week 9	land uses
Week 10	land uses
Week 11	land uses
Week 12	cadastral land uses
Week 13	cadastral land uses
Week 14	cadastral land uses
Week 15	Types of earth treatments
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	drawing scale
Week 2	drawing scale
Week 3	Keys to land uses and sector codes
Week 4	Keys to land uses and sector codes
Week 5	types of housing
Week 6	types of housing
Week 7	strip city
Week 8	strip city
Week 9	Garden City
Week 10	Garden City
Week 11	Garden City
Week 12	shopping centers
Week 13	shopping centers
Week 14	shopping centers
Week 15	Students' walks

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts		Yes
Recommended Texts		No

Grading Scheme

مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

<table>
<tr><th colspan="4">Module Information
معلومات المادة الدراسية</th></tr>
<tr><td>Module Title</td><td colspan="2">FUNDAMENTAL OF IMAGE PROCESSING</td><td>Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="2">Core</td><td rowspan="4">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="2">SUT 402</td></tr>
<tr><td>ECTS Credits</td><td colspan="2">6</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="2">150</td></tr>
<tr><td>Module Level</td><td>1</td><td>Semester of Delivery</td><td>1</td></tr>
<tr><td>Administering Department</td><td>Type Dept. Code</td><td>College</td><td>Type College Code</td></tr>
<tr><td>Module Leader</td><td>Mohammed Tareq Khaleel</td><td>e-mail</td><td>Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td>Module Leader’s Acad. Title</td><td>Professor</td><td>Module Leader’s Qualification</td><td>Ph.D.</td></tr>
<tr><td>Module Tutor</td><td>Name (if available)</td><td>e-mail</td><td>E-mail</td></tr>
<tr><td>Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td>E-mail</td></tr>
<tr><td>Scientific Committee Approval Date</td><td></td><td>Version Number</td><td></td></tr>
<tr><th colspan="4">Relation with other Modules
العلاقة مع المواد الدراسية الأخرى</th></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
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<tr><th colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</th></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>The objective is to provide individuals with the knowledge and skills necessary to understand and analyze digital images, enhance image quality, extract useful information, and perform various operations on images using computer algorithms. The objective of image processing is to manipulate, analyze, and interpret digital images to extract meaningful information or enhance their visual quality. It involves applying various algorithms and techniques to images with the goal of achieving specific objectives or tasks.</td></tr>
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Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Fundamentals of Image Processing** • **Outcome:** Students will demonstrate a clear understanding of the basic concepts of image processing, including image representation, types of images (e.g., grayscale, RGB), and the various mathematical operations used for image manipulation. • **Key Skills:** Understanding image data structures, pixel manipulation, and basic operations (e.g., filtering, transformations). **2. Apply Image Enhancement Techniques** • **Outcome:** Students will be able to apply and evaluate various image enhancement techniques, such as contrast adjustment, histogram equalization, and noise reduction, to improve image quality. • **Key Skills:** Practical application of image enhancement methods, evaluating results using appropriate performance metrics. **3. Perform Image Transformation and Geometric Operations** • **Outcome:** Students will be able to perform geometric transformations on images, such as scaling, rotation, translation, and affine transformations, and understand their impact on image alignment and interpretation. • **Key Skills:** Proficiency in applying transformation matrices, manipulating image geometries, and correcting image distortions. **4. Implement Image Filtering Techniques** • **Outcome:** Students will be able to implement and apply spatial and frequency domain filters, including low-pass and high-pass filters, edge detection filters (e.g., Sobel, Laplacian), and Gaussian filters. • **Key Skills:** Convolution, Fourier transforms, filtering in both spatial and frequency domains, edge detection. **5. Understand Image Segmentation and Object Recognition** • **Outcome:** Students will be able to apply image segmentation techniques (e.g., thresholding, region-growing, clustering) and basic object recognition methods to identify and extract meaningful objects from images. • **Key Skills:** Image segmentation, contour detection, object labeling, and feature extraction. **6. Implement Color Image Processing** • **Outcome:** Students will demonstrate the ability to process color images by manipulating color spaces (e.g., RGB, HSV), performing color correction, and applying color segmentation techniques. • **Key Skills:** Working with color models, converting between color spaces, color-based image enhancement. **7. Understand and Apply Image Compression Techniques** • **Outcome:** Students will be able to apply image compression algorithms (e.g., JPEG, PNG, lossless and lossy compression) and understand the trade-offs between compression ratio and image quality. • **Key Skills:** Understanding compression algorithms, implementing compression and decompression, analyzing quality loss. **8. Perform Image Restoration** • **Outcome:** Students will understand the principles of image restoration, including methods for correcting blurring, noise reduction, and deblurring, and will be able to apply these techniques in practical scenarios. • **Key Skills:** Image restoration algorithms, noise modeling, inverse filtering, Wiener filtering. **9. Evaluate Image Processing Algorithms and Techniques**

	• **Outcome:** Students will be able to critically evaluate the effectiveness of various image processing techniques based on specific image analysis goals, such as clarity, accuracy, or computational efficiency. • **Key Skills:** Algorithm comparison, performance metrics (e.g., PSNR, SSIM), and analysis of trade-offs in processing techniques. **10. Develop Image Processing Applications Using Software Tools** • **Outcome:** Students will demonstrate the ability to develop image processing applications using appropriate software tools and programming languages (e.g., Python with OpenCV, MATLAB, or other image processing libraries). • **Key Skills:** Programming, software tool proficiency, creating user interfaces for image processing applications. **11. Understand Advanced Topics in Image Processing** • **Outcome:** Students will be familiar with advanced image processing techniques such as image morphing, texture analysis, pattern recognition, and machine learning approaches applied to image processing tasks. • **Key Skills:** Advanced processing algorithms, integration of machine learning models with image data, pattern recognition. **12. Work on Image Processing Projects** • **Outcome:** Students will be able to design and implement an image processing project, from defining the problem to choosing appropriate techniques, evaluating results, and presenting findings. • **Key Skills:** Project planning, problem-solving, technical writing, project presentation.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Image Processing** • **Overview of Image Processing:** Definition, applications, and importance in various fields (e.g., medical imaging, computer vision, remote sensing). • **Image Representation:** Types of images (grayscale, color), digital image formats (JPEG, PNG, TIFF, etc.). • **Image Data Structures:** Pixel-based representation, image matrices, and color models (RGB, HSV, CMYK). **2. Image Enhancement** • **Basic Image Enhancement Techniques:** Contrast stretching, brightness adjustment, histogram equalization, and specification. • **Noise Reduction:** Techniques for smoothing and denoising images (e.g., mean filtering, median filtering, Gaussian filtering). • **Edge Enhancement:** Techniques for emphasizing edges (e.g., unsharp masking, high-pass filtering). **3. Geometric Transformations** • **Transformation Basics:** Translation, scaling, rotation, and affine transformations. • **Coordinate Systems:** Image coordinate systems and handling pixel locations. • **Interpolation Techniques:** Nearest-neighbor interpolation, bilinear interpolation, and bicubic interpolation for geometric transformations. • **Homographies:** Perspective transformations and projective geometry in image alignment. **4. Image Filtering** • **Spatial Domain Filters:** Convolution, kernel-based filtering, and application of filters (e.g., box filters, Gaussian filters, edge detection filters). • **Frequency Domain Filters:** Fourier Transform, low-pass and high-pass filters, and

	frequency domain processing for noise reduction and image enhancement. • **Edge Detection Techniques:** Sobel operator, Prewitt operator, Canny edge detector, Laplacian of Gaussian (LoG). **5. Image Segmentation** • **Segmentation Techniques:** Thresholding (global and adaptive), region growing, clustering-based methods (e.g., k-means, mean-shift). • **Edge-based Segmentation:** Detection of boundaries, active contours (snakes), and watershed algorithm. • **Region-based Segmentation:** Region splitting and merging, and segmentation based on homogeneity. • **Image Clustering:** Techniques for grouping similar pixels or objects in an image. **6. Color Image Processing** • **Color Models:** RGB, HSV, HSL, YCbCr, and their applications in image processing. • **Color Space Conversion:** Converting between color models, understanding the advantages and limitations of each model. • **Color Image Enhancement:** Techniques for improving color balance, saturation, and contrast in color images. • **Color Segmentation:** Using color models for segmentation tasks, such as detecting regions based on color. **7. Image Compression** • **Introduction to Image Compression:** Lossless vs. lossy compression, and why compression is necessary. • **Compression Algorithms:** JPEG, PNG, and GIF compression techniques. • **Transform Coding:** Discrete Cosine Transform (DCT) for JPEG compression. • **Compression Metrics:** Compression ratio, signal-to-noise ratio (SNR), Peak Signal-to-Noise Ratio (PSNR), and visual quality assessment. **8. Image Restoration** • **Restoration Techniques:** Noise modeling, inverse filtering, and Wiener filtering. • **Image De-blurring:** Methods for recovering sharpness in blurred images. • **Blind Deconvolution:** Techniques to estimate the blurring kernel when it is unknown. • **Application of Restoration in Real-World Scenarios:** Dealing with camera noise, motion blur, and atmospheric disturbances. **9. Feature Extraction and Representation** • **Point, Line, and Edge Features:** SIFT (Scale-Invariant Feature Transform), SURF (Speeded Up Robust Features), Harris Corner Detection. • **Texture Analysis:** Techniques for identifying patterns and textures (e.g., Gabor filters, co-occurrence matrices). • **Shape Representation:** Contour-based features, shape descriptors, and moments. **10. Object Recognition and Tracking** • **Template Matching:** Matching predefined templates to detect objects in images. • **Machine Learning for Recognition:** Introduction to supervised learning (e.g., support vector machines, k-nearest neighbors). • **Deep Learning for Image Recognition:** Using convolutional neural networks (CNNs) for object detection and classification. • **Image Matching and Tracking:** Techniques for tracking objects across video frames, optical flow, and Kalman filtering. **11. Advanced Image Processing Techniques** • **Morphological Operations:** Dilation, erosion, opening, and closing for binary image

	processing. • **Advanced Segmentation Algorithms:** Graph cuts, level sets, and deep learning-based segmentation (e.g., U-Net). • **3D Image Processing:** Techniques for processing 3D images, such as medical imaging (CT, MRI), and point cloud data from LIDAR. • **Image Registration:** Aligning multiple images (e.g., in medical imaging, satellite image stitching). **12. Applications of Image Processing** • **Medical Imaging:** Techniques for enhancing and analyzing medical images (e.g., CT scans, MRIs, X-rays). • **Remote Sensing and Satellite Imaging:** Processing satellite images for environmental monitoring, land-use classification, etc. • **Computer Vision:** Real-time video processing, object detection, recognition, and augmented reality. • **Forensic Imaging:** Enhancing forensic images for legal purposes, including crime scene analysis. **13. Image Processing Tools and Software** • **Image Processing Libraries:** Introduction to Python libraries like OpenCV, Pillow, and scikit-image; MATLAB for image processing. • **Practical Exercises:** Hands-on use of these tools to implement the algorithms and methods discussed throughout the course. • **Custom Image Processing Applications:** Building small image processing projects using programming languages and libraries. **14. Emerging Trends in Image Processing** • **Deep Learning and Neural Networks in Image Processing:** Exploring the use of deep learning in image recognition, segmentation, and enhancement tasks. • **Real-Time Image Processing:** Techniques for efficient real-time image processing, such as in autonomous vehicles and robotics. • **AI-Powered Image Processing:** Exploring AI-based tools for automatic image enhancement, restoration, and segmentation.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures** • **Purpose:** To introduce foundational concepts and theoretical aspects of image processing. • **Approach:** ○ Deliver interactive lectures that explain key topics such as image representation, filtering, segmentation, and compression. ○ Use visual aids, such as diagrams, animations, and real-time image processing demonstrations, to enhance understanding. ○ Encourage student participation by asking open-ended questions and promoting discussions. ○ Incorporate live coding demonstrations, where students can see how algorithms are implemented in real-time using programming languages like Python or

	MATLAB. **2. Hands-on Practice and Labs** • **Purpose:** To give students practical experience and help them apply theory to real-world problems. • **Approach:** o Organize **lab sessions** where students work on coding image processing algorithms using tools like **Python (OpenCV, scikit-image)** or **MATLAB**. o Provide **guided exercises** where students apply basic image processing techniques such as filtering, edge detection, and segmentation. o Encourage students to explore datasets (e.g., medical images, satellite imagery) and implement techniques to enhance, segment, or recognize objects. o Include **debugging sessions** where students learn how to troubleshoot their code, understand errors, and optimize image processing pipelines. **3. Problem-Based Learning (PBL)** • **Purpose:** To enhance critical thinking, problem-solving, and application skills by solving real-world problems. • **Approach:** o Present students with practical **image processing problems** (e.g., removing noise from images, detecting edges, performing face recognition). o Encourage collaborative teamwork, where groups of students tackle different aspects of a larger project. o Involve students in **project-based learning**, where they can work on image processing challenges from fields like medical imaging, remote sensing, or video surveillance. o Have students present their solutions to the class, explaining their approach, challenges, and results. **4. Flipped Classroom** • **Purpose:** To foster independent learning and give students more time for active learning and problem-solving in class. • **Approach:** o Provide **pre-recorded lectures**, reading materials, or instructional videos that introduce key image processing concepts. o Use class time for **hands-on activities** and guided exercises where students can implement what they learned from the pre-class materials. o Encourage students to **work on exercises in groups**, allowing them to discuss and collaborate on coding challenges, such as implementing edge detection or image segmentation algorithms. **5. Project-Based Learning (PBL)** • **Purpose:** To allow students to work on larger, integrative projects that apply a wide range of image processing techniques. • **Approach:** o Assign group or individual **projects** where students create end-to-end image processing applications (e.g., building a facial recognition system, developing an image enhancement tool). o Projects should require students to collect data, apply various processing techniques (e.g., filtering, compression, segmentation), and evaluate the results. o Allow students to **choose project topics** that align with their interests (e.g., medical image processing, computer vision, robotics). o Provide regular **checkpoints** for project progress, where students present their work for feedback from peers and instructors.

	6. Guest Lectures and Expert Talks • **Purpose:** To expose students to cutting-edge research and industry applications of image processing. • **Approach:** o Invite **industry professionals** or **researchers** working in areas like computer vision, medical imaging, or remote sensing to give guest lectures or webinars. o Organize **panel discussions** or Q&A sessions where students can ask about career opportunities, challenges in the field, and the future of image processing. o Use these opportunities to bridge the gap between theoretical knowledge and real-world applications. **7. Fluent Integration of Software Tools** • **Purpose:** To ensure that students become proficient in using popular image processing tools and software. • **Approach:** o Introduce students to widely-used image processing libraries such as **OpenCV** (for Python), **scikit-image**, **Pillow**, and **MATLAB Image Processing Toolbox**. o Organize workshops that walk students through how to use these tools to solve specific image processing tasks. o Allow students to **explore different software tools** to understand the strengths and weaknesses of each in solving specific problems (e.g., comparing MATLAB to Python-based OpenCV for real-time processing). **8. Collaborative Learning and Peer Feedback** • **Purpose:** To develop teamwork, communication, and critical analysis skills. • **Approach:** o **Peer review sessions** where students present their code, solutions, and findings to the class, and give constructive feedback on each other's work. o Encourage students to **collaborate** on coding tasks, where they can discuss their strategies, exchange ideas, and solve problems collectively. o Assign **group projects** that require collaborative work to develop complex image processing systems or solve real-world challenges. **9. Use of Real-World Case Studies** • **Purpose:** To apply theoretical knowledge to real-world image processing problems. • **Approach:** o Present case studies from different fields, such as **medical image processing** (e.g., MRI/CT scans), **satellite image processing**, **autonomous vehicles**, or **security and surveillance**. o Encourage students to analyze how image processing techniques are used in solving specific problems, and then design a solution for a similar scenario. o Use case studies to explore **ethical concerns** and the potential societal impact of image processing technologies (e.g., privacy issues in facial recognition). **10. Assessment through Practical Assignments** • **Purpose:** To assess students' technical and problem-solving abilities. • **Approach:** o Provide a series of **practical assignments** where students need to implement specific image processing tasks (e.g., image filtering, segmentation, feature extraction). o Include **project-based assessments** where students must apply multiple techniques to solve a complex problem, such as creating a fully functional image classification system or restoring damaged images. o Use **continuous assessment** methods, such as weekly coding challenges or

	quizzes based on theoretical concepts. **11. Interactive Online Platforms and Simulations** • **Purpose:** To engage students outside of classroom hours and provide additional support. • **Approach:** ○ Utilize online platforms such as **Jupyter Notebooks** or **Google Colab** where students can run image processing code and interact with image datasets. ○ Incorporate online **quizzes and coding challenges** to test students' understanding and encourage independent learning. ○ Offer **discussion forums** where students can ask questions, share ideas, and collaborate on solving image processing challenges. **12. Self-paced Learning and Resources** • **Purpose:** To promote independent learning and mastery of image processing tools and techniques. • **Approach:** ○ Provide supplementary **online tutorials**, reading materials, and reference guides to allow students to explore image processing topics at their own pace. ○ Encourage students to work through **self-assessment quizzes**, allowing them to measure their understanding of core concepts.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Review of Remote Sensing Concepts: spatial and radiometric characteristics – spectral and temporal characteristics
Week 2	Review of Remote Sensing Concepts: spatial and radiometric characteristics – spectral and temporal characteristics
Week 3	Optical Radiation Model: The wave/ particle models - energy/matter interaction – Radiometric Correction – Atmospheric Correction
Week 4	Optical Radiation Model: The wave/ particle models - energy/matter interaction – Radiometric Correction – Atmospheric Correction
Week 5	Digital Image Formation: point spread functions –sampling and quantization
Week 6	Digital Image Formation: point spread functions –sampling and quantization
Week 7	Digital Image Characteristics: Univariate and multivariate image statistics – noise models- power spectral density- co-occurrence matrix
Week 8	Digital Image Characteristics: Univariate and multivariate image statistics – noise models- power spectral density- co-occurrence matrix
Week 9	Image Enhancement and Spectral Transforms: contrast enhancement – band rationing – principal component analysis – vegetation transforms – texture transforms
Week 10	Image Enhancement and Spectral Transforms: contrast enhancement – band rationing – principal component analysis – vegetation transforms – texture transforms
Week 11	Spatial Transforms: convolution concept - low and high pass filtering – spatial transformations – Fourier transform – wavelet transforms
Week 12	Spatial Transforms: convolution concept - low and high pass filtering – spatial transformations – Fourier transform – wavelet transforms
Week 13	Spatial Transforms: convolution concept - low and high pass filtering – spatial transformations – Fourier transform – wavelet transforms
Week 14	Geometric Correction: sensor geometry and empirical models for geometric corrections
Week 15	Geometric Correction: sensor geometry and empirical models for geometric corrections
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	N/A
Week 2	
Week 3	

Week 4	
Week 5	
Week 6	
Week 7	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

<table>
<tr><td colspan="6">Module Information
معلومات المادة الدراسية</td></tr>
<tr><td>Module Title</td><td colspan="3">FUNDAMENTAL OF Radar Engineering</td><td colspan="2">Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="3">Core</td><td colspan="2" rowspan="4">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="3">SUT 403</td></tr>
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<tr><td>SWL (hr/sem)</td><td colspan="3">150</td></tr>
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<tr><td>Administering Department</td><td>Type Dept. Code</td><td>College</td><td colspan="3">Type College Code</td></tr>
<tr><td>Module Leader</td><td>Mohammed Tareq Khaleel</td><td>e-mail</td><td colspan="3">Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td>Module Leader’s Acad. Title</td><td>Lecturer</td><td>Module Leader’s Qualification</td><td colspan="3">Ph.D.</td></tr>
<tr><td>Module Tutor</td><td>Name (if available)</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td>Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td>Scientific Committee Approval Date</td><td></td><td>Version Number</td><td colspan="3"></td></tr>
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<tr><td colspan="4">Relation with other Modules
العلاقة مع المواد الدراسية الأخرى</td></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
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<tr><td colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</td></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>The objective is to provide individuals with the knowledge and skills necessary to understand and analyze radar systems, their principles of operation, and their applications in various fields. These are some of the key objectives in the field of engineering radar. The use of radar technology in engineering applications continues to evolve, and engineers employ radar systems in various industries and disciplines to solve complex problems, improve safety, and enhance efficiency in diverse fields such as transportation, aerospace, geosciences, and defense.</td></tr>
<tr><td>Module Learning Outcomes</td><td>1. Understand the Principles of Radar Systems
• Outcome: Students will demonstrate a clear understanding of the fundamental principles of radar systems, including the basic operation of radar, types of radar waves, and</td></tr>
</table>

مخرجات التعلم للمادة الدراسية	radar equations. • **Key Skills:** Understanding radar signal transmission and reception, radar wave propagation, and basic radar system design. **2. Analyze Radar Wave Propagation and Environmental Effects** • **Outcome:** Students will be able to analyze and explain radar wave propagation, including free-space path loss, atmospheric effects, and ground clutter. • **Key Skills:** Application of radar propagation models, understanding the effects of weather and terrain on radar signal behavior, and mitigating environmental interference. **3. Design Radar Transmitter and Receiver Systems** • **Outcome:** Students will be able to design basic radar transmitter and receiver systems, including the selection of frequency bands, modulation schemes, and receiver components. • **Key Skills:** Understanding the key components of radar systems, including oscillators, amplifiers, and mixers, and designing basic systems for radar transmission and reception. **4. Apply Signal Processing Techniques in Radar Systems** • **Outcome:** Students will demonstrate the ability to apply signal processing techniques in radar systems, such as filtering, Fourier analysis, and Doppler processing for target detection and tracking. • **Key Skills:** Signal processing algorithms for noise reduction, target detection, and tracking, as well as Doppler shift analysis and Fourier transforms in radar applications. **5. Understand and Implement Radar Detection and Estimation Techniques** • **Outcome:** Students will understand the principles of radar detection theory and be able to implement estimation techniques, such as matched filtering and probability of detection. • **Key Skills:** Radar detection methods, including signal-to-noise ratio (SNR) analysis, false alarm rates, and probability of detection, using techniques like matched filters. **6. Examine Doppler Radar and Velocity Measurement** • **Outcome:** Students will be able to explain the principles of Doppler radar and implement systems for velocity measurement, including the calculation of radial velocity and resolving Doppler shifts. • **Key Skills:** Understanding Doppler shifts, implementing Doppler radar systems, and applying velocity measurements for target tracking. **7. Evaluate Radar Waveforms and Modulation Techniques** • **Outcome:** Students will be able to evaluate the advantages and disadvantages of various radar waveforms and modulation schemes, including continuous wave (CW), pulse, and frequency-modulated continuous wave (FMCW) radar. • **Key Skills:** Understanding the performance trade-offs of different radar waveforms and modulation methods, and choosing the appropriate waveform for specific radar applications. **8. Understand Radar Clutter and Mitigation Techniques** • **Outcome:** Students will understand the concept of radar clutter and its impact on target detection, and will be able to apply techniques for clutter mitigation such as adaptive filtering and Doppler shift analysis. • **Key Skills:** Identifying and mitigating clutter using advanced signal processing techniques, improving the performance of radar systems in cluttered environments. **9. Understand Radar System Design and Integration** • **Outcome:** Students will demonstrate the ability to design and integrate radar systems, taking into account factors such as range, resolution, power, and interference. • **Key Skills:** Radar system integration and optimization, including balancing the trade-offs between range, resolution, power consumption, and system performance. **10. Evaluate Radar Systems Performance**

	• **Outcome:** Students will be able to assess the performance of radar systems, using metrics such as resolution, detection range, signal-to-noise ratio (SNR), and system efficiency. • **Key Skills:** Evaluating radar system performance using key metrics, performing system simulations, and analyzing real-world radar data. **11. Understand Advanced Radar Techniques** • **Outcome:** Students will gain an understanding of advanced radar techniques, such as synthetic aperture radar (SAR), phased array radar, and multiple-input multiple-output (MIMO) radar. • **Key Skills:** Knowledge of advanced radar technologies, including SAR for high-resolution imaging, phased array for beam steering, and MIMO for spatial diversity and improved detection capabilities. **12. Develop Radar Engineering Projects** • **Outcome:** Students will be able to plan, design, and implement radar engineering projects, incorporating the theory and practical skills learned in the module. • **Key Skills:** Project planning, design, and execution, including radar system prototyping, simulation, and testing.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Radar Engineering** • **Radar Fundamentals:** Basic principles of radar, radar signal transmission, and reception. • **Applications of Radar:** Overview of radar applications in aviation, military, weather forecasting, automotive, and remote sensing. • **Radar Components:** Basic radar system components, such as antennas, transmitters, receivers, and signal processing units. **2. Radar Wave Propagation** • **Electromagnetic Waves:** Characteristics of radar waves, wavelength, frequency, and propagation through various media. • **Free-Space Propagation:** Path loss, radar range equation, and free-space attenuation. • **Atmospheric Effects:** Atmospheric absorption, refraction, and scattering of radar signals. • **Ground Clutter and Interference:** Effect of terrain, weather, and environmental conditions on radar signal propagation and mitigation techniques. **3. Radar Transmitter and Receiver Design** • **Radar Transmitters:** Power generation, frequency selection, pulse modulation, and continuous wave (CW) radar. • **Radar Receivers:** Signal detection, noise, sensitivity, and gain control. • **Radar Antennas:** Antenna types (parabolic, phased array, planar), antenna design considerations, beamforming, and directivity. • **Modulation and Frequency Techniques:** Pulse modulation, frequency modulation, phase modulation, and waveform selection. **4. Radar Signal Processing** • **Basic Signal Processing Techniques:** Filtering, Fourier transforms, and Doppler analysis. • **Matched Filtering:** Maximizing signal-to-noise ratio (SNR) for target detection. • **Pulse Compression:** Techniques for improving range resolution, such as chirp pulses. • **Doppler Processing:** Detecting and measuring radial velocity and Doppler shifts in moving targets. • **Clutter Rejection:** Techniques to minimize interference from stationary or slow-

	moving objects. **5. Radar Detection and Estimation Theory** • **Radar Detection Theory:** Probability of detection, false alarm rates, and signal-to-noise ratio (SNR). • **Detection Methods:** Constant false alarm rate (CFAR), threshold detection, and likelihood ratio tests. • **Matched Filters and Signal Estimation:** Design and application of matched filters for optimal detection of targets in noise. • **Detection in Noise:** Gaussian noise, white noise, and non-Gaussian noise considerations. • **Estimation Techniques:** Radar target localization, range, velocity estimation, and Kalman filtering. **6. Radar Waveforms and Modulation Techniques** • **Continuous Wave (CW) Radar:** Principles, advantages, and limitations of CW radar. • **Pulse Radar:** Time-domain characteristics, pulse duration, and pulse repetition frequency. • **Frequency-Modulated Continuous Wave (FMCW) Radar:** Operating principles, use in automotive radar, and range measurement techniques. • **Waveform Design:** Trade-offs between radar resolution, power, and range; selection of appropriate waveform types for specific applications. **7. Radar Clutter and Mitigation Techniques** • **Clutter Identification:** Types of radar clutter (e.g., ground clutter, weather clutter, sea clutter) and their impact on target detection. • **Clutter Rejection Methods:** Doppler filtering, adaptive filtering, and moving target indication (MTI) radar. • **Clutter Maps:** Creating and using clutter maps to enhance radar performance in cluttered environments. • **Interference Mitigation:** Techniques for dealing with interference from other radars or electronic systems (e.g., electronic countermeasures). **8. Radar Imaging Systems** • **Synthetic Aperture Radar (SAR):** Principles of SAR, image formation, resolution enhancement, and motion compensation. • **Inverse Synthetic Aperture Radar (ISAR):** Applications in maritime and aerial imaging for object recognition. • **Radar Imaging Resolution:** Trade-offs between resolution, range, and processing time. • **Radar Data Fusion:** Combining multiple radar data streams for improved object tracking and scene interpretation. **9. Advanced Radar Systems** • **Phased Array Radar:** Concepts of electronically controlled beam steering, multi-beam radar, and adaptive beamforming. • **MIMO (Multiple-Input, Multiple-Output) Radar:** Principles of MIMO radar systems, spatial diversity, and target localization. • **Radar for Autonomous Vehicles:** Radar-based perception systems in autonomous driving, collision avoidance, and adaptive cruise control. • **Radar and Machine Learning:** Application of AI and machine learning techniques to improve radar target detection, classification, and tracking. **10. Radar System Design and Integration**

	• **Design of Radar Systems:** Design principles for radar system performance optimization, including range, resolution, and accuracy. • **Radar System Performance Metrics:** Evaluating radar systems based on parameters like range, accuracy, resolution, and SNR. • **Radar System Simulation:** Using simulation tools for radar system design and performance evaluation. • **Integration with Other Systems:** Radar integration with other sensors (e.g., LIDAR, cameras) for multi-sensor fusion in applications like autonomous systems. **11. Radar Calibration and Testing** • **Radar Calibration:** Methods for calibrating radar systems, including range and velocity calibration. • **Testing Radar Systems:** Techniques for testing radar performance, including test environments, measurement equipment, and performance evaluation. • **Field Testing and Performance Analysis:** Analyzing radar system performance in real-world conditions and troubleshooting. **12. Radar System Applications** • **Aviation Radar:** Air traffic control, weather radar, and collision avoidance. • **Military Radar:** Radar for surveillance, target acquisition, fire control, and missile guidance. • **Meteorological Radar:** Weather monitoring, precipitation tracking, and storm detection. • **Automotive Radar:** Applications in driver assistance systems, adaptive cruise control, and autonomous vehicles. • **Marine Radar:** Navigation, collision avoidance, and object detection in maritime environments. **13. Emerging Radar Technologies** • **Advanced Radar Modulation and Waveforms:** New modulation schemes for high-performance radar systems. • **Quantum Radar:** Theoretical and emerging applications of quantum radar technology. • **Miniaturization of Radar Systems:** Development of small and low-power radar for use in drones and portable applications. • **Radar in Space Applications:** Radar systems for remote sensing, planetary exploration, and space debris detection.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lectures with Visual Aids and Demonstrations** • **Purpose:** To introduce theoretical concepts and key principles of radar systems. • **Approach:** ○ **Interactive lectures** that cover the fundamentals of radar engineering, such as radar wave propagation, signal processing, and radar system design. ○ Use **visual aids** like diagrams, simulations, and animations to illustrate complex concepts such as wave propagation, Doppler effects, and radar waveforms. ○ **Demonstrations** of radar components, such as antennas, transmitters, and

	receivers, to show real-world applications and how different parts of a radar system work together. o Include **live demonstrations** using simulation software (e.g., MATLAB, Simulink) to illustrate radar signal processing, target detection, and estimation techniques. **2. Hands-on Laboratory Sessions** • **Purpose:** To provide practical experience in designing and implementing radar systems and processing radar signals. • **Approach:** o **Radar hardware labs** where students work with actual radar equipment (if available) to observe system performance, measure radar signals, and test radar devices. o **Software-based labs** using simulation tools like MATLAB, Simulink, or specific radar simulation software to create and test radar systems, process radar data, and evaluate system performance. o **Step-by-step exercises** where students implement basic radar signal processing techniques, such as matched filtering, Doppler shift detection, and range estimation. o Allow students to experiment with **real-world radar data sets**, such as weather radar data or traffic radar data, to test algorithms and troubleshoot radar systems. **3. Project-Based Learning (PBL)** • **Purpose:** To integrate theory with practical application by encouraging students to tackle real-world radar engineering problems. • **Approach:** o Assign **group projects** where students design and build a radar system or radar-based application (e.g., a simple radar sensor for obstacle detection). o Use **real-world case studies**, such as radar systems in aviation, military, automotive, or meteorological applications, and have students design solutions based on these examples. o Encourage students to work in teams, fostering **collaborative learning**, problem-solving, and communication skills as they tackle complex radar engineering problems together. o Integrate **project milestones** with specific learning objectives, such as the design of a radar transmitter, receiver, or signal processing algorithm. **4. Flipped Classroom Approach** • **Purpose:** To maximize in-class time for hands-on learning and problem-solving, while students independently engage with theoretical content before class. • **Approach:** o Provide **pre-recorded lectures**, readings, or tutorials that cover foundational radar concepts like the radar equation, signal processing, and system design. o In class, focus on **interactive problem-solving**, where students work on designing radar systems, processing radar signals, or analyzing radar data in small groups. o Use **peer teaching** techniques where students can explain concepts to each other in collaborative settings, enhancing their own understanding. o Assign **homework problems** that challenge students to apply what they learned in class to real-world scenarios (e.g., radar system design or detecting specific objects in noisy environments). **5. Simulation-Based Learning** • **Purpose:** To allow students to model, simulate, and analyze radar systems in a controlled environment, helping them understand complex systems without the constraints of hardware. • **Approach:**

	○ Introduce **radar simulation tools** (e.g., MATLAB, Simulink, or dedicated radar simulation software) that allow students to simulate radar systems, test different radar waveforms, and analyze radar signal processing algorithms. ○ **Simulate radar scenarios** like radar target detection in noisy or cluttered environments, Doppler shift effects, and multi-target tracking. ○ Use **model-based design** techniques to test radar system designs, analyze performance metrics (such as range, resolution, and accuracy), and iterate on solutions. ○ Enable students to run **real-time simulations** of radar systems that model propagation effects, signal processing, and radar performance in various environmental conditions. **6. Guest Lectures and Industry Visits** • **Purpose:** To expose students to current radar technology, applications, and industry practices. • **Approach:** ○ Invite **industry experts** (e.g., radar engineers, radar system designers, or researchers) to give guest lectures on cutting-edge radar technologies, such as phased array radar, radar for autonomous vehicles, or synthetic aperture radar (SAR). ○ Organize **site visits** to companies or research centers working on radar technology, where students can see radar systems in operation and interact with professionals in the field. ○ Use **real-world examples** of how radar is applied in various sectors, such as aerospace, automotive, and defense, and how emerging radar technologies are influencing future systems. **7. Problem-Based Learning (PBL) and Case Studies** • **Purpose:** To develop critical thinking, analytical, and problem-solving skills through real-life radar engineering scenarios. • **Approach:** ○ Provide students with **case studies** of radar system failures, design challenges, or real-world radar applications, asking them to propose solutions or optimize existing systems. ○ Present students with complex **radar system design problems**, such as designing a radar system for a specific application (e.g., collision avoidance in autonomous vehicles or air traffic control). ○ Encourage students to research **current radar technologies** and identify potential improvements, fostering innovation and a deeper understanding of radar system design. **8. Collaborative Learning and Peer Feedback** • **Purpose:** To encourage teamwork, communication, and collaborative problem-solving skills. • **Approach:** ○ Use **team-based projects** where students work together to solve radar engineering challenges, each contributing specific expertise, such as system design, signal processing, or software development. ○ Incorporate **peer review** sessions where students present their radar designs or solutions to the class and provide constructive feedback on each other's work. ○ Facilitate **team discussions** and brainstorming sessions to explore different approaches to radar design and signal processing, helping students learn from their peers and develop a more rounded understanding of radar engineering. **9. Formative and Summative Assessments**

	• **Purpose:** To assess both theoretical knowledge and practical skills in radar engineering. • **Approach:** ○ Use **formative assessments**, such as quizzes, coding assignments, or lab exercises, to test understanding of radar principles, signal processing techniques, and system design. ○ Incorporate **summative assessments**, such as a final project or exam, where students design a complete radar system or solve a complex radar problem. ○ Assess **practical competencies** through lab-based assessments where students build and test radar systems, analyze data, and apply signal processing techniques. ○ Provide **feedback** on both individual and group performance to help students understand areas for improvement. **10. Interactive Learning Platforms and Tools** • **Purpose:** To encourage active learning outside of the classroom and provide additional resources for students. • **Approach:** ○ Integrate **online learning platforms** (e.g., Moodle, Canvas, or Google Classroom) to host lecture materials, discussion boards, assignments, and quizzes. ○ Use **interactive simulators** and tools (e.g., radar signal processing apps, interactive radar tutorials) to help students visualize complex radar concepts and experiment with different system parameters. ○ Provide **access to code repositories** (e.g., GitHub) where students can share and collaborate on radar-related coding projects and research. **11. Research and Independent Study** • **Purpose:** To develop research and independent learning skills in radar engineering. • **Approach:** ○ Encourage students to undertake **independent research** on emerging radar technologies, such as MIMO radar, quantum radar, or radar in autonomous systems. ○ Assign **research papers** or **literature reviews** on specific radar technologies, encouraging students to engage with academic literature and stay updated on new advancements in radar engineering. ○ Foster **critical thinking** through assignments that ask students to evaluate the trade-offs in radar design and suggest innovative solutions to current radar challenges.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation تقييم المادة الدراسية					
As		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	Midterm Exam	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	Material Covered
Week 1	Introduction to Radar Systems: Basic principles and concepts of radar, Radar system components and their functions Radar system classification and applications
Week 2	Introduction to Radar Systems: Basic principles and concepts of radar, Radar system components and their functions • Radar system classification and applications
Week 3	Introduction to Radar Systems: Basic principles and concepts of radar, Radar system components and their functions • Radar system classification and applications
Week 4	Radar Signal and Data Processing: Radar waveforms and their characteristics ,Pulse compression techniques Clutter rejection and suppression Doppler processing and target detection Radar tracking and data fusion
Week 5	Radar Signal and Data Processing: Radar waveforms and their characteristics ,Pulse compression techniques Clutter rejection and suppression Doppler processing and target detection Radar tracking and data fusion
Week 6	Radar Signal and Data Processing: Radar waveforms and their characteristics ,Pulse compression techniques Clutter rejection and suppression Doppler processing and target detection Radar tracking and data fusion
Week 7	Radar Signal and Data Processing: Radar waveforms and their characteristics ,Pulse compression techniques Clutter rejection and suppression Doppler processing and target detection Radar tracking and data fusion
Week 8	Radar Signal and Data Processing: Radar waveforms and their characteristics ,Pulse compression techniques Clutter rejection and suppression Doppler processing and target detection Radar tracking and data fusion
Week 9	Radar Antennas and Propagation: Antenna fundamentals and types Antenna characteristics and parameters Antenna radiation patterns and beam forming Radar propagation and atmospheric effects
Week 10	Radar Antennas and Propagation: Antenna fundamentals and types Antenna characteristics and parameters Antenna radiation patterns and beam forming Radar propagation and atmospheric effects
Week 11	Radar Antennas and Propagation: Antenna fundamentals and types Antenna characteristics and parameters

	Antenna radiation patterns and beam forming Radar propagation and atmospheric effects
Week 12	Radar Antennas and Propagation: Antenna fundamentals and types Antenna characteristics and parameters Antenna radiation patterns and beam forming Radar propagation and atmospheric effects
Week 13	Radar System Design: Radar system requirements and specifications Radar system architecture and configurations Transmitter and receiver design Signal processing algorithms and techniques Radar performance analysis and evaluation
Week 14	Radar System Design: • Radar system requirements and specifications Radar system architecture and configurations • Transmitter and receiver design • Signal processing algorithms and techniques • Radar performance analysis and evaluation
Week 15	Radar System Design: • Radar system requirements and specifications Radar system architecture and configurations • Transmitter and receiver design • Signal processing algorithms and techniques • Radar performance analysis and evaluation
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	N/A
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	
Week 10	
Week 11	
Week 12	
Week 13	
Week 14	
Week 15	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		No
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

<table>
<tr><th colspan="4">Module Information
معلومات المادة الدراسية</th></tr>
<tr><td>Module Title</td><td colspan="2">FUNDAMENTAL OF TRAFFIC ENGINEERING</td><td>Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="2">Core</td><td rowspan="4">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="2">SUT 404</td></tr>
<tr><td>ECTS Credits</td><td colspan="2">4</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="2">100</td></tr>
</table>

Module Level	1	**Semester of Delivery**	1
Administering Department	Type Dept. Code	**College**	Type College Code
Module Leader	Mohammed Tareq Khaleel	**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)	**e-mail**	E-mail
Peer Reviewer Name	Name	**e-mail**	E-mail
Scientific Committee Approval Date		**Version Number**	

Relation with other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Objectives أهداف المادة الدراسية	The objective of studying "Traffic Engineering" topics is to provide individuals with the knowledge and skills necessary to understand, analyze, and design transportation systems and infrastructure to ensure safe, efficient, and sustainable movement of vehicles, pedestrians, and other modes of transportation. These are some of the key objectives of traffic engineering. By applying various strategies and techniques, traffic engineers work towards creating safe, efficient, and sustainable transportation systems that accommodate the needs of communities and facilitate smooth and reliable mobility for all road users.
Module Learning Outcomes	**1. Understand the Fundamentals of Traffic Engineering** • **Outcome:** Students will demonstrate a clear understanding of the fundamental

مخرجات التعلم للمادة الدراسية	principles of traffic flow, road capacity, and the factors affecting traffic conditions. • **Key Skills:** Understanding traffic flow theory, vehicle interactions, and the impact of road geometry on traffic performance. **2. Apply Traffic Flow Theories** • **Outcome:** Students will be able to apply traffic flow models to analyze and predict traffic behavior under different conditions (e.g., free flow, congestion, and queueing). • **Key Skills:** Using traffic flow theory, such as the fundamental diagram of traffic flow (density, speed, and flow), to model traffic conditions and optimize road capacity. **3. Design Traffic Control Systems** • **Outcome:** Students will be able to design traffic control systems, including signalized intersections, roundabouts, and traffic signs, to improve traffic safety and efficiency. • **Key Skills:** Traffic signal design, intersection control strategies, and the application of modern traffic management techniques (e.g., adaptive signals, intelligent transport systems). **4. Analyze Traffic Data and Conduct Traffic Surveys** • **Outcome:** Students will demonstrate the ability to collect, analyze, and interpret traffic data, including traffic volume, speed, and accident data, to assess road performance and safety. • **Key Skills:** Conducting traffic surveys, analyzing traffic data, and using software tools (e.g., Synchro, VISSIM) to evaluate traffic patterns and performance. **5. Evaluate Road Capacity and Level of Service (LOS)** • **Outcome:** Students will be able to assess the capacity and level of service (LOS) of various roadways and intersections, and make recommendations for improvements based on traffic performance. • **Key Skills:** Evaluating LOS using standard methodologies (e.g., Highway Capacity Manual), determining road capacity, and recommending infrastructure improvements to enhance traffic flow. **6. Understand the Principles of Traffic Safety** • **Outcome:** Students will understand the principles of traffic safety, including the causes of accidents, safety audits, and risk assessments, and apply strategies to reduce accidents and improve road safety. • **Key Skills:** Identifying common traffic safety issues, conducting road safety audits, and implementing measures to reduce accidents (e.g., road design improvements, safety awareness campaigns). **7. Apply Traffic Simulation Techniques** • **Outcome:** Students will be able to use traffic simulation software to model traffic flow and congestion in different road networks and assess the impact of proposed changes. • **Key Skills:** Using tools such as VISSIM, SYNCHRO, or Aimsun to simulate traffic conditions, evaluate alternatives, and optimize traffic management strategies. **8. Analyze and Design Pedestrian and Bicycle Facilities** • **Outcome:** Students will be able to assess the needs of non-motorized road users (e.g., pedestrians and cyclists) and design appropriate facilities that enhance safety and mobility. • **Key Skills:** Designing pedestrian crossings, bike lanes, and shared spaces; applying guidelines and standards for non-motorized transportation. **9. Understand and Mitigate Traffic Congestion** • **Outcome:** Students will be able to identify causes of traffic congestion and propose strategies to alleviate it, such as traffic demand management and the implementation of public transportation. • **Key Skills:** Analyzing congestion patterns, evaluating congestion management strategies (e.g., congestion pricing, HOV lanes), and understanding the role of public transit

	and carpooling. **10. Develop Sustainable Traffic Engineering Solutions** • **Outcome:** Students will develop an understanding of sustainable traffic engineering practices, considering environmental, social, and economic factors when designing transportation systems. • **Key Skills:** Designing traffic systems that minimize environmental impact, promoting sustainable modes of transport, and integrating green infrastructure in traffic engineering projects. **11. Conduct Traffic Impact Studies** • **Outcome:** Students will be able to conduct traffic impact studies for new developments, including transportation demand forecasts, traffic flow analysis, and the evaluation of proposed mitigation measures. • **Key Skills:** Performing traffic impact analysis, forecasting future traffic demand, and recommending measures to mitigate the effects of new developments on traffic flow and safety. **12. Understand the Role of Intelligent Transport Systems (ITS)** • **Outcome:** Students will understand the role of ITS in modern traffic management, including the application of technologies like automated traffic control, real-time traffic monitoring, and connected vehicles. • **Key Skills:** Understanding and applying ITS technologies, including adaptive signal control, traffic surveillance systems, and integration of smart technologies for efficient traffic flow.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Traffic Engineering** • Definition and scope of traffic engineering • Evolution and history of traffic engineering • Relationship with other transportation disciplines • Basic principles of traffic flow **2. Traffic Flow Theory** • Definition and key concepts of traffic flow • Traffic stream characteristics: flow, speed, density, and occupancy • Queuing theory in traffic • Traffic flow models: fundamental diagrams (speed-density, flow-density) • Microsimulation vs. macroscopic models **3. Traffic Volume and Capacity Analysis** • Methods of traffic volume measurement • Peak hour traffic flow • Volume/capacity ratio • Capacity of highways, intersections, and intersections with traffic signals • Service levels in traffic flow • Saturation flow and lane capacity **4. Traffic Control Devices** • Types of traffic signs: regulatory, warning, and guide signs • Traffic signals: design and operation • Pavement markings and their role in traffic control • Roadway lighting • Intelligent Traffic Systems (ITS) **5. Traffic Intersection Design** • Types of intersections: at-grade, grade-separated, roundabouts, etc.

	• Geometric design principles for intersections • Signalized and non-signalized intersection design • Traffic signal timing and optimization • Pedestrian and bicycle facility integration at intersections **6. Traffic Safety and Accident Analysis** • Traffic accident statistics and analysis methods • Accident prediction models • Identifying high-risk zones and black spots • Traffic safety audits • Road safety improvements and countermeasures • Human factors in traffic safety **7. Roadway Design and Geometric Design Principles** • Horizontal and vertical alignment design • Cross-section and lane width design • Roadway capacity and level of service (LOS) • Design for different road classes: urban, rural, expressways • Design of interchanges and ramps **8. Traffic Simulation and Modeling** • Introduction to traffic simulation tools (e.g., VISSIM, SYNCHRO) • Model calibration and validation techniques • Impact of traffic control measures on flow • Microscopic and macroscopic simulation approaches **9. Parking and Transit Systems** • On-street and off-street parking demand analysis • Design of parking lots and garages • Transit systems design and operation • Integration of transit and non-motorized transport • Bicycle lanes and pedestrian facilities **10. Traffic Demand Management (TDM)** • Principles and strategies for TDM • Pricing strategies (e.g., congestion pricing) • Carpooling and ridesharing • Public transportation promotion • Active transportation planning (bicycles, walking) **11. Sustainable and Smart Traffic Management** • Eco-friendly traffic management strategies • Green transportation systems and policies • Use of data analytics and machine learning in traffic management • Autonomous vehicles and their impact on traffic engineering • Smart cities and their role in traffic planning **12. Transport Planning and Policy** • Transportation planning process and stages • Integrated land use and transportation planning • Government policies and regulations in traffic management • Environmental considerations in traffic engineering • Transport economics **13. Advanced Topics in Traffic Engineering**

	• Traffic simulation in urban settings • Urban mobility and smart transportation systems • Analysis of freight traffic and logistics systems • Congestion management techniques • Autonomous vehicle integration **14. Case Studies and Practical Applications** • Real-world case studies in traffic control and planning • Traffic engineering applications in different regions and cities • Lessons learned from successful and failed traffic projects • Field surveys and traffic data analysis **15. Future Trends in Traffic Engineering** • Emerging technologies in traffic management (AI, IoT) • Impact of electric and autonomous vehicles • Evolution of smart transportation networks • Urban mobility and future transportation systems

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lecture-Based Teaching** • **Clear Explanations**: Start with foundational theories, principles, and definitions, gradually introducing more complex concepts. • **Visual Aids**: Use diagrams, flow charts, and infographics to explain traffic flow, intersection design, and safety measures. • **Real-World Examples**: Incorporate current traffic problems and solutions from different regions and cities to contextualize theory. **2. Problem-Based Learning (PBL)** • **Case Studies**: Assign case studies of real-world traffic engineering problems (e.g., traffic congestion, accident analysis, intersection redesign). • **Group Work**: Encourage students to work in groups to solve these problems, which fosters collaboration and practical problem-solving skills. • **Project Work**: Assign long-term projects that involve traffic simulation, data collection, or the design of traffic systems. This helps integrate theory and practice. **3. Field Visits and Practical Exposure** • **Site Visits**: Organize visits to traffic control centers, signalized intersections, highway construction sites, or smart city traffic management systems to observe traffic engineering in practice. • **Traffic Data Collection**: Have students collect and analyze real traffic data, such as vehicle counts, speeds, and accident data, using modern tools or manual counting techniques. • **Traffic Simulation Labs**: Use traffic simulation software (like VISSIM, SYNCHRO) to allow students to model and simulate traffic flow and control systems in a virtual environment. **4. Hands-On Activities and Exercises** • **Design Exercises**: Engage students in designing intersections, roads, or parking facilities, using CAD software or hand-drawing techniques. • **Traffic Flow Analysis**: Use real-time traffic data (e.g., from sensors or online

	sources) to analyze flow, congestion, and capacity. • **Signal Timing Optimization**: Allow students to work with signal timing software to optimize light cycles at busy intersections. • **Accident Investigation**: Simulate or investigate traffic accidents, analyze their causes, and suggest remedial measures. **5. Flipped Classroom** • **Pre-Class Learning**: Assign reading materials or videos before class to introduce key concepts such as traffic flow theory, roadway design, and control devices. • **In-Class Activities**: Use classroom time for active learning, group discussions, and solving traffic-related problems, which allows for deeper understanding. • **Peer Teaching**: Students can take turns teaching certain topics to their peers, which reinforces learning and enhances comprehension. **6. Use of Technology and Simulation Tools** • **Traffic Simulation Software**: Introduce traffic simulation tools (e.g., VISSIM, SYNCHRO, AIMSUN) for practical applications in traffic flow and control analysis. • **GIS and Data Analytics**: Teach students how Geographic Information Systems (GIS) can be used to analyze traffic patterns, accident hotspots, and urban mobility. • **Mobile Apps**: Use apps and online platforms to track and analyze traffic patterns in real time, allowing students to study dynamic traffic systems. **7. Collaborative Learning and Group Discussions** • **Peer Review and Feedback**: Organize group discussions on contemporary traffic challenges (e.g., congestion pricing, pedestrian safety). Encourage peer feedback to develop critical thinking. • **Debates and Role Plays**: Organize debates on issues like autonomous vehicles, smart traffic systems, or the environmental impact of transport. • **Collaborative Projects**: Create interdisciplinary projects with urban planning or environmental engineering students to promote holistic learning. **8. Interactive Workshops and Seminars** • **Workshops on Traffic Safety**: Organize interactive workshops to develop skills in traffic safety auditing, accident analysis, and designing safer roadways. • **Industry Seminars**: Invite professionals and experts from the transportation and traffic engineering sectors to give talks on current trends, challenges, and innovations. **9. Assessment and Feedback** • **Formative Assessment**: Use quizzes, assignments, and periodic assessments to evaluate students' understanding of fundamental concepts such as traffic flow theory, safety, and intersection design. • **Summative Assessment**: Involve larger assessments (e.g., a final project, research paper, or exam) that require students to integrate all the material covered in the course. • **Peer and Self-Assessment**: Allow students to assess their own work and the work of their peers, helping to foster self-reflection and accountability in learning. **10. Integration of Environmental and Sustainable Aspects** • **Sustainability Focus**: Incorporate sustainability principles into traffic engineering topics, such as reducing carbon emissions, promoting public transport, and designing pedestrian-friendly cities. • **Smart Mobility**: Teach students about the intersection of traffic engineering with emerging technologies like electric vehicles, autonomous cars, and smart cities, using current case studies. **11. Continuous Professional Development (CPD)** • **Industry Linkages**: Encourage students to attend conferences, workshops, and

	internships related to traffic engineering, where they can interact with professionals in the field. • **Certifications**: Promote the attainment of professional certifications in traffic management tools, such as traffic signal timing software or transportation planning. **12. Cross-Disciplinary Approach** • **Integration with Urban Planning**: Traffic engineering cannot be studied in isolation. Encourage collaboration with urban planning, civil engineering, and environmental studies to understand the broader impact of traffic systems. • **Economics and Policy**: Engage students in discussions on the economic aspects of transportation (e.g., funding, toll systems, pricing) and policy-making to provide a well-rounded view.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Introduction to planning (types - stages - theories)

Week 2	Introduction to planning (types - stages - theories)
Week 3	Planning cycle (models - planning patterns)
Week 4	Planning cycle (models - planning patterns)
Week 5	basic design
Week 6	basic design
Week 7	Survey work for basic design
Week 8	Survey work for basic design
Week 9	land uses
Week 10	land uses
Week 11	cadastral land uses
Week 12	cadastral land uses
Week 13	cadastral land uses
Week 14	Types of earth treatments
Week 15	Types of earth treatments
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	drawing scale
Week 2	drawing scale
Week 3	Keys to land uses and sector codes
Week 4	Keys to land uses and sector codes
Week 5	types of housing
Week 6	types of housing
Week 7	strip city
Week 8	strip city
Week 9	Garden City
Week 10	Garden City
Week 11	shopping centers
Week 12	shopping centers
Week 13	shopping centers
Week 14	Students' walks
Week 15	Students' walks

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**FUNDAMENTAL OF THEORY OF ERRORS 1**		**Module Delivery**	
Module Type	**Core**		☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 405**			
ECTS Credits	**5**			
SWL (hr/sem)	125			
Module Level			**Semester of Delivery**	1
Administering Department			**College**	Type College Code
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)		**e-mail**	E-mail
Peer Reviewer Name	Name		**e-mail**	E-mail
Scientific Committee Approval Date			**Version Number**	1.0

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives	The objective of studying "Theory of Errors" topics is to provide individuals with the knowledge and skills necessary to understand and analyze the sources of errors in

أهداف المادة الدراسية	measurements and calculations, and to apply statistical methods to quantify and propagate these errors. By addressing these objectives, the theory of errors helps ensure that measurements and experimental data are reliable, accurate, and properly interpreted. It provides a systematic approach to quantifying uncertainties, minimizing errors, and making sound decisions based on measurement results. The theory of errors is widely applied in various scientific and engineering fields, including physics, chemistry, biology, engineering, and metrology.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understanding of Measurement and Errors** • **MLO 1**: Explain the fundamental concepts of measurement, errors, and uncertainties in the context of engineering and scientific analysis. • **MLO 2**: Identify and differentiate between various types of errors, including systematic, random, and gross errors, and their implications on measurement accuracy. **2. Quantification of Errors** • **MLO 3**: Calculate absolute, relative, and percentage errors in measurements and assess their significance in different measurement contexts. • **MLO 4**: Apply statistical methods to quantify random errors, including mean, standard deviation, and variance, in measured data. **3. Error Propagation and Analysis** • **MLO 5**: Understand and apply error propagation formulas to determine how errors in input measurements affect the accuracy and precision of calculated results. • **MLO 6**: Evaluate the impact of multiple sources of errors on the final result through propagation techniques for both simple and complex measurements. **4. Precision and Accuracy of Measurements** • **MLO 7**: Analyze the precision and accuracy of measurement systems and instruments, and understand their influence on the quality of data. • **MLO 8**: Evaluate the repeatability and reproducibility of measurements through statistical tests and experimental design. **5. Significance Testing and Confidence Intervals** • **MLO 9**: Apply statistical methods to assess the reliability of experimental results, including hypothesis testing and the calculation of confidence intervals. • **MLO 10**: Interpret the meaning and importance of confidence levels and intervals in the context of measurement uncertainty. **6. Calibration and Instrumental Errors** • **MLO 11**: Understand the role of calibration in minimizing systematic errors and describe methods for calibrating measurement instruments. • **MLO 12**: Identify common sources of instrumental errors and propose strategies for minimizing or compensating for these errors. **7. Data Fitting and Curve Fitting Techniques** • **MLO 13**: Apply least squares fitting and regression analysis to experimental data to obtain the best possible model while minimizing errors. • **MLO 14**: Interpret the results of data fitting and analyze the goodness of fit using

	appropriate statistical tools (e.g., R-squared, residual analysis). **8. Application of Theory of Errors in Real-World Measurements** • **MLO 15**: Demonstrate the application of the theory of errors in real-world engineering measurements and data analysis scenarios. • **MLO 16**: Critically evaluate the impact of errors in engineering designs and measurements, and recommend methods to improve accuracy and precision. **9. Ethical Considerations in Data Reporting** • **MLO 17**: Recognize and adhere to ethical principles in the collection, reporting, and interpretation of measurement data, ensuring transparency and integrity. • **MLO 18**: Understand the importance of reporting uncertainty and error margins in scientific and engineering work, ensuring that results are communicated accurately. **10. Use of Computational Tools for Error Analysis** • **MLO 19**: Utilize computational tools and software (e.g., MATLAB, Python, Excel) for error analysis, propagation, and visualization in measurement data. • **MLO 20**: Implement error analysis methods in computational tools to automate the assessment of measurement uncertainties and error propagation.
Indicative Contents المحتويات الإرشادية	**1. Introduction to the Theory of Errors** • Definition of error and uncertainty in measurement • Importance of error analysis in scientific and engineering practice • Types of errors: **systematic**, **random**, and **gross** errors • Sources of errors in measurement systems (e.g., instrument limitations, environmental factors) • Impact of errors on data accuracy and precision **2. Basic Concepts in Measurement** • Understanding **precision** and **accuracy** • Difference between **absolute error**, **relative error**, and **percentage error** • Concept of **uncertainty** in measurements • Measurement scales: **nominal**, **ordinal**, **interval**, and **ratio** **3. Classification of Errors** • **Systematic Errors**: ○ Causes and examples (e.g., instrument calibration, environmental factors) ○ Methods of detecting and correcting systematic errors • **Random Errors**: ○ Sources of random errors (e.g., environmental fluctuations, observer variability) ○ Characteristics of random errors (e.g., Gaussian distribution) ○ Reducing random errors through repetition and statistical analysis • **Gross Errors**: ○ Causes and identification of gross errors (e.g., human mistakes, faulty equipment)

- Methods for preventing and handling gross errors

4. Error Propagation

- **Propagation of errors** in arithmetic operations:
  - Addition, subtraction, multiplication, and division
- **Propagation of errors** in functions of multiple variables (e.g., f(x, y, z))
- Linear approximations for error propagation in measurements
- Application of **partial derivatives** for error propagation in complex formulas
- Practical examples of error propagation in real-world measurements

5. Statistical Treatment of Errors

- Introduction to **statistics** in error analysis
- Measures of central tendency: **mean**, **median**, **mode**
- Measures of variability: **variance**, **standard deviation**, **range**
- Concept of **Gaussian distribution** and its relation to random errors
- Confidence intervals and their role in uncertainty estimation
- Calculation of **standard error of the mean** and confidence levels
- **Least squares** fitting and error minimization

6. Determining the Accuracy of Measurements

- Accuracy vs. precision: Their impact on data quality
- **Repeatability** and **reproducibility** of measurements
- Techniques for measuring precision (e.g., standard deviation, variance)
- Quantifying accuracy using **bias** and **precision** parameters
- Statistical tests for evaluating accuracy and precision

7. Data Fitting and Curve Fitting

- **Regression analysis** and fitting models to experimental data
- **Least squares fitting** for linear and nonlinear models
- Interpretation of regression coefficients, residuals, and error margins
- Assessing the goodness of fit using **R-squared**, **chi-square**, and other statistical tests
- Practical application of data fitting in experimental and real-world scenarios

8. Calibration of Instruments

- Definition and importance of **instrument calibration**
- Calibration methods and error sources in calibration
- Detection and correction of **systematic errors** through calibration
- Concepts of **calibration curve**, **zeroing**, and **span adjustment**
- Practical examples of calibration procedures and their role in measurement accuracy

9. Uncertainty in Measurement

- **Type A** and **Type B** evaluations of uncertainty
- Combining uncertainties from different sources (e.g., random and systematic)
- **Propagation of uncertainty** through different measurement processes

	• Calculation of total uncertainty in a complex measurement setup • Reporting uncertainty using **expanded uncertainty** and **coverage factor** • Application of uncertainty in reporting experimental results **10. Use of Computational Tools in Error Analysis** • Software tools for error analysis (e.g., MATLAB, Python, Excel) • Performing error propagation and uncertainty calculations using computational tools • Statistical analysis of measurement data using software packages • Visualizing error distributions and confidence intervals **11. Practical Application of Error Theory** • Application of error analysis in **engineering** and **scientific experiments** • Use of error analysis in **quality control** and **process optimization** • Handling uncertainty in **design calculations** and **engineering simulations** • Real-life case studies demonstrating the importance of error analysis • Engineering examples (e.g., measurement of material properties, structural testing) **12. Ethical Considerations in Data and Error Reporting** • Ethical responsibilities in reporting measurement errors and uncertainty • Transparency in documenting and communicating measurement uncertainties • Recognizing and addressing **bias** and **manipulation** in reported results • Proper documentation of error analysis in scientific and engineering work **13. Emerging Trends in Error Analysis** • The role of error analysis in **big data** and **machine learning** applications • New developments in **uncertainty quantification** for complex systems • Application of error theory in **smart sensors**, **IoT**, and **autonomous systems** • Advances in **real-time error detection** and **automated calibration** techniques **14. Case Studies and Practical Exercises** • In-depth analysis of real-world engineering problems involving measurement errors • Hands-on exercises and lab work to apply theory to practical measurement systems • Use of software tools (e.g., MATLAB or Python) to analyze and propagate errors in experimental data

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lecture-Based Instruction with Interactive Elements** • **Structured Lectures**: Provide a solid foundation in the theoretical concepts of errors, uncertainty, and statistical analysis. Use visuals, graphs, and examples to explain key concepts

	such as systematic errors, random errors, and propagation of uncertainty. • **Interactive Discussions**: Incorporate class discussions where students can apply theory to real-world examples. Ask students to identify types of errors in different measurement scenarios and propose ways to minimize them. **2. Hands-On Software Tutorials** • **Software Integration**: Teach students how to use computational tools such as MATLAB, Python, or Excel for error analysis and data fitting. Demonstrate the application of error propagation and statistical methods for analyzing and reducing errors. • **Guided Exercises**: Walk students through step-by-step tutorials to practice error propagation, uncertainty analysis, and regression analysis using these software tools. Provide datasets that require students to perform these tasks. • **Real-World Data Analysis**: Provide students with real-world measurement data (e.g., from engineering experiments, sensor data, or field measurements) for them to analyze errors and uncertainties using computational tools. **3. Problem-Based Learning (PBL)** • **Real-Life Case Studies**: Present real-world engineering or scientific case studies where measurement errors have had significant impacts (e.g., failed experiments, miscalculated designs). Ask students to identify errors and suggest methods for improving accuracy. • **Problem-Solving Tasks**: Use PBL to encourage students to apply error theory to practical engineering problems, such as designing an experiment with minimal error or correcting errors in a set of measurements. • **Group Projects**: Assign group projects where students must collectively analyze and reduce errors in a simulated or actual measurement process. This fosters teamwork and enhances problem-solving skills. **4. Laboratory Sessions and Field Work** • **Hands-On Labs**: Organize laboratory sessions where students conduct measurements using instruments (e.g., digital calipers, thermometers, or other sensors). Afterward, guide them through error analysis, calculating absolute and relative errors, and identifying sources of errors. • **Field Visits**: Arrange field visits to engineering sites (e.g., construction sites, laboratories, or industrial plants) where students can observe how errors are managed in real-life settings. Encourage students to assess the accuracy and precision of measurements in the field and identify common sources of error. • **Measurement Practice**: Have students conduct real-world measurements, using their tools to gather data, then analyzing the errors and uncertainties involved. **5. Flipped Classroom Approach** • **Pre-Class Preparation**: Provide pre-recorded videos, reading materials, or online tutorials that cover key concepts like types of errors, error propagation, and statistical analysis before the class. This allows students to learn at their own pace. • **Active In-Class Learning**: In class, focus on applying the concepts learned, such as solving practical error analysis problems, performing calculations, and working with data.

	Encourage peer-to-peer learning by having students discuss and solve problems in groups. **6. Collaborative Learning and Peer Reviews** • **Group Work and Peer Feedback**: Assign students group projects where they work together to analyze and reduce errors in an engineering context. Encourage peer review where students assess each other's error analysis and give constructive feedback. • **Classroom Problem Solving**: Divide the class into teams and present error analysis problems for them to solve collaboratively. Afterward, facilitate a class-wide discussion of the solutions, encouraging students to explain their approach and reasoning. **7. Active Learning through Case Studies** • **Case Study Discussions**: Present students with case studies from real-world engineering, science, or manufacturing contexts where errors in measurements had serious consequences. Discuss how those errors could have been mitigated or minimized using proper error analysis techniques. • **Error Analysis in Design**: Encourage students to consider how error analysis influences design decisions in engineering projects. For example, students could explore how measurement uncertainty affects the design of structures, the calibration of instruments, or the quality of materials. **8. Socratic Method and Inquiry-Based Learning** • **Critical Thinking**: Use the Socratic method to encourage students to think critically about the assumptions they make during error analysis. Ask probing questions to help them analyze the validity of measurements, identify potential sources of error, and understand how uncertainty affects their conclusions. • **Inquiry-Based Problem Solving**: Provide students with incomplete datasets or ambiguous measurement situations and encourage them to question the data, assess the sources of error, and develop strategies for addressing uncertainties. **9. Use of Real-Time Data and Simulation** • **Simulations**: Use simulations to model how errors propagate in complex systems. Allow students to manipulate variables and see how different errors affect results. Simulations can be used to model error propagation in mechanical systems, electrical measurements, or chemical processes. • **Real-Time Error Analysis**: Have students engage in live data collection and error analysis activities during lab sessions or field trips. This hands-on approach helps students understand how errors affect real-time data. **10. Evaluation and Feedback** • **Frequent Formative Assessments**: Use quizzes, short assignments, or in-class exercises to gauge students' understanding of key error analysis concepts. Provide timely feedback to help students correct misunderstandings early. • **Summative Assessments**: Assign larger projects, reports, or exams that require students to apply error analysis principles to complex, multi-step problems. Encourage students to explain their thought processes, including how they identified and handled sources of error. • **Peer Evaluation**: Have students review and critique each other's work in group projects, offering insights into their classmates' error analysis processes.

	11. Integration of Ethical Considerations • **Ethics in Reporting Errors**: Teach students about the ethical implications of misreporting measurement errors or uncertainties. Discuss the importance of honesty and transparency when reporting experimental results, particularly in scientific and engineering practice. • **Ethical Case Studies**: Present case studies where failure to properly account for errors led to ethical dilemmas (e.g., incorrect reporting of results, miscommunication of uncertainties in safety-critical systems). **12. Guest Lectures and Expert Talks** • **Industry Experts**: Invite guest speakers from industries such as manufacturing, aerospace, or instrumentation to talk about the role of error analysis in their work. Experts can provide valuable insights into how error theory is applied in practice and the tools used to manage measurement uncertainty. • **Professional Experiences**: Allow students to hear from professionals about real-world challenges they've faced with measurement accuracy, error handling, and the importance of rigorous error analysis in ensuring safety and quality. **13. Continuous Professional Development (CPD)** • **Encourage Independent Learning**: Suggest online resources, courses, and certification programs (e.g., courses on MATLAB, Python, or statistics for engineers) for students to continue building their error analysis skills beyond the classroom. • **Workshops and Webinars**: Organize workshops or webinars on advanced topics in error analysis or computational tools used for handling errors in measurement. **14. Technology and Innovation in Error Analysis** • **Smart Sensors and IoT**: Discuss how new technologies such as smart sensors, IoT devices, and automation in measurement systems are changing the landscape of error analysis. Have students explore how these technologies handle uncertainty and improve data accuracy. • **AI and Machine Learning**: Introduce students to the role of AI in error detection, anomaly detection, and improving accuracy in data analysis.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل		**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**75**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Accuracy and types of errors
Week 2	Accuracy and types of errors
Week 3	Classification of errors
Week 4	Classification of errors
Week 5	Most likely error
Week 6	Most likely error
Week 7	Ordinary equations with three variables
Week 8	Ordinary equations with three variables
Week 9	Solve equations with weights
Week 10	Solve equations with weights
Week 11	Solve equations with weights
Week 12	Solve equations with weights
Week 13	Alternative method of difference
Week 14	Alternative method of difference
Week 15	Engagement method

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	N/A
Week 2	

Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		Yes
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Urban Planning**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 407**				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level		4	**Semester of Delivery**		2
Administering Department		Type Dept. Code	**College**	Type College Code	
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq	
Module Leader's Acad. Title			**Module Leader's Qualification**		Ph.D.
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name		Name	**e-mail**	E-mail	
Scientific Committee Approval Date			**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective is to provide individuals with the knowledge and skills necessary to understand and contribute to the development and management of urban areas. Urban planning is a multidisciplinary field that focuses on creating sustainable, functional, and inclusive urban environments. The objective of urban planning is to create well-designed, sustainable, and functional urban environments that cater to the needs of communities and promote the overall well-being of residents. Urban planning involves the systematic organization and design of physical, social, and economic elements of cities and towns.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Analyze Urbanization Trends and Issues** • **Outcome:** Students will be able to critically analyze patterns and trends of urbanization, identifying their causes, consequences, and challenges at local, national, and global levels. • **Key Skills:** Data analysis, trend identification, and critical thinking in urban studies. **2. Apply Urban Planning Theories and Concepts** • **Outcome:** Students will be able to apply key urban planning theories, concepts, and frameworks to real-world urban issues and development scenarios. • **Key Skills:** Application of theoretical knowledge, strategic thinking, and problem-solving. **3. Design Sustainable Urban Spaces** • **Outcome:** Students will demonstrate the ability to design urban spaces that balance environmental, social, and economic sustainability, considering both short-term and long-term impacts. • **Key Skills:** Urban design, sustainability principles, and creative problem-solving. **4. Evaluate Infrastructure Planning and Development** • **Outcome:** Students will be able to assess the effectiveness and challenges of urban infrastructure planning, including transportation, housing, energy, and water systems. • **Key Skills:** Infrastructure analysis, systems thinking, and planning evaluation. **5. Address Social Equity and Inclusion** • **Outcome:** Students will be able to evaluate urban planning practices through the lens of social equity, identifying strategies to enhance inclusion, affordable housing, and access to essential services. • **Key Skills:** Social equity analysis, policy assessment, and community engagement. **6. Develop Urban Policies and Governance Frameworks** • **Outcome:** Students will be able to assess and develop urban policies that promote sustainable development and effective governance, considering local, regional, and national contexts. • **Key Skills:** Policy analysis, governance understanding, and regulatory framework development. **7. Integrate Technology in Urban Planning** • **Outcome:** Students will demonstrate an understanding of how technologies like Geographic Information Systems (GIS), smart city tools, and digital infrastructure contribute to modern urban planning practices. • **Key Skills:** Technology integration, digital literacy, and GIS skills. **8. Implement Transportation and Mobility Solutions** • **Outcome:** Students will be able to plan and implement urban mobility strategies that enhance transportation efficiency, reduce congestion, and promote sustainable travel options. • **Key Skills:** Transportation planning, mobility strategy development, and systems

	integration. **9. Promote Resilience and Climate Adaptation in Urban Areas** • **Outcome:** Students will be able to assess urban vulnerabilities to climate change and develop resilience strategies to mitigate environmental risks in urban settings. • **Key Skills:** Climate resilience planning, risk assessment, and environmental mitigation. **10. Examine the Ethical Dimensions of Urban Planning** • **Outcome:** Students will be able to recognize and address ethical dilemmas in urban planning, including issues related to fairness, justice, and accountability in decision-making processes. • **Key Skills:** Ethical analysis, professional integrity, and ethical decision-making. **11. Engage Stakeholders and Communities in the Planning Process** • **Outcome:** Students will be able to effectively engage diverse stakeholders, including local communities, in the urban planning process to ensure participation and transparency. • **Key Skills:** Public engagement, stakeholder management, and communication. **12. Conduct Urban Planning Research and Analysis** • **Outcome:** Students will develop the ability to conduct research on urban planning issues using qualitative and quantitative methods, synthesizing data to inform planning decisions. • **Key Skills:** Research methodology, data collection, analysis, and report writing. **13. Work Collaboratively on Urban Planning Projects** • **Outcome:** Students will demonstrate the ability to collaborate in interdisciplinary teams, integrating perspectives from urban design, policy, and engineering to solve complex urban problems. • **Key Skills:** Teamwork, collaboration, and interdisciplinary thinking. **14. Present Urban Planning Solutions Effectively** • **Outcome:** Students will be able to present urban planning proposals clearly and effectively to various stakeholders, including government officials, community groups, and investors. • **Key Skills:** Communication, presentation, and negotiation.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Urban Planning** • Definition, scope, and history of urban planning • Key urban planning principles and approaches • Urbanization and its global trends • The role of urban planners in shaping cities **2. Urban Planning Theories and Models** • Classical urban planning theories (e.g., the Garden City, the Radiant City) • Modern planning theories (e.g., new urbanism, sustainable urban development) • Theories of city growth and development (e.g., concentric zone theory, sector theory, multiple nuclei theory) • Comparative urban planning models (e.g., Western vs. Eastern, global south urbanism) **3. Urban Design and the Built Environment** • Principles of urban design (e.g., public space design, accessibility, scale) • Urban aesthetics, form, and architecture • Streetscape and public realm design • Zoning and land-use planning (e.g., residential, commercial, industrial, mixed-use)

	• Smart cities and technology-driven design **4. Sustainable Urban Development** • Principles of sustainability in urban planning • Green urbanism and ecological urban design • Climate change and environmental challenges in cities • Low-carbon cities and urban energy efficiency • Sustainable transportation systems (e.g., public transit, cycling infrastructure) **5. Urban Infrastructure and Services** • Urban transportation planning and mobility (e.g., roads, public transport, pedestrian systems) • Water, waste, and energy management systems • Housing and urban regeneration • Urban sanitation and waste management • Urban utilities and their integration into planning **6. Urban Governance and Policy** • Urban governance frameworks: local government vs. central government • The role of urban policies in shaping cities (e.g., zoning laws, housing policies, environmental regulations) • Planning systems and instruments (e.g., master planning, strategic planning, participatory planning) • Public-private partnerships in urban development • Conflict resolution and negotiation in urban planning **7. Social Equity and Inclusive Urban Planning** • Social justice and equity in urban planning • Affordable housing and homelessness prevention • Planning for marginalized communities (e.g., low-income, minorities, refugees) • Community participation and public involvement in planning processes • Access to public services and social infrastructure (e.g., healthcare, education, recreation) **8. Urban Economics and Land Use** • Economic drivers of urban development (e.g., real estate, employment, commerce) • The role of land markets in urban growth • Urban land use planning and policies • Land value capture and taxation in urban areas • Gentrification and urban renewal **9. Transportation Planning and Mobility** • Urban mobility challenges: congestion, air pollution, and mobility equity • Transport infrastructure planning: road networks, public transit, cycling, and pedestrian infrastructure • Sustainable transportation: green transport modes, electric vehicles, mobility as a service (MaaS) • Urban transport governance and regulation • Planning for resilient transportation systems in the face of climate change **10. Urban Resilience and Climate Adaptation** • Urban vulnerability to natural disasters (e.g., floods, earthquakes, heatwaves) • Building resilient cities: disaster risk reduction, preparedness, and recovery • Climate adaptation strategies for cities • Green infrastructure and nature-based solutions for urban resilience

	• The role of urban planning in disaster risk management **11. Urban Planning and Technology** • The role of Geographic Information Systems (GIS) in urban planning • Urban planning in the context of smart cities and IoT (Internet of Things) • Data-driven urban management: big data, urban sensors, and digital twins • Digital governance and e-planning tools • Innovations in urban planning technologies (e.g., autonomous vehicles, drone use in planning) **12. Ethics and Professionalism in Urban Planning** • Ethical challenges in urban planning practice • Professional codes of conduct for urban planners • Balancing private interests and public good in urban planning • Conflict of interest and accountability in planning decisions • The role of urban planners in advocating for social justice **13. Planning for Urban Health and Well-being** • The relationship between urban form and public health • Planning for healthy cities: green spaces, walkability, and pollution reduction • Mental health considerations in urban planning • Addressing urban food security and access to healthy food • Creating inclusive environments that promote well-being for all residents **14. Urban Planning Challenges and Future Directions** • The future of cities: megacities, shrinking cities, and urban sprawl • Urban planning in the Global South: informal settlements and slums • Urban planning in post-conflict and post-disaster settings • Innovations in urban planning for the future: autonomous cities, AI-driven planning, and sustainable urbanism • The role of urban planning in achieving the United Nations Sustainable Development Goals (SDGs)

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lectures and Seminars** • **Purpose:** To deliver foundational knowledge, introduce key concepts, theories, and frameworks of urban planning. • **Approach:** ○ Use **interactive lectures** to engage students with discussions, case studies, and real-life examples. ○ **Seminars** can be used to explore specific topics in-depth, allowing students to debate and present their views. ○ Encourage critical thinking by asking open-ended questions and using multimedia tools (e.g., videos, GIS data visualizations). **2. Case Studies** • **Purpose:** To link theory with practice by exploring real-world urban planning problems and solutions. • **Approach:**

	○ Present **local and global case studies** of cities dealing with issues like congestion, climate change, housing crises, and social inequality. ○ Ask students to analyze and propose solutions based on learned theories and planning models. ○ Use **comparative case studies** to explore planning challenges in diverse urban contexts (e.g., developed vs. developing cities). ○ Encourage group work where students collaborate to analyze and present solutions for specific case studies. **3. Field Trips and Site Visits** • **Purpose:** To provide students with a tangible understanding of urban planning in practice. • **Approach:** ○ Organize visits to urban development projects, planning offices, or areas undergoing regeneration to observe firsthand the planning process. ○ Field trips can include visits to cities or neighborhoods that have implemented innovative urban design solutions or face significant planning challenges. ○ Encourage students to observe the interaction of social, economic, and environmental factors in urban settings. **4. Collaborative Learning and Group Work** • **Purpose:** To foster teamwork, problem-solving skills, and interdisciplinary thinking. • **Approach:** ○ Assign group projects where students work together on urban planning proposals (e.g., designing a sustainable neighborhood, creating a transport plan). ○ Encourage collaboration between students from diverse backgrounds, as urban planning often requires interdisciplinary work (e.g., urban design, transportation, policy). ○ Facilitate peer reviews and group critiques to refine ideas and approaches. **5. Problem-Based Learning (PBL)** • **Purpose:** To develop critical thinking, research skills, and the ability to apply knowledge to complex urban planning problems. • **Approach:** ○ Present students with **real-world urban planning challenges** (e.g., traffic congestion, affordable housing, environmental degradation) and ask them to develop practical solutions. ○ Students conduct research, evaluate planning strategies, and propose solutions, often in groups, with guidance from the instructor. ○ Use **simulations and role-play** exercises, where students take on the roles of different stakeholders in the planning process (e.g., city officials, developers, community members). **6. Workshops and Interactive Sessions** • **Purpose:** To enhance practical skills in urban design, policy analysis, and planning tools. • **Approach:** ○ Organize hands-on **workshops** on tools commonly used in urban planning, such as Geographic Information Systems (GIS), urban modeling software, or environmental impact assessment. ○ Have students work on creating zoning maps, transportation plans, or sustainable development proposals using these tools. ○ Introduce **design charrettes** (collaborative planning exercises) where students work intensively on design solutions for specific sites or issues.

	7. Guest Lectures and Industry Speakers • **Purpose:** To expose students to expert insights, contemporary issues, and innovations in urban planning. • **Approach:** ○ Invite guest speakers such as urban planners, architects, policy makers, or activists to share their expertise and experiences. ○ Use **panel discussions** to foster dialogue between experts and students, exploring various perspectives on urban planning topics (e.g., smart cities, affordable housing). ○ Guest speakers can also share their career paths and advice for entering the urban planning profession. **8. Technology Integration and Digital Learning** • **Purpose:** To familiarize students with the digital tools and technologies used in modern urban planning. • **Approach:** ○ Integrate **GIS** tools and urban planning software into coursework for spatial analysis, land-use planning, and transportation modeling. ○ Use **virtual field trips** or interactive simulations (e.g., urban planning games, online mapping tools) to engage students with city planning problems and solutions. ○ Incorporate **online learning platforms** for collaborative projects, discussions, and assignments. **9. Flipped Classroom** • **Purpose:** To encourage active learning and deeper engagement with course content. • **Approach:** ○ Provide students with **pre-recorded lectures, readings, or videos** to study at home. ○ Use class time for **active learning activities** such as discussions, case study analyses, group work, and problem-solving. ○ Encourage students to come prepared with questions and ideas for in-class activities. **10. Assessments and Critiques** • **Purpose:** To evaluate student progress and deepen understanding through constructive feedback. • **Approach:** ○ Use a combination of **formative assessments** (e.g., quizzes, essays, presentations) and **summative assessments** (e.g., exams, final projects). ○ Encourage regular **peer reviews** where students critique each other's work, providing constructive feedback on urban planning proposals. ○ Implement **oral presentations** to assess communication skills, where students present their planning proposals or research findings to the class or a panel of experts. **11. Role of Reflection and Personal Development** • **Purpose:** To help students reflect on their learning, connect theory with practice, and develop professional identity. • **Approach:** ○ Encourage students to maintain a **learning journal** or portfolio where they reflect on their learning experiences, challenges, and insights. ○ Incorporate opportunities for **self-assessment** and peer feedback, enabling students to track their own development and growth in urban planning. ○ Provide guidance on **career pathways** in urban planning and opportunities for professional development (e.g., internships, conferences, and networking).

	12. Community Engagement and Service Learning • **Purpose:** To connect students with local communities and provide hands-on experience in participatory planning. • **Approach:** ○ Organize **service-learning projects** where students work with local communities to address urban issues (e.g., neighborhood design, community health, or local transportation). ○ Collaborate with local planning agencies or NGOs to offer students real-world experience in community engagement, policy-making, or urban design projects.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**125**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	0	10% (10)	Continuous	All
	Report	5	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**

Week 1	Introduction to transportation and traffic engineering planning
Week 2	Introduction to transportation and traffic engineering planning
Week 3	Operating Elements and Traffic Design
Week 4	Operating Elements and Traffic Design
Week 5	Types of streets (residential)
Week 6	Types of streets (residential)
Week 7	Street classification
Week 8	Street classification
Week 9	ntersections
Week 10	ntersections
Week 11	Parking Standards
Week 12	Parking Standards
Week 13	Railway
Week 14	Railway
Week 15	Airports
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Residential spaces
Week 2	Residential spaces
Week 3	design patterns charts
Week 4	design patterns charts
Week 5	basic design
Week 6	basic design
Week 7	Street intersections
Week 8	Street intersections
Week 9	types of streets
Week 10	types of streets
Week 11	Car parking types and plans
Week 12	Car parking types and plans
Week 13	railway plans
Week 14	railway plans
Week 15	Airport Schemes

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Image Processing**		**Module Delivery**	
Module Type	**Core**		☒ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**SUT 408**			
ECTS Credits	**6**			
SWL (hr/sem)	**150**			
Module Level	1		**Semester of Delivery**	1
Administering Department	Type Dept. Code		**College**	Type College Code
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)		**e-mail**	E-mail
Peer Reviewer Name	Name		**e-mail**	E-mail
Scientific Committee Approval Date			**Version Number**	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective is to provide individuals with the knowledge and skills necessary to understand and analyze digital images, enhance image quality, extract useful information, and perform various operations on images using computer algorithms. The objective of image processing is to manipulate, analyze, and interpret digital images to extract meaningful information or enhance their visual quality. It involves applying various algorithms and techniques to images with the goal of achieving specific objectives or tasks.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Fundamentals of Image Processing** • **Outcome:** Students will demonstrate a clear understanding of the basic concepts of image processing, including image representation, types of images (e.g., grayscale, RGB), and the various mathematical operations used for image manipulation.

	• **Key Skills:** Understanding image data structures, pixel manipulation, and basic operations (e.g., filtering, transformations). **2. Apply Image Enhancement Techniques** • **Outcome:** Students will be able to apply and evaluate various image enhancement techniques, such as contrast adjustment, histogram equalization, and noise reduction, to improve image quality. • **Key Skills:** Practical application of image enhancement methods, evaluating results using appropriate performance metrics. **3. Perform Image Transformation and Geometric Operations** • **Outcome:** Students will be able to perform geometric transformations on images, such as scaling, rotation, translation, and affine transformations, and understand their impact on image alignment and interpretation. • **Key Skills:** Proficiency in applying transformation matrices, manipulating image geometries, and correcting image distortions. **4. Implement Image Filtering Techniques** • **Outcome:** Students will be able to implement and apply spatial and frequency domain filters, including low-pass and high-pass filters, edge detection filters (e.g., Sobel, Laplacian), and Gaussian filters. • **Key Skills:** Convolution, Fourier transforms, filtering in both spatial and frequency domains, edge detection. **5. Understand Image Segmentation and Object Recognition** • **Outcome:** Students will be able to apply image segmentation techniques (e.g., thresholding, region-growing, clustering) and basic object recognition methods to identify and extract meaningful objects from images. • **Key Skills:** Image segmentation, contour detection, object labeling, and feature extraction. **6. Implement Color Image Processing** • **Outcome:** Students will demonstrate the ability to process color images by manipulating color spaces (e.g., RGB, HSV), performing color correction, and applying color segmentation techniques. • **Key Skills:** Working with color models, converting between color spaces, color-based image enhancement. **7. Understand and Apply Image Compression Techniques** • **Outcome:** Students will be able to apply image compression algorithms (e.g., JPEG, PNG, lossless and lossy compression) and understand the trade-offs between compression ratio and image quality. • **Key Skills:** Understanding compression algorithms, implementing compression and decompression, analyzing quality loss. **8. Perform Image Restoration** • **Outcome:** Students will understand the principles of image restoration, including methods for correcting blurring, noise reduction, and deblurring, and will be able to apply these techniques in practical scenarios. • **Key Skills:** Image restoration algorithms, noise modeling, inverse filtering, Wiener filtering. **9. Evaluate Image Processing Algorithms and Techniques** • **Outcome:** Students will be able to critically evaluate the effectiveness of various image processing techniques based on specific image analysis goals, such as clarity, accuracy, or computational efficiency. • **Key Skills:** Algorithm comparison, performance metrics (e.g., PSNR, SSIM), and

	analysis of trade-offs in processing techniques. **10. Develop Image Processing Applications Using Software Tools** • **Outcome:** Students will demonstrate the ability to develop image processing applications using appropriate software tools and programming languages (e.g., Python with OpenCV, MATLAB, or other image processing libraries). • **Key Skills:** Programming, software tool proficiency, creating user interfaces for image processing applications. **11. Understand Advanced Topics in Image Processing** • **Outcome:** Students will be familiar with advanced image processing techniques such as image morphing, texture analysis, pattern recognition, and machine learning approaches applied to image processing tasks. • **Key Skills:** Advanced processing algorithms, integration of machine learning models with image data, pattern recognition. **12. Work on Image Processing Projects** • **Outcome:** Students will be able to design and implement an image processing project, from defining the problem to choosing appropriate techniques, evaluating results, and presenting findings. • **Key Skills:** Project planning, problem-solving, technical writing, project presentation.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Image Processing** • **Overview of Image Processing:** Definition, applications, and importance in various fields (e.g., medical imaging, computer vision, remote sensing). • **Image Representation:** Types of images (grayscale, color), digital image formats (JPEG, PNG, TIFF, etc.). • **Image Data Structures:** Pixel-based representation, image matrices, and color models (RGB, HSV, CMYK). **2. Image Enhancement** • **Basic Image Enhancement Techniques:** Contrast stretching, brightness adjustment, histogram equalization, and specification. • **Noise Reduction:** Techniques for smoothing and denoising images (e.g., mean filtering, median filtering, Gaussian filtering). • **Edge Enhancement:** Techniques for emphasizing edges (e.g., unsharp masking, high-pass filtering). **3. Geometric Transformations** • **Transformation Basics:** Translation, scaling, rotation, and affine transformations. • **Coordinate Systems:** Image coordinate systems and handling pixel locations. • **Interpolation Techniques:** Nearest-neighbor interpolation, bilinear interpolation, and bicubic interpolation for geometric transformations. • **Homographies:** Perspective transformations and projective geometry in image alignment. **4. Image Filtering** • **Spatial Domain Filters:** Convolution, kernel-based filtering, and application of filters (e.g., box filters, Gaussian filters, edge detection filters). • **Frequency Domain Filters:** Fourier Transform, low-pass and high-pass filters, and frequency domain processing for noise reduction and image enhancement. • **Edge Detection Techniques:** Sobel operator, Prewitt operator, Canny edge detector, Laplacian of Gaussian (LoG). **5. Image Segmentation**

- **Segmentation Techniques:** Thresholding (global and adaptive), region growing, clustering-based methods (e.g., k-means, mean-shift).
- **Edge-based Segmentation:** Detection of boundaries, active contours (snakes), and watershed algorithm.
- **Region-based Segmentation:** Region splitting and merging, and segmentation based on homogeneity.
- **Image Clustering:** Techniques for grouping similar pixels or objects in an image.

6. Color Image Processing

- **Color Models:** RGB, HSV, HSL, YCbCr, and their applications in image processing.
- **Color Space Conversion:** Converting between color models, understanding the advantages and limitations of each model.
- **Color Image Enhancement:** Techniques for improving color balance, saturation, and contrast in color images.
- **Color Segmentation:** Using color models for segmentation tasks, such as detecting regions based on color.

7. Image Compression

- **Introduction to Image Compression:** Lossless vs. lossy compression, and why compression is necessary.
- **Compression Algorithms:** JPEG, PNG, and GIF compression techniques.
- **Transform Coding:** Discrete Cosine Transform (DCT) for JPEG compression.
- **Compression Metrics:** Compression ratio, signal-to-noise ratio (SNR), Peak Signal-to-Noise Ratio (PSNR), and visual quality assessment.

8. Image Restoration

- **Restoration Techniques:** Noise modeling, inverse filtering, and Wiener filtering.
- **Image De-blurring:** Methods for recovering sharpness in blurred images.
- **Blind Deconvolution:** Techniques to estimate the blurring kernel when it is unknown.
- **Application of Restoration in Real-World Scenarios:** Dealing with camera noise, motion blur, and atmospheric disturbances.

9. Feature Extraction and Representation

- **Point, Line, and Edge Features:** SIFT (Scale-Invariant Feature Transform), SURF (Speeded Up Robust Features), Harris Corner Detection.
- **Texture Analysis:** Techniques for identifying patterns and textures (e.g., Gabor filters, co-occurrence matrices).
- **Shape Representation:** Contour-based features, shape descriptors, and moments.

10. Object Recognition and Tracking

- **Template Matching:** Matching predefined templates to detect objects in images.
- **Machine Learning for Recognition:** Introduction to supervised learning (e.g., support vector machines, k-nearest neighbors).
- **Deep Learning for Image Recognition:** Using convolutional neural networks (CNNs) for object detection and classification.
- **Image Matching and Tracking:** Techniques for tracking objects across video frames, optical flow, and Kalman filtering.

11. Advanced Image Processing Techniques

- **Morphological Operations:** Dilation, erosion, opening, and closing for binary image processing.
- **Advanced Segmentation Algorithms:** Graph cuts, level sets, and deep learning-based segmentation (e.g., U-Net).
- **3D Image Processing:** Techniques for processing 3D images, such as medical

	imaging (CT, MRI), and point cloud data from LIDAR. • **Image Registration:** Aligning multiple images (e.g., in medical imaging, satellite image stitching). **12. Applications of Image Processing** • **Medical Imaging:** Techniques for enhancing and analyzing medical images (e.g., CT scans, MRIs, X-rays). • **Remote Sensing and Satellite Imaging:** Processing satellite images for environmental monitoring, land-use classification, etc. • **Computer Vision:** Real-time video processing, object detection, recognition, and augmented reality. • **Forensic Imaging:** Enhancing forensic images for legal purposes, including crime scene analysis. **13. Image Processing Tools and Software** • **Image Processing Libraries:** Introduction to Python libraries like OpenCV, Pillow, and scikit-image; MATLAB for image processing. • **Practical Exercises:** Hands-on use of these tools to implement the algorithms and methods discussed throughout the course. • **Custom Image Processing Applications:** Building small image processing projects using programming languages and libraries. **14. Emerging Trends in Image Processing** • **Deep Learning and Neural Networks in Image Processing:** Exploring the use of deep learning in image recognition, segmentation, and enhancement tasks. • **Real-Time Image Processing:** Techniques for efficient real-time image processing, such as in autonomous vehicles and robotics. • **AI-Powered Image Processing:** Exploring AI-based tools for automatic image enhancement, restoration, and segmentation.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Interactive Lectures** • **Purpose:** To introduce foundational concepts and theoretical aspects of image processing. • **Approach:** ○ Deliver interactive lectures that explain key topics such as image representation, filtering, segmentation, and compression. ○ Use visual aids, such as diagrams, animations, and real-time image processing demonstrations, to enhance understanding. ○ Encourage student participation by asking open-ended questions and promoting discussions. ○ Incorporate live coding demonstrations, where students can see how algorithms are implemented in real-time using programming languages like Python or MATLAB. **2. Hands-on Practice and Labs** • **Purpose:** To give students practical experience and help them apply theory to real-world problems.

	• **Approach:** o Organize **lab sessions** where students work on coding image processing algorithms using tools like **Python (OpenCV, scikit-image)** or **MATLAB**. o Provide **guided exercises** where students apply basic image processing techniques such as filtering, edge detection, and segmentation. o Encourage students to explore datasets (e.g., medical images, satellite imagery) and implement techniques to enhance, segment, or recognize objects. o Include **debugging sessions** where students learn how to troubleshoot their code, understand errors, and optimize image processing pipelines. **3. Problem-Based Learning (PBL)** • **Purpose:** To enhance critical thinking, problem-solving, and application skills by solving real-world problems. • **Approach:** o Present students with practical **image processing problems** (e.g., removing noise from images, detecting edges, performing face recognition). o Encourage collaborative teamwork, where groups of students tackle different aspects of a larger project. o Involve students in **project-based learning**, where they can work on image processing challenges from fields like medical imaging, remote sensing, or video surveillance. o Have students present their solutions to the class, explaining their approach, challenges, and results. **4. Flipped Classroom** • **Purpose:** To foster independent learning and give students more time for active learning and problem-solving in class. • **Approach:** o Provide **pre-recorded lectures**, reading materials, or instructional videos that introduce key image processing concepts. o Use class time for **hands-on activities** and guided exercises where students can implement what they learned from the pre-class materials. o Encourage students to **work on exercises in groups**, allowing them to discuss and collaborate on coding challenges, such as implementing edge detection or image segmentation algorithms. **5. Project-Based Learning (PBL)** • **Purpose:** To allow students to work on larger, integrative projects that apply a wide range of image processing techniques. • **Approach:** o Assign group or individual **projects** where students create end-to-end image processing applications (e.g., building a facial recognition system, developing an image enhancement tool). o Projects should require students to collect data, apply various processing techniques (e.g., filtering, compression, segmentation), and evaluate the results. o Allow students to **choose project topics** that align with their interests (e.g., medical image processing, computer vision, robotics). o Provide regular **checkpoints** for project progress, where students present their work for feedback from peers and instructors. **6. Guest Lectures and Expert Talks** • **Purpose:** To expose students to cutting-edge research and industry applications of image processing. • **Approach:**

	○ Invite **industry professionals** or **researchers** working in areas like computer vision, medical imaging, or remote sensing to give guest lectures or webinars. ○ Organize **panel discussions** or Q&A sessions where students can ask about career opportunities, challenges in the field, and the future of image processing. ○ Use these opportunities to bridge the gap between theoretical knowledge and real-world applications. **7. Fluent Integration of Software Tools** • **Purpose:** To ensure that students become proficient in using popular image processing tools and software. • **Approach:** ○ Introduce students to widely-used image processing libraries such as **OpenCV** (for Python), **scikit-image**, **Pillow**, and **MATLAB Image Processing Toolbox**. ○ Organize workshops that walk students through how to use these tools to solve specific image processing tasks. ○ Allow students to **explore different software tools** to understand the strengths and weaknesses of each in solving specific problems (e.g., comparing MATLAB to Python-based OpenCV for real-time processing). **8. Collaborative Learning and Peer Feedback** • **Purpose:** To develop teamwork, communication, and critical analysis skills. • **Approach:** ○ **Peer review sessions** where students present their code, solutions, and findings to the class, and give constructive feedback on each other's work. ○ Encourage students to **collaborate** on coding tasks, where they can discuss their strategies, exchange ideas, and solve problems collectively. ○ Assign **group projects** that require collaborative work to develop complex image processing systems or solve real-world challenges. **9. Use of Real-World Case Studies** • **Purpose:** To apply theoretical knowledge to real-world image processing problems. • **Approach:** ○ Present case studies from different fields, such as **medical image processing** (e.g., MRI/CT scans), **satellite image processing**, **autonomous vehicles**, or **security and surveillance**. ○ Encourage students to analyze how image processing techniques are used in solving specific problems, and then design a solution for a similar scenario. ○ Use case studies to explore **ethical concerns** and the potential societal impact of image processing technologies (e.g., privacy issues in facial recognition). **10. Assessment through Practical Assignments** • **Purpose:** To assess students’ technical and problem-solving abilities. • **Approach:** ○ Provide a series of **practical assignments** where students need to implement specific image processing tasks (e.g., image filtering, segmentation, feature extraction). ○ Include **project-based assessments** where students must apply multiple techniques to solve a complex problem, such as creating a fully functional image classification system or restoring damaged images. ○ Use **continuous assessment** methods, such as weekly coding challenges or quizzes based on theoretical concepts. **11. Interactive Online Platforms and Simulations** • **Purpose:** To engage students outside of classroom hours and provide additional support.

	• **Approach:** ○ Utilize online platforms such as **Jupyter Notebooks** or **Google Colab** where students can run image processing code and interact with image datasets. ○ Incorporate online **quizzes and coding challenges** to test students' understanding and encourage independent learning. ○ Offer **discussion forums** where students can ask questions, share ideas, and collaborate on solving image processing challenges. **12. Self-paced Learning and Resources** • **Purpose:** To promote independent learning and mastery of image processing tools and techniques. • **Approach:** ○ Provide supplementary **online tutorials**, reading materials, and reference guides to allow students to explore image processing topics at their own pace. ○ Encourage students to work through **self-assessment quizzes**, allowing them to measure their understanding of core concepts.

Student Workload (SWL)

الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation

تقييم المادة الدراسية

As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

Week	Material Covered
Week 1	Thematic Information Extraction: review of supervised and unsupervised image classification – Maximum Likelihood and Bayesian classification .
Week 2	Thematic Information Extraction: review of supervised and unsupervised image classification – Maximum Likelihood and Bayesian classification .
Week 3	Machine Learning: neural networks – expert systems –support vector machine .
Week 4	Machine Learning: neural networks – expert systems –support vector machine .
Week 5	Machine Learning: neural networks – Deep Learning.
Week 6	Machine Learning: neural networks – Deep Learning.
Week 7	Hyperspectral Image Preprocessing: atmospheric correction – dimensionality reduction - minimum noise fraction transformation – endmember determination – pixel purity index – orthogonal sub-space projection.
Week 8	Hyperspectral Image Preprocessing: atmospheric correction – dimensionality reduction - minimum noise fraction transformation – endmember determination – pixel purity index – orthogonal sub-space projection.
Week 9	Hyperspectral Image Classification: spectral angle mapper – linear spectral un-mixing – spectroscopic library matching – Hyperspectral vegetation Indices.
Week 10	Hyperspectral Image Classification: spectral angle mapper – linear spectral un-mixing – spectroscopic library matching – Hyperspectral vegetation Indices.
Week 11	LiDAR data acquisition- multiple returns vs. full-waveform data– feature extraction from LiDAR data.
Week 12	LiDAR data acquisition- multiple returns vs. full-waveform data– feature extraction from LiDAR data.
Week 13	Miscellaneous Topics - Final Project Reviews, Final Project Presentations (optional) and Discussion.
Week 14	Miscellaneous Topics - Final Project Reviews, Final Project Presentations (optional) and Discussion.
Week 15	Miscellaneous Topics - Final Project Reviews, Final Project Presentations (optional) and Discussion.
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

Week	Material Covered
Week 1	N/A
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
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Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Radar Engineering**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**SUT 409**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	1		**Semester of Delivery**	1	
Administering Department	Type Dept. Code		**College**	Type College Code	
Module Leader	Mohammed Tareq Khaleel		**e-mail**	Mohammed.alsafaawe@ntu.edu.iq	
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	Ph.D.	
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name	Name		**e-mail**	E-mail	
Scientific Committee Approval Date			**Version Number**		

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective is to provide individuals with the knowledge and skills necessary to understand and analyze radar systems, their principles of operation, and their applications in various fields. These are some of the key objectives in the field of engineering radar. The use of radar technology in engineering applications continues to evolve, and engineers employ radar systems in various industries and disciplines to solve complex problems, improve safety, and enhance efficiency in diverse fields such as transportation, aerospace, geosciences, and defense.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understand the Principles of Radar Systems** • **Outcome:** Students will demonstrate a clear understanding of the fundamental principles of radar systems, including the basic operation of radar, types of radar waves, and radar equations.

	• **Key Skills:** Understanding radar signal transmission and reception, radar wave propagation, and basic radar system design. **2. Analyze Radar Wave Propagation and Environmental Effects** • **Outcome:** Students will be able to analyze and explain radar wave propagation, including free-space path loss, atmospheric effects, and ground clutter. • **Key Skills:** Application of radar propagation models, understanding the effects of weather and terrain on radar signal behavior, and mitigating environmental interference. **3. Design Radar Transmitter and Receiver Systems** • **Outcome:** Students will be able to design basic radar transmitter and receiver systems, including the selection of frequency bands, modulation schemes, and receiver components. • **Key Skills:** Understanding the key components of radar systems, including oscillators, amplifiers, and mixers, and designing basic systems for radar transmission and reception. **4. Apply Signal Processing Techniques in Radar Systems** • **Outcome:** Students will demonstrate the ability to apply signal processing techniques in radar systems, such as filtering, Fourier analysis, and Doppler processing for target detection and tracking. • **Key Skills:** Signal processing algorithms for noise reduction, target detection, and tracking, as well as Doppler shift analysis and Fourier transforms in radar applications. **5. Understand and Implement Radar Detection and Estimation Techniques** • **Outcome:** Students will understand the principles of radar detection theory and be able to implement estimation techniques, such as matched filtering and probability of detection. • **Key Skills:** Radar detection methods, including signal-to-noise ratio (SNR) analysis, false alarm rates, and probability of detection, using techniques like matched filters. **6. Examine Doppler Radar and Velocity Measurement** • **Outcome:** Students will be able to explain the principles of Doppler radar and implement systems for velocity measurement, including the calculation of radial velocity and resolving Doppler shifts. • **Key Skills:** Understanding Doppler shifts, implementing Doppler radar systems, and applying velocity measurements for target tracking. **7. Evaluate Radar Waveforms and Modulation Techniques** • **Outcome:** Students will be able to evaluate the advantages and disadvantages of various radar waveforms and modulation schemes, including continuous wave (CW), pulse, and frequency-modulated continuous wave (FMCW) radar. • **Key Skills:** Understanding the performance trade-offs of different radar waveforms and modulation methods, and choosing the appropriate waveform for specific radar applications. **8. Understand Radar Clutter and Mitigation Techniques** • **Outcome:** Students will understand the concept of radar clutter and its impact on target detection, and will be able to apply techniques for clutter mitigation such as adaptive filtering and Doppler shift analysis. • **Key Skills:** Identifying and mitigating clutter using advanced signal processing techniques, improving the performance of radar systems in cluttered environments. **9. Understand Radar System Design and Integration** • **Outcome:** Students will demonstrate the ability to design and integrate radar systems, taking into account factors such as range, resolution, power, and interference. • **Key Skills:** Radar system integration and optimization, including balancing the trade-offs between range, resolution, power consumption, and system performance. **10. Evaluate Radar Systems Performance** • **Outcome:** Students will be able to assess the performance of radar systems, using

	metrics such as resolution, detection range, signal-to-noise ratio (SNR), and system efficiency. • **Key Skills:** Evaluating radar system performance using key metrics, performing system simulations, and analyzing real-world radar data. **11. Understand Advanced Radar Techniques** • **Outcome:** Students will gain an understanding of advanced radar techniques, such as synthetic aperture radar (SAR), phased array radar, and multiple-input multiple-output (MIMO) radar. • **Key Skills:** Knowledge of advanced radar technologies, including SAR for high-resolution imaging, phased array for beam steering, and MIMO for spatial diversity and improved detection capabilities. **12. Develop Radar Engineering Projects** • **Outcome:** Students will be able to plan, design, and implement radar engineering projects, incorporating the theory and practical skills learned in the module. • **Key Skills:** Project planning, design, and execution, including radar system prototyping, simulation, and testing.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Radar Engineering** • **Radar Fundamentals:** Basic principles of radar, radar signal transmission, and reception. • **Applications of Radar:** Overview of radar applications in aviation, military, weather forecasting, automotive, and remote sensing. • **Radar Components:** Basic radar system components, such as antennas, transmitters, receivers, and signal processing units. **2. Radar Wave Propagation** • **Electromagnetic Waves:** Characteristics of radar waves, wavelength, frequency, and propagation through various media. • **Free-Space Propagation:** Path loss, radar range equation, and free-space attenuation. • **Atmospheric Effects:** Atmospheric absorption, refraction, and scattering of radar signals. • **Ground Clutter and Interference:** Effect of terrain, weather, and environmental conditions on radar signal propagation and mitigation techniques. **3. Radar Transmitter and Receiver Design** • **Radar Transmitters:** Power generation, frequency selection, pulse modulation, and continuous wave (CW) radar. • **Radar Receivers:** Signal detection, noise, sensitivity, and gain control. • **Radar Antennas:** Antenna types (parabolic, phased array, planar), antenna design considerations, beamforming, and directivity. • **Modulation and Frequency Techniques:** Pulse modulation, frequency modulation, phase modulation, and waveform selection. **4. Radar Signal Processing** • **Basic Signal Processing Techniques:** Filtering, Fourier transforms, and Doppler analysis. • **Matched Filtering:** Maximizing signal-to-noise ratio (SNR) for target detection. • **Pulse Compression:** Techniques for improving range resolution, such as chirp pulses. • **Doppler Processing:** Detecting and measuring radial velocity and Doppler shifts in moving targets. • **Clutter Rejection:** Techniques to minimize interference from stationary or slow-moving objects.

	5. Radar Detection and Estimation Theory • **Radar Detection Theory:** Probability of detection, false alarm rates, and signal-to-noise ratio (SNR). • **Detection Methods:** Constant false alarm rate (CFAR), threshold detection, and likelihood ratio tests. • **Matched Filters and Signal Estimation:** Design and application of matched filters for optimal detection of targets in noise. • **Detection in Noise:** Gaussian noise, white noise, and non-Gaussian noise considerations. • **Estimation Techniques:** Radar target localization, range, velocity estimation, and Kalman filtering. **6. Radar Waveforms and Modulation Techniques** • **Continuous Wave (CW) Radar:** Principles, advantages, and limitations of CW radar. • **Pulse Radar:** Time-domain characteristics, pulse duration, and pulse repetition frequency. • **Frequency-Modulated Continuous Wave (FMCW) Radar:** Operating principles, use in automotive radar, and range measurement techniques. • **Waveform Design:** Trade-offs between radar resolution, power, and range; selection of appropriate waveform types for specific applications. **7. Radar Clutter and Mitigation Techniques** • **Clutter Identification:** Types of radar clutter (e.g., ground clutter, weather clutter, sea clutter) and their impact on target detection. • **Clutter Rejection Methods:** Doppler filtering, adaptive filtering, and moving target indication (MTI) radar. • **Clutter Maps:** Creating and using clutter maps to enhance radar performance in cluttered environments. • **Interference Mitigation:** Techniques for dealing with interference from other radars or electronic systems (e.g., electronic countermeasures). **8. Radar Imaging Systems** • **Synthetic Aperture Radar (SAR):** Principles of SAR, image formation, resolution enhancement, and motion compensation. • **Inverse Synthetic Aperture Radar (ISAR):** Applications in maritime and aerial imaging for object recognition. • **Radar Imaging Resolution:** Trade-offs between resolution, range, and processing time. • **Radar Data Fusion:** Combining multiple radar data streams for improved object tracking and scene interpretation. **9. Advanced Radar Systems** • **Phased Array Radar:** Concepts of electronically controlled beam steering, multi-beam radar, and adaptive beamforming. • **MIMO (Multiple-Input, Multiple-Output) Radar:** Principles of MIMO radar systems, spatial diversity, and target localization. • **Radar for Autonomous Vehicles:** Radar-based perception systems in autonomous driving, collision avoidance, and adaptive cruise control. • **Radar and Machine Learning:** Application of AI and machine learning techniques to improve radar target detection, classification, and tracking. **10. Radar System Design and Integration** • **Design of Radar Systems:** Design principles for radar system performance

	optimization, including range, resolution, and accuracy. • **Radar System Performance Metrics:** Evaluating radar systems based on parameters like range, accuracy, resolution, and SNR. • **Radar System Simulation:** Using simulation tools for radar system design and performance evaluation. • **Integration with Other Systems:** Radar integration with other sensors (e.g., LIDAR, cameras) for multi-sensor fusion in applications like autonomous systems. **11. Radar Calibration and Testing** • **Radar Calibration:** Methods for calibrating radar systems, including range and velocity calibration. • **Testing Radar Systems:** Techniques for testing radar performance, including test environments, measurement equipment, and performance evaluation. • **Field Testing and Performance Analysis:** Analyzing radar system performance in real-world conditions and troubleshooting. **12. Radar System Applications** • **Aviation Radar:** Air traffic control, weather radar, and collision avoidance. • **Military Radar:** Radar for surveillance, target acquisition, fire control, and missile guidance. • **Meteorological Radar:** Weather monitoring, precipitation tracking, and storm detection. • **Automotive Radar:** Applications in driver assistance systems, adaptive cruise control, and autonomous vehicles. • **Marine Radar:** Navigation, collision avoidance, and object detection in maritime environments. **13. Emerging Radar Technologies** • **Advanced Radar Modulation and Waveforms:** New modulation schemes for high-performance radar systems. • **Quantum Radar:** Theoretical and emerging applications of quantum radar technology. • **Miniaturization of Radar Systems:** Development of small and low-power radar for use in drones and portable applications. • **Radar in Space Applications:** Radar systems for remote sensing, planetary exploration, and space debris detection.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lectures with Visual Aids and Demonstrations** • **Purpose:** To introduce theoretical concepts and key principles of radar systems. • **Approach:** ○ **Interactive lectures** that cover the fundamentals of radar engineering, such as radar wave propagation, signal processing, and radar system design. ○ Use **visual aids** like diagrams, simulations, and animations to illustrate complex concepts such as wave propagation, Doppler effects, and radar waveforms. ○ **Demonstrations** of radar components, such as antennas, transmitters, and receivers, to show real-world applications and how different parts of a radar system work

	together. ○ Include **live demonstrations** using simulation software (e.g., MATLAB, Simulink) to illustrate radar signal processing, target detection, and estimation techniques. **2. Hands-on Laboratory Sessions** • **Purpose:** To provide practical experience in designing and implementing radar systems and processing radar signals. • **Approach:** ○ **Radar hardware labs** where students work with actual radar equipment (if available) to observe system performance, measure radar signals, and test radar devices. ○ **Software-based labs** using simulation tools like MATLAB, Simulink, or specific radar simulation software to create and test radar systems, process radar data, and evaluate system performance. ○ **Step-by-step exercises** where students implement basic radar signal processing techniques, such as matched filtering, Doppler shift detection, and range estimation. ○ Allow students to experiment with **real-world radar data sets**, such as weather radar data or traffic radar data, to test algorithms and troubleshoot radar systems. **3. Project-Based Learning (PBL)** • **Purpose:** To integrate theory with practical application by encouraging students to tackle real-world radar engineering problems. • **Approach:** ○ Assign **group projects** where students design and build a radar system or radar-based application (e.g., a simple radar sensor for obstacle detection). ○ Use **real-world case studies**, such as radar systems in aviation, military, automotive, or meteorological applications, and have students design solutions based on these examples. ○ Encourage students to work in teams, fostering **collaborative learning**, problem-solving, and communication skills as they tackle complex radar engineering problems together. ○ Integrate **project milestones** with specific learning objectives, such as the design of a radar transmitter, receiver, or signal processing algorithm. **4. Flipped Classroom Approach** • **Purpose:** To maximize in-class time for hands-on learning and problem-solving, while students independently engage with theoretical content before class. • **Approach:** ○ Provide **pre-recorded lectures**, readings, or tutorials that cover foundational radar concepts like the radar equation, signal processing, and system design. ○ In class, focus on **interactive problem-solving**, where students work on designing radar systems, processing radar signals, or analyzing radar data in small groups. ○ Use **peer teaching** techniques where students can explain concepts to each other in collaborative settings, enhancing their own understanding. ○ Assign **homework problems** that challenge students to apply what they learned in class to real-world scenarios (e.g., radar system design or detecting specific objects in noisy environments). **5. Simulation-Based Learning** • **Purpose:** To allow students to model, simulate, and analyze radar systems in a controlled environment, helping them understand complex systems without the constraints of hardware. • **Approach:** ○ Introduce **radar simulation tools** (e.g., MATLAB, Simulink, or dedicated

radar simulation software) that allow students to simulate radar systems, test different radar waveforms, and analyze radar signal processing algorithms.

○ **Simulate radar scenarios** like radar target detection in noisy or cluttered environments, Doppler shift effects, and multi-target tracking.

○ Use **model-based design** techniques to test radar system designs, analyze performance metrics (such as range, resolution, and accuracy), and iterate on solutions.

○ Enable students to run **real-time simulations** of radar systems that model propagation effects, signal processing, and radar performance in various environmental conditions.

6. Guest Lectures and Industry Visits

- **Purpose:** To expose students to current radar technology, applications, and industry practices.
- **Approach:**

○ Invite **industry experts** (e.g., radar engineers, radar system designers, or researchers) to give guest lectures on cutting-edge radar technologies, such as phased array radar, radar for autonomous vehicles, or synthetic aperture radar (SAR).

○ Organize **site visits** to companies or research centers working on radar technology, where students can see radar systems in operation and interact with professionals in the field.

○ Use **real-world examples** of how radar is applied in various sectors, such as aerospace, automotive, and defense, and how emerging radar technologies are influencing future systems.

7. Problem-Based Learning (PBL) and Case Studies

- **Purpose:** To develop critical thinking, analytical, and problem-solving skills through real-life radar engineering scenarios.
- **Approach:**

○ Provide students with **case studies** of radar system failures, design challenges, or real-world radar applications, asking them to propose solutions or optimize existing systems.

○ Present students with complex **radar system design problems**, such as designing a radar system for a specific application (e.g., collision avoidance in autonomous vehicles or air traffic control).

○ Encourage students to research **current radar technologies** and identify potential improvements, fostering innovation and a deeper understanding of radar system design.

8. Collaborative Learning and Peer Feedback

- **Purpose:** To encourage teamwork, communication, and collaborative problem-solving skills.
- **Approach:**

○ Use **team-based projects** where students work together to solve radar engineering challenges, each contributing specific expertise, such as system design, signal processing, or software development.

○ Incorporate **peer review** sessions where students present their radar designs or solutions to the class and provide constructive feedback on each other's work.

○ Facilitate **team discussions** and brainstorming sessions to explore different approaches to radar design and signal processing, helping students learn from their peers and develop a more rounded understanding of radar engineering.

9. Formative and Summative Assessments

- **Purpose:** To assess both theoretical knowledge and practical skills in radar

	engineering. • **Approach:** ○ Use **formative assessments**, such as quizzes, coding assignments, or lab exercises, to test understanding of radar principles, signal processing techniques, and system design. ○ Incorporate **summative assessments**, such as a final project or exam, where students design a complete radar system or solve a complex radar problem. ○ Assess **practical competencies** through lab-based assessments where students build and test radar systems, analyze data, and apply signal processing techniques. ○ Provide **feedback** on both individual and group performance to help students understand areas for improvement. **10. Interactive Learning Platforms and Tools** • **Purpose:** To encourage active learning outside of the classroom and provide additional resources for students. • **Approach:** ○ Integrate **online learning platforms** (e.g., Moodle, Canvas, or Google Classroom) to host lecture materials, discussion boards, assignments, and quizzes. ○ Use **interactive simulators** and tools (e.g., radar signal processing apps, interactive radar tutorials) to help students visualize complex radar concepts and experiment with different system parameters. ○ Provide **access to code repositories** (e.g., GitHub) where students can share and collaborate on radar-related coding projects and research. **11. Research and Independent Study** • **Purpose:** To develop research and independent learning skills in radar engineering. • **Approach:** ○ Encourage students to undertake **independent research** on emerging radar technologies, such as MIMO radar, quantum radar, or radar in autonomous systems. ○ Assign **research papers** or **literature reviews** on specific radar technologies, encouraging students to engage with academic literature and stay updated on new advancements in radar engineering. ○ Foster **critical thinking** through assignments that ask students to evaluate the trade-offs in radar design and suggest innovative solutions to current radar challenges.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Radar Imaging and Remote Sensing: Synthetic Aperture Radar (SAR) Ground Moving Target Indication (GMTI) Radar altimetry, Radar interferometry
Week 2	Radar Imaging and Remote Sensing: Synthetic Aperture Radar (SAR) Ground Moving Target Indication (GMTI) Radar altimetry, Radar interferometry
Week 3	Radar Cross Section (RCS) and Stealth Technology: RCS fundamentals and measurement techniques Stealth design principles and techniques Low Observable (LO) materials and structures
Week 4	Radar Cross Section (RCS) and Stealth Technology: RCS fundamentals and measurement techniques Stealth design principles and techniques Low Observable (LO) materials and structures
Week 5	Radar Communication and Networking: Radar networking and data exchange Coordinated and distributed radar systems Radar communication protocols and standards
Week 6	Radar Communication and Networking: Radar networking and data exchange Coordinated and distributed radar systems Radar communication protocols and standards
Week 7	Radar System Calibration and Maintenance: Calibration techniques for radar systems Maintenance procedures and troubleshooting Quality assurance and performance testing
Week 8	Radar System Calibration and Maintenance: Calibration techniques for radar systems Maintenance procedures and troubleshooting Quality assurance and performance testing
Week 9	Radar System Calibration and Maintenance: Calibration techniques for radar systems Maintenance procedures and troubleshooting Quality assurance and performance testing
Week 10	Radar System Calibration and Maintenance: Calibration techniques for radar systems Maintenance procedures and troubleshooting Quality assurance and performance testing
Week 11	Radar Systems Integration: Integration of radar systems with other sensor systems Radar system

	integration challenges and solutions □ Interference analysis and mitigation
Week 12	Radar Systems Integration: □ Integration of radar systems with other sensor systems □ Radar system integration challenges and solutions □ Interference analysis and mitigation
Week 13	Radar Systems Integration: □ Integration of radar systems with other sensor systems □ Radar system integration challenges and solutions □ Interference analysis and mitigation
Week 14	Radar Systems Integration: □ Integration of radar systems with other sensor systems □ Radar system integration challenges and solutions □ Interference analysis and mitigation
Week 15	Radar Systems Integration: □ Integration of radar systems with other sensor systems □ Radar system integration challenges and solutions □ Interference analysis and mitigation
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	N/A
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	
Week 10	
Week 11	
Week 12	
Week 13	
Week 14	
Week 15	

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts		No
Recommended Texts		No

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

<table>
<tr><td colspan="6">Module Information
معلومات المادة الدراسية</td></tr>
<tr><td>Module Title</td><td colspan="3">Traffic Engineering</td><td colspan="2">Module Delivery</td></tr>
<tr><td>Module Type</td><td colspan="3">Core</td><td colspan="2" rowspan="4">☒ Theory
☒ Lecture
☒ Lab
☐ Tutorial
☐ Practical
☐ Seminar</td></tr>
<tr><td>Module Code</td><td colspan="3">SUT 410</td></tr>
<tr><td>ECTS Credits</td><td colspan="3">4</td></tr>
<tr><td>SWL (hr/sem)</td><td colspan="3">100</td></tr>
<tr><td>Module Level</td><td>2</td><td colspan="2">Semester of Delivery</td><td colspan="2">2</td></tr>
<tr><td>Administering Department</td><td>Type Dept. Code</td><td>College</td><td colspan="3">Type College Code</td></tr>
<tr><td>Module Leader</td><td>Mohammed Tareq Khaleel</td><td>e-mail</td><td colspan="3">Mohammed.alsafaawe@ntu.edu.iq</td></tr>
<tr><td>Module Leader’s Acad. Title</td><td>Lecturer</td><td colspan="2">Module Leader’s Qualification</td><td colspan="2">Ph.D.</td></tr>
<tr><td>Module Tutor</td><td>Name (if available)</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td>Peer Reviewer Name</td><td>Name</td><td>e-mail</td><td colspan="3">E-mail</td></tr>
<tr><td>Scientific Committee Approval Date</td><td></td><td colspan="2">Version Number</td><td colspan="2"></td></tr>
</table>

<table>
<tr><td colspan="4">Relation with other Modules
العلاقة مع المواد الدراسية الأخرى</td></tr>
<tr><td>Prerequisite module</td><td>None</td><td>Semester</td><td></td></tr>
<tr><td>Co-requisites module</td><td>None</td><td>Semester</td><td></td></tr>
</table>

<table>
<tr><td colspan="2">Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية</td></tr>
<tr><td>Module Objectives
أهداف المادة الدراسية</td><td>The objective of studying "Traffic Engineering" topics is to provide individuals with the knowledge and skills necessary to understand, analyze, and design transportation systems and infrastructure to ensure safe, efficient, and sustainable movement of vehicles, pedestrians, and other modes of transportation. These are some of the key objectives of traffic engineering. By applying various strategies and techniques, traffic engineers work towards creating safe, efficient, and sustainable transportation systems that accommodate the needs of communities and facilitate smooth and reliable mobility for all road users.</td></tr>
<tr><td>Module Learning Outcomes</td><td>1. Understand the Fundamentals of Traffic Engineering
• Outcome: Students will demonstrate a clear understanding of the fundamental principles of traffic flow, road capacity, and the factors affecting traffic conditions.</td></tr>
</table>

مخرجات التعلم للمادة الدراسية	• **Key Skills:** Understanding traffic flow theory, vehicle interactions, and the impact of road geometry on traffic performance. **2. Apply Traffic Flow Theories** • **Outcome:** Students will be able to apply traffic flow models to analyze and predict traffic behavior under different conditions (e.g., free flow, congestion, and queueing). • **Key Skills:** Using traffic flow theory, such as the fundamental diagram of traffic flow (density, speed, and flow), to model traffic conditions and optimize road capacity. **3. Design Traffic Control Systems** • **Outcome:** Students will be able to design traffic control systems, including signalized intersections, roundabouts, and traffic signs, to improve traffic safety and efficiency. • **Key Skills:** Traffic signal design, intersection control strategies, and the application of modern traffic management techniques (e.g., adaptive signals, intelligent transport systems). **4. Analyze Traffic Data and Conduct Traffic Surveys** • **Outcome:** Students will demonstrate the ability to collect, analyze, and interpret traffic data, including traffic volume, speed, and accident data, to assess road performance and safety. • **Key Skills:** Conducting traffic surveys, analyzing traffic data, and using software tools (e.g., Synchro, VISSIM) to evaluate traffic patterns and performance. **5. Evaluate Road Capacity and Level of Service (LOS)** • **Outcome:** Students will be able to assess the capacity and level of service (LOS) of various roadways and intersections, and make recommendations for improvements based on traffic performance. • **Key Skills:** Evaluating LOS using standard methodologies (e.g., Highway Capacity Manual), determining road capacity, and recommending infrastructure improvements to enhance traffic flow. **6. Understand the Principles of Traffic Safety** • **Outcome:** Students will understand the principles of traffic safety, including the causes of accidents, safety audits, and risk assessments, and apply strategies to reduce accidents and improve road safety. • **Key Skills:** Identifying common traffic safety issues, conducting road safety audits, and implementing measures to reduce accidents (e.g., road design improvements, safety awareness campaigns). **7. Apply Traffic Simulation Techniques** • **Outcome:** Students will be able to use traffic simulation software to model traffic flow and congestion in different road networks and assess the impact of proposed changes. • **Key Skills:** Using tools such as VISSIM, SYNCHRO, or Aimsun to simulate traffic conditions, evaluate alternatives, and optimize traffic management strategies. **8. Analyze and Design Pedestrian and Bicycle Facilities** • **Outcome:** Students will be able to assess the needs of non-motorized road users (e.g., pedestrians and cyclists) and design appropriate facilities that enhance safety and mobility. • **Key Skills:** Designing pedestrian crossings, bike lanes, and shared spaces; applying guidelines and standards for non-motorized transportation. **9. Understand and Mitigate Traffic Congestion** • **Outcome:** Students will be able to identify causes of traffic congestion and propose strategies to alleviate it, such as traffic demand management and the implementation of public transportation. • **Key Skills:** Analyzing congestion patterns, evaluating congestion management strategies (e.g., congestion pricing, HOV lanes), and understanding the role of public transit and carpooling.

	10. Develop Sustainable Traffic Engineering Solutions • **Outcome:** Students will develop an understanding of sustainable traffic engineering practices, considering environmental, social, and economic factors when designing transportation systems. • **Key Skills:** Designing traffic systems that minimize environmental impact, promoting sustainable modes of transport, and integrating green infrastructure in traffic engineering projects. **11. Conduct Traffic Impact Studies** • **Outcome:** Students will be able to conduct traffic impact studies for new developments, including transportation demand forecasts, traffic flow analysis, and the evaluation of proposed mitigation measures. • **Key Skills:** Performing traffic impact analysis, forecasting future traffic demand, and recommending measures to mitigate the effects of new developments on traffic flow and safety. **12. Understand the Role of Intelligent Transport Systems (ITS)** • **Outcome:** Students will understand the role of ITS in modern traffic management, including the application of technologies like automated traffic control, real-time traffic monitoring, and connected vehicles. • **Key Skills:** Understanding and applying ITS technologies, including adaptive signal control, traffic surveillance systems, and integration of smart technologies for efficient traffic flow.
Indicative Contents المحتويات الإرشادية	**1. Introduction to Traffic Engineering** • Definition and scope of traffic engineering • Evolution and history of traffic engineering • Relationship with other transportation disciplines • Basic principles of traffic flow **2. Traffic Flow Theory** • Definition and key concepts of traffic flow • Traffic stream characteristics: flow, speed, density, and occupancy • Queuing theory in traffic • Traffic flow models: fundamental diagrams (speed-density, flow-density) • Microsimulation vs. macroscopic models **3. Traffic Volume and Capacity Analysis** • Methods of traffic volume measurement • Peak hour traffic flow • Volume/capacity ratio • Capacity of highways, intersections, and intersections with traffic signals • Service levels in traffic flow • Saturation flow and lane capacity **4. Traffic Control Devices** • Types of traffic signs: regulatory, warning, and guide signs • Traffic signals: design and operation • Pavement markings and their role in traffic control • Roadway lighting • Intelligent Traffic Systems (ITS) **5. Traffic Intersection Design** • Types of intersections: at-grade, grade-separated, roundabouts, etc. • Geometric design principles for intersections

	• Signalized and non-signalized intersection design • Traffic signal timing and optimization • Pedestrian and bicycle facility integration at intersections **6. Traffic Safety and Accident Analysis** • Traffic accident statistics and analysis methods • Accident prediction models • Identifying high-risk zones and black spots • Traffic safety audits • Road safety improvements and countermeasures • Human factors in traffic safety **7. Roadway Design and Geometric Design Principles** • Horizontal and vertical alignment design • Cross-section and lane width design • Roadway capacity and level of service (LOS) • Design for different road classes: urban, rural, expressways • Design of interchanges and ramps **8. Traffic Simulation and Modeling** • Introduction to traffic simulation tools (e.g., VISSIM, SYNCHRO) • Model calibration and validation techniques • Impact of traffic control measures on flow • Microscopic and macroscopic simulation approaches **9. Parking and Transit Systems** • On-street and off-street parking demand analysis • Design of parking lots and garages • Transit systems design and operation • Integration of transit and non-motorized transport • Bicycle lanes and pedestrian facilities **10. Traffic Demand Management (TDM)** • Principles and strategies for TDM • Pricing strategies (e.g., congestion pricing) • Carpooling and ridesharing • Public transportation promotion • Active transportation planning (bicycles, walking) **11. Sustainable and Smart Traffic Management** • Eco-friendly traffic management strategies • Green transportation systems and policies • Use of data analytics and machine learning in traffic management • Autonomous vehicles and their impact on traffic engineering • Smart cities and their role in traffic planning **12. Transport Planning and Policy** • Transportation planning process and stages • Integrated land use and transportation planning • Government policies and regulations in traffic management • Environmental considerations in traffic engineering • Transport economics **13. Advanced Topics in Traffic Engineering** • Traffic simulation in urban settings

	• Urban mobility and smart transportation systems • Analysis of freight traffic and logistics systems • Congestion management techniques • Autonomous vehicle integration **14. Case Studies and Practical Applications** • Real-world case studies in traffic control and planning • Traffic engineering applications in different regions and cities • Lessons learned from successful and failed traffic projects • Field surveys and traffic data analysis **15. Future Trends in Traffic Engineering** • Emerging technologies in traffic management (AI, IoT) • Impact of electric and autonomous vehicles • Evolution of smart transportation networks • Urban mobility and future transportation systems

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lecture-Based Teaching** • **Clear Explanations**: Start with foundational theories, principles, and definitions, gradually introducing more complex concepts. • **Visual Aids**: Use diagrams, flow charts, and infographics to explain traffic flow, intersection design, and safety measures. • **Real-World Examples**: Incorporate current traffic problems and solutions from different regions and cities to contextualize theory. **2. Problem-Based Learning (PBL)** • **Case Studies**: Assign case studies of real-world traffic engineering problems (e.g., traffic congestion, accident analysis, intersection redesign). • **Group Work**: Encourage students to work in groups to solve these problems, which fosters collaboration and practical problem-solving skills. • **Project Work**: Assign long-term projects that involve traffic simulation, data collection, or the design of traffic systems. This helps integrate theory and practice. **3. Field Visits and Practical Exposure** • **Site Visits**: Organize visits to traffic control centers, signalized intersections, highway construction sites, or smart city traffic management systems to observe traffic engineering in practice. • **Traffic Data Collection**: Have students collect and analyze real traffic data, such as vehicle counts, speeds, and accident data, using modern tools or manual counting techniques. • **Traffic Simulation Labs**: Use traffic simulation software (like VISSIM, SYNCHRO) to allow students to model and simulate traffic flow and control systems in a virtual environment. **4. Hands-On Activities and Exercises** • **Design Exercises**: Engage students in designing intersections, roads, or parking facilities, using CAD software or hand-drawing techniques. • **Traffic Flow Analysis**: Use real-time traffic data (e.g., from sensors or online sources) to analyze flow, congestion, and capacity.

	• **Signal Timing Optimization**: Allow students to work with signal timing software to optimize light cycles at busy intersections. • **Accident Investigation**: Simulate or investigate traffic accidents, analyze their causes, and suggest remedial measures. **5. Flipped Classroom** • **Pre-Class Learning**: Assign reading materials or videos before class to introduce key concepts such as traffic flow theory, roadway design, and control devices. • **In-Class Activities**: Use classroom time for active learning, group discussions, and solving traffic-related problems, which allows for deeper understanding. • **Peer Teaching**: Students can take turns teaching certain topics to their peers, which reinforces learning and enhances comprehension. **6. Use of Technology and Simulation Tools** • **Traffic Simulation Software**: Introduce traffic simulation tools (e.g., VISSIM, SYNCHRO, AIMSUN) for practical applications in traffic flow and control analysis. • **GIS and Data Analytics**: Teach students how Geographic Information Systems (GIS) can be used to analyze traffic patterns, accident hotspots, and urban mobility. • **Mobile Apps**: Use apps and online platforms to track and analyze traffic patterns in real time, allowing students to study dynamic traffic systems. **7. Collaborative Learning and Group Discussions** • **Peer Review and Feedback**: Organize group discussions on contemporary traffic challenges (e.g., congestion pricing, pedestrian safety). Encourage peer feedback to develop critical thinking. • **Debates and Role Plays**: Organize debates on issues like autonomous vehicles, smart traffic systems, or the environmental impact of transport. • **Collaborative Projects**: Create interdisciplinary projects with urban planning or environmental engineering students to promote holistic learning. **8. Interactive Workshops and Seminars** • **Workshops on Traffic Safety**: Organize interactive workshops to develop skills in traffic safety auditing, accident analysis, and designing safer roadways. • **Industry Seminars**: Invite professionals and experts from the transportation and traffic engineering sectors to give talks on current trends, challenges, and innovations. **9. Assessment and Feedback** • **Formative Assessment**: Use quizzes, assignments, and periodic assessments to evaluate students' understanding of fundamental concepts such as traffic flow theory, safety, and intersection design. • **Summative Assessment**: Involve larger assessments (e.g., a final project, research paper, or exam) that require students to integrate all the material covered in the course. • **Peer and Self-Assessment**: Allow students to assess their own work and the work of their peers, helping to foster self-reflection and accountability in learning. **10. Integration of Environmental and Sustainable Aspects** • **Sustainability Focus**: Incorporate sustainability principles into traffic engineering topics, such as reducing carbon emissions, promoting public transport, and designing pedestrian-friendly cities. • **Smart Mobility**: Teach students about the intersection of traffic engineering with emerging technologies like electric vehicles, autonomous cars, and smart cities, using current case studies. **11. Continuous Professional Development (CPD)** • **Industry Linkages**: Encourage students to attend conferences, workshops, and internships related to traffic engineering, where they can interact with professionals in the field.

	• **Certifications**: Promote the attainment of professional certifications in traffic management tools, such as traffic signal timing software or transportation planning. **12. Cross-Disciplinary Approach** • **Integration with Urban Planning**: Traffic engineering cannot be studied in isolation. Encourage collaboration with urban planning, civil engineering, and environmental studies to understand the broader impact of traffic systems. • **Economics and Policy**: Engage students in discussions on the economic aspects of transportation (e.g., funding, toll systems, pricing) and policy-making to provide a well-rounded view.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	109	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	7
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	91	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

Module Evaluation تقييم المادة الدراسية					
As		**Time/Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	10	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	10	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	0	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
Week	**Material Covered**
Week 1	Introduction to transportation and traffic engineering planning

Week 2	Introduction to transportation and traffic engineering planning
Week 3	Operating Elements and Traffic Design
Week 4	Operating Elements and Traffic Design
Week 5	Types of streets (residential)
Week 6	Types of streets (residential)
Week 7	Street classification
Week 8	Street classification
Week 9	Intersections
Week 10	Intersections
Week 11	Parking Standards
Week 12	Parking Standards
Week 13	Railway
Week 14	Railway
Week 15	Airports
Week 16	**Preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
Week	**Material Covered**
Week 1	Residential spaces
Week 2	Residential spaces
Week 3	design patterns charts
Week 4	design patterns charts
Week 5	basic design
Week 6	basic design
Week 7	Street intersections
Week 8	Street intersections
Week 9	types of streets
Week 10	types of streets
Week 11	Car parking types and plans
Week 12	Car parking types and plans
Week 13	railway plans
Week 14	railway plans
Week 15	Airport Schemes

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		No

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A –** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C – Good	جيد	70 - 79	Sound work with notable errors
	D – Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E – Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.

Websites	

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	Theory of Errors		**Module Delivery**	
Module Type	**Core**		☒ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**SUT 411**			
ECTS Credits	**5**			
SWL (hr/sem)	125			
Module Level			**Semester of Delivery**	1
Administering Department			**College**	Type College Code
Module Leader			**e-mail**	E-mail
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)		**e-mail**	E-mail
Peer Reviewer Name	Name		**e-mail**	E-mail
Scientific Committee Approval Date			**Version Number**	1.0

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	The objective of studying "Theory of Errors" topics is to provide individuals with the knowledge and skills necessary to understand and analyze the sources of errors in measurements and calculations, and to apply statistical methods to quantify and propagate these errors. By addressing these objectives, the theory of errors helps ensure that measurements and

	experimental data are reliable, accurate, and properly interpreted. It provides a systematic approach to quantifying uncertainties, minimizing errors, and making sound decisions based on measurement results. The theory of errors is widely applied in various scientific and engineering fields, including physics, chemistry, biology, engineering, and metrology.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1. Understanding of Measurement and Errors** • **MLO 1**: Explain the fundamental concepts of measurement, errors, and uncertainties in the context of engineering and scientific analysis. • **MLO 2**: Identify and differentiate between various types of errors, including systematic, random, and gross errors, and their implications on measurement accuracy. **2. Quantification of Errors** • **MLO 3**: Calculate absolute, relative, and percentage errors in measurements and assess their significance in different measurement contexts. • **MLO 4**: Apply statistical methods to quantify random errors, including mean, standard deviation, and variance, in measured data. **3. Error Propagation and Analysis** • **MLO 5**: Understand and apply error propagation formulas to determine how errors in input measurements affect the accuracy and precision of calculated results. • **MLO 6**: Evaluate the impact of multiple sources of errors on the final result through propagation techniques for both simple and complex measurements. **4. Precision and Accuracy of Measurements** • **MLO 7**: Analyze the precision and accuracy of measurement systems and instruments, and understand their influence on the quality of data. • **MLO 8**: Evaluate the repeatability and reproducibility of measurements through statistical tests and experimental design. **5. Significance Testing and Confidence Intervals** • **MLO 9**: Apply statistical methods to assess the reliability of experimental results, including hypothesis testing and the calculation of confidence intervals. • **MLO 10**: Interpret the meaning and importance of confidence levels and intervals in the context of measurement uncertainty. **6. Calibration and Instrumental Errors** • **MLO 11**: Understand the role of calibration in minimizing systematic errors and describe methods for calibrating measurement instruments. • **MLO 12**: Identify common sources of instrumental errors and propose strategies for minimizing or compensating for these errors. **7. Data Fitting and Curve Fitting Techniques** • **MLO 13**: Apply least squares fitting and regression analysis to experimental data to obtain the best possible model while minimizing errors. • **MLO 14**: Interpret the results of data fitting and analyze the goodness of fit using appropriate statistical tools (e.g., R-squared, residual analysis). **8. Application of Theory of Errors in Real-World Measurements**

	• **MLO 15**: Demonstrate the application of the theory of errors in real-world engineering measurements and data analysis scenarios. • **MLO 16**: Critically evaluate the impact of errors in engineering designs and measurements, and recommend methods to improve accuracy and precision. **9. Ethical Considerations in Data Reporting** • **MLO 17**: Recognize and adhere to ethical principles in the collection, reporting, and interpretation of measurement data, ensuring transparency and integrity. • **MLO 18**: Understand the importance of reporting uncertainty and error margins in scientific and engineering work, ensuring that results are communicated accurately. **10. Use of Computational Tools for Error Analysis** • **MLO 19**: Utilize computational tools and software (e.g., MATLAB, Python, Excel) for error analysis, propagation, and visualization in measurement data. • **MLO 20**: Implement error analysis methods in computational tools to automate the assessment of measurement uncertainties and error propagation.
Indicative Contents المحتويات الإرشادية	**1. Introduction to the Theory of Errors** • Definition of error and uncertainty in measurement • Importance of error analysis in scientific and engineering practice • Types of errors: **systematic**, **random**, and **gross** errors • Sources of errors in measurement systems (e.g., instrument limitations, environmental factors) • Impact of errors on data accuracy and precision **2. Basic Concepts in Measurement** • Understanding **precision** and **accuracy** • Difference between **absolute error**, **relative error**, and **percentage error** • Concept of **uncertainty** in measurements • Measurement scales: **nominal**, **ordinal**, **interval**, and **ratio** **3. Classification of Errors** • **Systematic Errors**: ○ Causes and examples (e.g., instrument calibration, environmental factors) ○ Methods of detecting and correcting systematic errors • **Random Errors**: ○ Sources of random errors (e.g., environmental fluctuations, observer variability) ○ Characteristics of random errors (e.g., Gaussian distribution) ○ Reducing random errors through repetition and statistical analysis • **Gross Errors**: ○ Causes and identification of gross errors (e.g., human mistakes, faulty equipment) ○ Methods for preventing and handling gross errors

	4. Error Propagation • **Propagation of errors** in arithmetic operations: ○ Addition, subtraction, multiplication, and division • **Propagation of errors** in functions of multiple variables (e.g., f(x, y, z)) • Linear approximations for error propagation in measurements • Application of **partial derivatives** for error propagation in complex formulas • Practical examples of error propagation in real-world measurements **5. Statistical Treatment of Errors** • Introduction to **statistics** in error analysis • Measures of central tendency: **mean**, **median**, **mode** • Measures of variability: **variance**, **standard deviation**, **range** • Concept of **Gaussian distribution** and its relation to random errors • Confidence intervals and their role in uncertainty estimation • Calculation of **standard error of the mean** and confidence levels • **Least squares** fitting and error minimization **6. Determining the Accuracy of Measurements** • Accuracy vs. precision: Their impact on data quality • **Repeatability** and **reproducibility** of measurements • Techniques for measuring precision (e.g., standard deviation, variance) • Quantifying accuracy using **bias** and **precision** parameters • Statistical tests for evaluating accuracy and precision **7. Data Fitting and Curve Fitting** • **Regression analysis** and fitting models to experimental data • **Least squares fitting** for linear and nonlinear models • Interpretation of regression coefficients, residuals, and error margins • Assessing the goodness of fit using **R-squared**, **chi-square**, and other statistical tests • Practical application of data fitting in experimental and real-world scenarios **8. Calibration of Instruments** • Definition and importance of **instrument calibration** • Calibration methods and error sources in calibration • Detection and correction of **systematic errors** through calibration • Concepts of **calibration curve**, **zeroing**, and **span adjustment** • Practical examples of calibration procedures and their role in measurement accuracy **9. Uncertainty in Measurement** • **Type A** and **Type B** evaluations of uncertainty • Combining uncertainties from different sources (e.g., random and systematic) • **Propagation of uncertainty** through different measurement processes • Calculation of total uncertainty in a complex measurement setup • Reporting uncertainty using **expanded uncertainty** and **coverage factor**

	• Application of uncertainty in reporting experimental results **10. Use of Computational Tools in Error Analysis** • Software tools for error analysis (e.g., MATLAB, Python, Excel) • Performing error propagation and uncertainty calculations using computational tools • Statistical analysis of measurement data using software packages • Visualizing error distributions and confidence intervals **11. Practical Application of Error Theory** • Application of error analysis in **engineering** and **scientific experiments** • Use of error analysis in **quality control** and **process optimization** • Handling uncertainty in **design calculations** and **engineering simulations** • Real-life case studies demonstrating the importance of error analysis • Engineering examples (e.g., measurement of material properties, structural testing) **12. Ethical Considerations in Data and Error Reporting** • Ethical responsibilities in reporting measurement errors and uncertainty • Transparency in documenting and communicating measurement uncertainties • Recognizing and addressing **bias** and **manipulation** in reported results • Proper documentation of error analysis in scientific and engineering work **13. Emerging Trends in Error Analysis** • The role of error analysis in **big data** and **machine learning** applications • New developments in **uncertainty quantification** for complex systems • Application of error theory in **smart sensors**, **IoT**, and **autonomous systems** • Advances in **real-time error detection** and **automated calibration** techniques **14. Case Studies and Practical Exercises** • In-depth analysis of real-world engineering problems involving measurement errors • Hands-on exercises and lab work to apply theory to practical measurement systems • Use of software tools (e.g., MATLAB or Python) to analyze and propagate errors in experimental data

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**1. Lecture-Based Instruction with Interactive Elements** • **Structured Lectures**: Provide a solid foundation in the theoretical concepts of errors, uncertainty, and statistical analysis. Use visuals, graphs, and examples to explain key concepts such as systematic errors, random errors, and propagation of uncertainty. • **Interactive Discussions**: Incorporate class discussions where students can apply

	theory to real-world examples. Ask students to identify types of errors in different measurement scenarios and propose ways to minimize them. **2. Hands-On Software Tutorials** • **Software Integration**: Teach students how to use computational tools such as MATLAB, Python, or Excel for error analysis and data fitting. Demonstrate the application of error propagation and statistical methods for analyzing and reducing errors. • **Guided Exercises**: Walk students through step-by-step tutorials to practice error propagation, uncertainty analysis, and regression analysis using these software tools. Provide datasets that require students to perform these tasks. • **Real-World Data Analysis**: Provide students with real-world measurement data (e.g., from engineering experiments, sensor data, or field measurements) for them to analyze errors and uncertainties using computational tools. **3. Problem-Based Learning (PBL)** • **Real-Life Case Studies**: Present real-world engineering or scientific case studies where measurement errors have had significant impacts (e.g., failed experiments, miscalculated designs). Ask students to identify errors and suggest methods for improving accuracy. • **Problem-Solving Tasks**: Use PBL to encourage students to apply error theory to practical engineering problems, such as designing an experiment with minimal error or correcting errors in a set of measurements. • **Group Projects**: Assign group projects where students must collectively analyze and reduce errors in a simulated or actual measurement process. This fosters teamwork and enhances problem-solving skills. **4. Laboratory Sessions and Field Work** • **Hands-On Labs**: Organize laboratory sessions where students conduct measurements using instruments (e.g., digital calipers, thermometers, or other sensors). Afterward, guide them through error analysis, calculating absolute and relative errors, and identifying sources of errors. • **Field Visits**: Arrange field visits to engineering sites (e.g., construction sites, laboratories, or industrial plants) where students can observe how errors are managed in real-life settings. Encourage students to assess the accuracy and precision of measurements in the field and identify common sources of error. • **Measurement Practice**: Have students conduct real-world measurements, using their tools to gather data, then analyzing the errors and uncertainties involved. **5. Flipped Classroom Approach** • **Pre-Class Preparation**: Provide pre-recorded videos, reading materials, or online tutorials that cover key concepts like types of errors, error propagation, and statistical analysis before the class. This allows students to learn at their own pace. • **Active In-Class Learning**: In class, focus on applying the concepts learned, such as solving practical error analysis problems, performing calculations, and working with data. Encourage peer-to-peer learning by having students discuss and solve problems in groups. **6. Collaborative Learning and Peer Reviews** • **Group Work and Peer Feedback**: Assign students group projects where they work

together to analyze and reduce errors in an engineering context. Encourage peer review where students assess each other's error analysis and give constructive feedback.

- **Classroom Problem Solving**: Divide the class into teams and present error analysis problems for them to solve collaboratively. Afterward, facilitate a class-wide discussion of the solutions, encouraging students to explain their approach and reasoning.

7. Active Learning through Case Studies

- **Case Study Discussions**: Present students with case studies from real-world engineering, science, or manufacturing contexts where errors in measurements had serious consequences. Discuss how those errors could have been mitigated or minimized using proper error analysis techniques.

- **Error Analysis in Design**: Encourage students to consider how error analysis influences design decisions in engineering projects. For example, students could explore how measurement uncertainty affects the design of structures, the calibration of instruments, or the quality of materials.

8. Socratic Method and Inquiry-Based Learning

- **Critical Thinking**: Use the Socratic method to encourage students to think critically about the assumptions they make during error analysis. Ask probing questions to help them analyze the validity of measurements, identify potential sources of error, and understand how uncertainty affects their conclusions.

- **Inquiry-Based Problem Solving**: Provide students with incomplete datasets or ambiguous measurement situations and encourage them to question the data, assess the sources of error, and develop strategies for addressing uncertainties.

9. Use of Real-Time Data and Simulation

- **Simulations**: Use simulations to model how errors propagate in complex systems. Allow students to manipulate variables and see how different errors affect results. Simulations can be used to model error propagation in mechanical systems, electrical measurements, or chemical processes.

- **Real-Time Error Analysis**: Have students engage in live data collection and error analysis activities during lab sessions or field trips. This hands-on approach helps students understand how errors affect real-time data.

10. Evaluation and Feedback

- **Frequent Formative Assessments**: Use quizzes, short assignments, or in-class exercises to gauge students' understanding of key error analysis concepts. Provide timely feedback to help students correct misunderstandings early.

- **Summative Assessments**: Assign larger projects, reports, or exams that require students to apply error analysis principles to complex, multi-step problems. Encourage students to explain their thought processes, including how they identified and handled sources of error.

- **Peer Evaluation**: Have students review and critique each other's work in group projects, offering insights into their classmates' error analysis processes.

11. Integration of Ethical Considerations

- **Ethics in Reporting Errors**: Teach students about the ethical implications of misreporting measurement errors or uncertainties. Discuss the importance of honesty and

	transparency when reporting experimental results, particularly in scientific and engineering practice. • **Ethical Case Studies**: Present case studies where failure to properly account for errors led to ethical dilemmas (e.g., incorrect reporting of results, miscommunication of uncertainties in safety-critical systems). **12. Guest Lectures and Expert Talks** • **Industry Experts**: Invite guest speakers from industries such as manufacturing, aerospace, or instrumentation to talk about the role of error analysis in their work. Experts can provide valuable insights into how error theory is applied in practice and the tools used to manage measurement uncertainty. • **Professional Experiences**: Allow students to hear from professionals about real-world challenges they've faced with measurement accuracy, error handling, and the importance of rigorous error analysis in ensuring safety and quality. **13. Continuous Professional Development (CPD)** • **Encourage Independent Learning**: Suggest online resources, courses, and certification programs (e.g., courses on MATLAB, Python, or statistics for engineers) for students to continue building their error analysis skills beyond the classroom. • **Workshops and Webinars**: Organize workshops or webinars on advanced topics in error analysis or computational tools used for handling errors in measurement. **14. Technology and Innovation in Error Analysis** • **Smart Sensors and IoT**: Discuss how new technologies such as smart sensors, IoT devices, and automation in measurement systems are changing the landscape of error analysis. Have students explore how these technologies handle uncertainty and improve data accuracy. • **AI and Machine Learning**: Introduce students to the role of AI in error detection, anomaly detection, and improving accuracy in data analysis.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل		**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**125**		

Module Evaluation تقييم المادة الدراسية

As		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	5	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	5	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	2	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	Midterm Exam	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

Week	Material Covered
Week 1	method of least squares
Week 2	method of least squares
Week 3	Trigonometric adjustments
Week 4	Trigonometric adjustments
Week 5	Single angle correction
Week 6	Single angle correction
Week 7	Geodetic triangle correction
Week 8	Geodetic triangle correction
Week 9	Calculation of spherical increase
Week 10	Calculation of spherical increase
Week 11	Calculating the sides of a spherical triangle
Week 12	Calculating the sides of a spherical triangle
Week 13	Trigonometry series correction
Week 14	Trigonometry series correction
Week 15	Geodetic parallelogram correction

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

Week	Material Covered
Week 1	N/A
Week 2	
Week 3	
Week 4	

Week 5	
Week 6	
Week 7	
Week 8	
Week 9	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts		Yes
Recommended Texts		Yes
Websites		

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks %**	**Definition**
Success Group (50 - 100)	**A -** Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX –** Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.