Republic of Iraq - Ministry of Higher Education and Scientific Research

Scientific Supervision and Evaluation Apparatus - Quality Assurance and Academic Accreditation Directorate

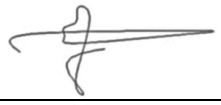
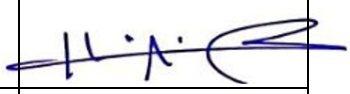
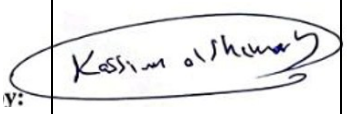
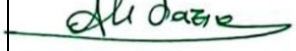
University of Al-Qadisiyah - College of Engineering - Department of Roads and Transport Engineering

Complete Academic Program Specification and Module Description Handbook

Bologna Process System (Undergraduate Stages 1, 2, and 3)

Academic Year 2025-2026

Academic Program Description Form	
University Name:	University of Al-Qadisiyah
College / Institute:	College of Engineering
Scientific Department:	Department of Roads and Transport Engineering
Academic Program Title:	Bachelor of Science (B.Sc.) in Roads and Transport Engineering
Final Qualification Title:	B.Sc. Degree in Roads and Transport Engineering
Academic Study System:	Bologna Process Credit System (Stages: First, Second, and Third)
Total Program Workload / ECTS:	180 ECTS Credits (4,500 Total Student Workload Hours)
Date of File Preparation:	12-10-2025
File Date Filled:	12-10-2025

Administrative Role	Full Name	Date	Signature / Endorsement
Head of Scientific Department	Assoc. Prof. Salam Maytham Jaber	20/1/2025	
Scientific Associate Dean	Prof. Dr. Haitham Ali Badi	20/1/2025	
Quality Assurance Director	Assoc. Prof. Qasim Kazem Humaid	22/1/2025	
Dean of College of Engineering	Prof. Dr. Ali Abdulhussein Al-Khalidi	22/1/2025	

University of Qadisiyah

College of Engineering - Roads and Transportation Department



Introduction:

An educational program serves as a coordinated, structured package of academic courses comprising procedures, practical training, and theoretical learning activities organized into specific module syllabi. Its primary purpose is to build, refine, and certify graduates' technical competencies, soft skills, and professional engineering ethics, preparing them to meet the dynamic demands of the labor market in transportation planning, highway geometric design, pavement engineering, traffic operations, and resilient infrastructure.

The program is continuously reviewed and audited annually through internal quality assurance systems and external evaluation frameworks, including external examiner systems and program accreditation reviews. The Academic Program Description provides a comprehensive summary of the main features of the program and its constituent modules, specifying the learning outcomes students are expected to achieve.

This updated handbook incorporates the latest ministerial directives from the Ministry of Higher Education and Scientific Research (MHESR) in Iraq, fully implementing the Bologna Process framework across Stages 1, 2, and 3 in the Department of Roads and Transport Engineering at the University of Al-Qadisiyah for the Academic Year 2025-2026.

Key Concepts and Definitions

- **Academic Program Description:** A formal document outlining the program's vision, mission, objectives, structure, teaching strategies, assessment methods, and intended learning outcomes mapped to national quality standards.
- **Module Description (Syllabus):** A detailed course specification defining the characteristics of an individual module, including learning outcomes, credit hours, student workload, weekly topics, and evaluation criteria.
- **Bologna Process:** A European higher education framework adopted in Iraq to enhance transparency, mobility, and comparability through standard ECTS credit allocation and outcome-based learning.
- **European Credit Transfer and Accumulation System (ECTS):** A student-centered credit system where 1 ECTS credit equals 25 total Student Workload (SWL) hours. Each academic year consists of 60 ECTS credits (1,500 SWL hours).
- **Student Workload (SWL):** The total time required by an average student to achieve the intended learning outcomes, comprising direct contact hours (lectures, tutorials, labs) and

independent study hours (homework, projects, exam preparation).

- **Program Educational Objectives (PEOs):** Broad statements describing career and professional accomplishments that the program prepares graduates to achieve within 3–5 years post-graduation.
- **Program Learning Outcomes (PLOs):** Specific statements describing the knowledge, skills, and values/attitudes that students are expected to know and be able to perform upon graduation.
- **Formative and Summative Assessment:** Continuous evaluation methods (quizzes, lab reports, assignments) used to monitor learning progress, alongside summative exams (midterms, final exams) measuring overall competence.

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1. Program Vision

To be a nationally and regionally recognized center of excellence in roads, pavement, traffic, and transportation engineering education and research, leading sustainable infrastructure development and smart mobility solutions in Iraq.

2. Program Mission

Providing high-quality engineering education integrated with applied research and industry collaboration, producing highly qualified roads and transport engineers capable of solving complex transportation challenges, improving road safety, and supporting economic growth.

3. Program Educational Objectives (PEOs)

1. **Technical Proficiency:** Practice successfully as professional transportation engineers, applying advanced principles of highway design, pavement materials, traffic engineering, and geotechnical analysis.
2. **Modern Tool Integration:** Utilize modern engineering software, Building Information Modeling (BIM), GIS, and traffic simulation tools (e.g., AutoCAD Civil 3D, VISSIM, SYNCHRO, ArcGIS) to solve real-world infrastructure problems.
3. **Professional Leadership & Communication:** Communicate technical information effectively, work collaboratively in multi-disciplinary teams, and lead engineering projects with high ethical standards.
4. **Sustainable Infrastructure & Safety:** Design transportation systems that prioritize public safety, environmental sustainability, economic viability, and resilience.
5. **Lifelong Learning & Research:** Engage in continuous professional development, graduate studies, and applied scientific research addressing regional transportation needs.

4. Academic Accreditation

Program accreditation granted on 08-06-2026 under Ministerial Order No. 1305-62509, fully aligned with the Iraqi Council for Engineering Education Accreditation (IQCEEA) and ABET criteria.

5. Other External Influences

The program strictly complies with national engineering benchmarks set by the Ministry of Higher Education and Scientific Research, AASHTO geometric and pavement design standards, and the Highway Capacity Manual (HCM).

6. Program Structure Summary (Stages 1, 2, and 3)

Program Structure Category	Number of Modules	Credit Units / ECTS	Type / Status
University Basic Requirements	8	16.0 ECTS	Mandatory Basic
College Support Requirements	4	11.0 ECTS	Mandatory Support
Department Core Requirements	25	148.0 ECTS	Mandatory Core
Summer Practical Training	1	5.0 ECTS (Pass/Fail)	Mandatory Practical
Total Undergraduate Workload (Stages 1-3)	**38 Modules**	**180.0 ECTS**	**Full Degree Program**

7. Complete Curriculum Structure Scheme

Module Type Codes: (C = Core Mandatory Module, S = Support Engineering Module, B = Basic University Requirement)

Level	Module Code	Module Title	ECTS	Type	Credit Hours	
					Theory	Practical
Stage 1 Semester 1 (30 ECTS)	**ENG.111**	Mathematics I	6	Basic (B)	3	1
	RE.112	Engineering Drawing & AutoCAD I	7	Basic (B)	2	4

Level	Module Code	Module Title	ECTS	Type	Credit Hours	
					Theory	Practical
	RE.113	Physics	7	Basic (B)	3	2
	RE.114	Engineering Materials Properties	5	Core (C)	2	2
	QU04	Computer I	3	Basic (B)	1	2
	QU01	English Language I	2	Basic (B)	2	0
Stage 1 Semester 2 (30 ECTS)	**ENG.121**	Mathematics II	6	Basic (B)	3	1
	RE.122	Engineering Drawing & AutoCAD II	6	Basic (B)	2	3
	RE.123	Static Mechanics	6	Core (C)	3	1
	RE.124	Construction Materials	4	Core (C)	2	2
	RE.125	Geology	4	Basic (B)	2	1
	QU06	Arabic Language I	2	Basic (B)	2	0
	QU02	English Language	2	Basic (B)	2	0
Stage 2 Semester 3 (30 ECTS)	**ENG.211**	Mathematics III	3	Basic (B)	2	1
	RE.211	Asphalt Technology I	5	Core (C)	2	2
	RE.212	Concrete Technology I	5	Core (C)	2	2
	RE.213	Strength of Materials I	5	Core (C)	3	1
	RE.214	Engineering Surveying I	4	Core (C)	2	2
	RE.215	Fluid Mechanics	4	Basic (B)	2	1
	QU21	English Language II	2	Basic (B)	2	0
	ENG.08	Ba'ath Regime Crimes in Iraq	2	Support (S)	2	0
Stage 2 Semester 4 (30 ECTS)	**ENG.221**	Mathematics IV	3	Basic (B)	2	1
	RE.221	Asphalt Technology II	5	Core (C)	2	2
	RE.222	Concrete Technology II	5	Core (C)	2	2
	RE.223	Strength of Materials II	5	Core (C)	3	1
	RE.224	Engineering Surveying II	4	Core (C)	2	2
	RE.225	Construction of Roads & Bridges	3	Core (C)	2	1
	QU24	Computer II	3	Basic (B)	1	2

Level	Module Code	Module Title	ECTS	Type	Credit Hours	
					Theory	Practical
	QU26	English Language	2	Basic (B)	2	0
Stage 3 Semester 5 (30 ECTS)	**RE.311**	Advanced Math & Eng. Analysis	4	Basic (B)	3	1
	RE.312	Theory of Structures	4	Core (C)	3	1
	RE.313	Soil Mechanics I	4	Core (C)	2	2
	RE.314	Traffic Engineering I	4	Core (C)	2	2
	RE.315	Pavement Design I	4	Core (C)	2	1
	RE.316	Computer Programming	3	Basic (B)	1	2
	RE.317	Airport Engineering	3	Support (S)	2	1
	RE.318	Statistics and Probability	4	Basic (B)	3	0
Stage 3 Semester 5 (30 ECTS)	**RE.321**	Design of Concrete Structures	4	Core (C)	3	1
	RE.322	Traffic Engineering II	4	Core (C)	2	2
	RE.323	Pavement Design II	4	Core (C)	2	1
	RE.324	Soil Mechanics II	4	Core (C)	2	2
	RE.325	Computer Applications	3	Basic (B)	1	2
	RE.326	Railways Engineering	4	Core (C)	3	0
	RE.327	Engineering Management & Economy	2	Basic (B)	2	0
	RE.328	Advanced Math & Numerical Analysis	5	Basic (B)	3	2

8. Program Learning Outcomes (PLOs)

Domain	PLO Code	Program Intended Learning Outcomes Description
Knowledge (K)	**GO.1**	Ability to identify, formulate, and solve complex transportation, pavement, traffic, and infrastructure engineering problems by applying principles of engineering, science, and mathematics.
	GO.6	Ability to recognize the ongoing necessity of acquiring new

Domain	PLO Code	Program Intended Learning Outcomes Description
		professional knowledge, selecting, evaluating, and applying modern engineering software and specifications appropriately.
Skills (S)	**GO.2**	Ability to apply engineering design to produce highway alignments, pavement structures, traffic control systems, and transport facilities meeting specified needs with consideration of public health, safety, and welfare.
	GO.3	Ability to develop and conduct appropriate field surveying, soil testing, pavement quality testing, and traffic data collection, analyze and interpret data, and use engineering judgment to draw conclusions.
Values & Ethics (V)	**GO.4**	Ability to communicate effectively with a range of audiences through technical reports, presentations, CAD drawings, and oral communication.
	GO.5	Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, considering the impact of engineering solutions in global, economic, environmental, and societal contexts.
	GO.7	Ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

9. Teaching and Learning Strategies

1. **Interactive Classroom Lectures:** In-depth instruction on theoretical principles, highway design standards (AASHTO, HCM, MUTCD), mathematical derivations, and problem-solving workshops.
2. **Laboratory & Experimental Testing:** Hands-on laboratory sessions in soil mechanics, bituminous materials, aggregate quality testing, concrete durability, and hydraulics.
3. **Field Surveying & Site Work:** Direct field practicals utilizing Total Stations, GPS equipment, automatic levels, highway construction site visits, and asphalt mixing plant tours.
4. **Computer-Aided Design & Simulation:** Applied computer lab sessions on AutoCAD Civil 3D, ArcGIS Pro, VISSIM, SYNCHRO, and MATLAB for transport network design and traffic simulation.
5. **Problem-Based Learning & Case Studies:** Analysis of real-world highway bottlenecks,

pavement distresses, traffic crash data, and geometric redesign projects in Iraq.

6. **Collaborative Group Projects & Presentations:** Team-based engineering design projects, technical report drafting, and public oral presentations.

10. Assessment Methods

1. **Continuous Formative Assessments:** Unannounced and scheduled quizzes, tutorial worksheets, homework assignments, and classroom discussion participation (10–15%).
2. **Laboratory & Field Practical Evaluation:** Assessment of experimental work, data precision, lab report drafting, field survey worksheets, and practical lab exams (15–20%).
3. **Engineering Design Projects:** Portfolio submission of CAD drawings, highway alignment designs, traffic capacity calculations, and oral project defenses (15–20%).
4. **Midterm Summative Examinations:** Written examinations evaluating theoretical knowledge, analytical problem-solving, and design derivations (15–20%).
5. **Final Summative Examinations:** Comprehensive written and practical final examinations assessing cumulative module learning outcomes (40–50%).

11. Academic Faculty Staff Roster and Professional Development

The Department of Roads and Transport Engineering at the University of Al-Qadisiyah maintains a highly qualified academic faculty specializing in transportation planning, pavement technology, traffic engineering, geotechnics, and structural engineering.

Faculty Member Name	Academic Rank	General Specialization	Specific Specialization	Status
Jalal Taqi Shaker Al-Obaedi	Professor	Civil Engineering	Roads and Airports Engineering	Full-time
Basim Hassan Al-Humeidawi	Professor	Roads & Transport Eng.	Highway and Transportation Engineering	Full-time
Saif Alzabeebee	Assistant Professor	Civil Engineering	Geotechnics	Full-time
Haider M.K. Mahdi Al-Jelawy	Assistant Professor	Civil Engineering	Structural Engineering	Full-time
Sura Ali Saadoon	Assistant Professor	Civil Engineering	Geotechnics	Full-time
Abeer Saeed Zebalah	Assistant Professor	Civil Engineering	Geotechnics	Full-time
Hamsa Abbas Zubaidi	Assistant Professor	Roads & Transport Eng.	Highway and Transportation Engineering	Full-time

Faculty Member Name	Academic Rank	General Specialization	Specific Specialization	Status
Ihsan Ali Obaid	Assistant Professor	Roads & Transport Eng.	Highway and Transportation Engineering	Full-time
Salam Al-Obaidi	Assistant Professor	Civil Engineering	Structural Analysis and Design	Full-time
Hawraa Sami Malik	Assistant Professor	Civil Engineering	Structural Engineering	Full-time
Hayder Abaas Naeem	Assistant Professor	Civil Engineering	Geomaticis	Full-time
Ali Jaafar Dakhil Alzubaidy	Assistant Professor	Civil Engineering	Public Works	Full-time
Elaf Dheyaa Abdul Ridha	Assistant Professor	Civil Engineering	Engineering Management	Full-time
Sara Husein Toman	Assistant Professor	Comp. Science	Comp. Science	Full-time
Shuruq Abd Al-Ameer Jawaad	Assistant Professor	Control Engineering	Mechatronics	Full-time
Alaa Jaleel Naji	Lecturer	Civil Engineering	Construction	Full-time
Amer Ghani Jihad	Lecturer	Civil Engineering	Foundation Engineering and Soil Mechanics	Full-time
Hasan Hadi Kraidi	Lecturer	Civil Engineering	Environmental and Sustainable Engineering – Hydrosystems	Full-time
Hayder Ahmad Jassim	Lecturer	Civil Engineering	Civil Engineering	Full-time
Khawla Abbas Farhan	Lecturer	Civil Engineering	Construction	Full-time
Mohanad Mohamed Mahdie	Lecturer	Civil Engineering	Civil Eng.	Full-time
Muhammed Abaaas Musa	Lecturer	Civil Engineering	Structural Engineering	Full-time
Noor Safaaldin Farhan	Lecturer	Civil Engineering	Geotechnics	Full-time
Osamah Hasan Chafat	Lecturer	Civil Engineering	Highway and Transportation Engineering	Full-time
Rasha Muthana Jameel	Lecturer	Computer Science	Image Processing	Full-time
Saba Mohammed Shaheed	Lecturer	Civil Engineering	Soil Mechanics	Full-time
Sahar Basim Jawad	Lecturer	Civil Engineering	Roads and Transport Engineering	Full-time
Samir Hamed Malik	Lecturer	Civil Engineering	Construction Materials	Full-time
Thulfiqar Salim Hussein	Lecturer	Civil Engineering	Building and	Full-time

Faculty Member Name	Academic Rank	General Specialization	Specific Specialization	Status
			Construction Engineering	
Zaid Abdul Zahra Mahdi	Lecturer	Roads & Transport Eng.	Transportation	Full-time
Zaid Ali Kadhim	Lecturer	Civil Engineering	Structural Engineering	Full-time
Abdulsamad Adnan Lafta	Assistant Lecturer	Arch. Eng.	Arch. Eng.	Full-time
Dhuha Tuaimah Abdul Kadhim	Assistant Lecturer	Mathematics	Mathematics	Full-time
Hiba Aref Jasim AL.dolamie	Assistant Lecturer	Arch. Eng.	Arch Eng	Full-time

Faculty Professional Development Guidelines:

- Mandatory training on Bologna Process credit management, SWL calculation, and ECTS grading scales.
- Workshops on advanced engineering software (AutoCAD Civil 3D, ArcGIS Pro, VISSIM, SYNCHRO, Primavera).
- Encouraging high-impact scientific publishing in Scopus / Web of Science indexed journals.
- Continuous participation in quality assurance audits, course portfolio preparation, and ABET accreditation self-study reports.

12. Admission Criteria

Admission to the B.Sc. program in Roads and Transport Engineering is governed centrally by the Ministry of Higher Education and Scientific Research (MHESR) in Iraq:

1. Successful graduation from the Iraqi Secondary School Examination (Scientific/Biology/Applied Branch) or certified foreign equivalent.
2. Achieving the minimum competitive threshold score set annually for the College of Engineering at the University of Al-Qadisiyah.
3. Central allocation based on departmental capacity, laboratory resources, top-ranking student transfer tracks, and government employee advancement quotas.

13. Main Sources of Information About the Program

- Official University of Al-Qadisiyah College of Engineering Portal (https://eng.qu.edu.iq).
- Department of Roads and Transport Engineering Academic Catalog & Bologna Student Guide.
- Official Regulations and Directives of the Iraqi Ministry of Higher Education and Scientific Research (MHESR).

14. Program Development Plan

The department's continuous development strategy emphasizes expanding laboratory infrastructure (Advanced Asphalt Testing Lab, Traffic Simulation Lab), incorporating Intelligent Transportation Systems (ITS) and green paving materials into core curricula, strengthening partnerships with highway ministries, and achieving national and international (ABET) program accreditation.

Program Learning Outcomes (PLOs) Alignment Matrix

Comprehensive mapping of all 38 modules across Stages 1, 2, and 3 to Program Intended Learning Outcomes (GO.1 - GO.7):

Stage	Module Code	Module Title	Type	GO.1	GO.2	GO.3	GO.4	GO.5	GO.6	GO.7
Stage 1 Semester 1 (30 ECTS)	**ENG.111**	Mathematics I	Basic	√					√	
	RE.112	Engineering Drawing & AutoCAD I	Basic		√		√			√
	RE.113	Physics	Basic	√		√				
	RE.114	Engineering Materials Properties	Core	√		√			√	
	QU04	Computer I	Basic				√		√	
	QU01	English Language I	Basic				√	√		
Stage 1 Semester 2 (30 ECTS)	**ENG.121**	Mathematics II	Basic	√					√	
	RE.122	Engineering Drawing & AutoCAD II	Basic		√		√			√
	RE.123	Static Mechanics	Core	√	√					
	RE.124	Construction Materials	Core	√		√			√	
	RE.125	Geology	Basic	√						
	QU06	Arabic Language I	Basic				√			
	QU02	English Language	Basic				√	√		
Stage 2 Semester 3 (30 ECTS)	**ENG.211**	Mathematics III	Basic	√					√	
	RE.211	Asphalt Technology I	Core	√	√	√				
	RE.212	Concrete Technology I	Core	√	√	√				
	RE.213	Strength of Materials I	Core	√	√					
	RE.214	Engineering Surveying I	Core	√	√	√	√			√

Stage	Module Code	Module Title	Type	GO.1	GO.2	GO.3	GO.4	GO.5	GO.6	GO.7
	RE.215	Fluid Mechanics	Basic	√		√				
	QU21	English Language II	Basic				√	√		
	ENG.08	Ba'ath Regime Crimes in Iraq	Suppo rt					√	√	
Stage 2 Semester 4 (30 ECTS)	**ENG.221**	Mathematics IV	Basic	√					√	
	RE.221	Asphalt Technology II	Core	√	√	√				√
	RE.222	Concrete Technology II	Core	√	√	√				√
	RE.223	Strength of Materials II	Core	√	√					
	RE.224	Engineering Surveying II	Core	√	√	√	√			√
	RE.225	Construction of Roads & Bridges	Core	√	√			√		√
	QU24	Computer II	Basic				√		√	
	QU26	English Language	Basic				√	√		
Stage 3 Semester 5 (30 ECTS)	**RE.311**	Advanced Math & Eng. Analysis	Basic	√	√				√	
	RE.312	Theory of Structures	Core	√	√					
	RE.313	Soil Mechanics I	Core	√	√	√				
	RE.314	Traffic Engineering I	Core	√	√	√	√			√
	RE.315	Pavement Design I	Core	√	√	√		√		
	RE.316	Computer Programming	Basic	√			√		√	
	RE.317	Airport Engineering	Suppo rt	√	√			√		
	RE.318	Statistics and Probability	Basic	√		√			√	
Stage 4 Semester 6 (30 ECTS)	**RE.321**	Design of Concrete Structures	Core	√	√			√		
	RE.322	Traffic Engineering II	Core	√	√	√	√			√
	RE.323	Pavement Design II	Core	√	√	√		√		
	RE.324	Soil Mechanics II	Core	√	√	√				
	RE.325	Computer Applications	Basic	√			√		√	
	RE.326	Railways Engineering	Core	√	√			√		
	RE.327	Engineering Management & Economy	Basic		√		√	√		√
	RE.328	Advanced Math & Numerical Analysis	Basic	√	√				√	

First Stage

Semester 1

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Mathematics I
Module Type	Support learning activity
Module Code	ENG.111
ECTS Credits	6
SWL (hr/sem)	200
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☑ Tutorial ☐ Practical ☑ Seminar
Semester of Delivery	Semester 1
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant Lecturer Dhuha Tuaimah Abdul Kadhim
Module Leader's e-mail	dhuha.tuaimah@qu.edu.iq
Module Leader's Acad. Title	Assistant Lecturerl
Module Leader's Qualification	MSC
Module Tutor	Lecturer Rasha Muthana Jameel rasha.muthna.alfatlawy@qu.edu.iq
Peer Reviewer Name	professorJalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** ENG.112 (Mathematics II) | **Semester:** 2
- **Co-requisites module:** None | **Semester:** -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Understanding Mathematical Concepts:** Ensure that students develop a solid understanding of fundamental mathematical concepts and principles, including precalculus, algebra, limits, and single-variable differential calculus.

2. **Mathematical Modeling:** Teach students how to formulate mathematical models that represent real-world civil and highway engineering problems.

3. **Problem-Solving Skills:** Develop students' problem-solving capabilities using mathematical techniques, enabling them to analyze engineering data, interpret results, and make sound technical decisions.

4. **Computational Skills:** Teach students the foundational mathematical methods required for computational engineering software, programming algorithms, and numerical analyses.

5. **Critical Thinking and Analytical Skills:** Build logical reasoning, pattern recognition, and quantitative analysis skills by deconstructing complex engineering problems.

6. **Communication and Presentation:** Enhance students' ability to communicate mathematical concepts and technical solutions effectively through technical reports, visual aids, and oral presentations.

Module Learning Outcomes

1. To learn algebraic topics introduced in precalculus and trigonometry.

2. To understand limits and investigate their fundamental properties.

3. To understand the basic relationship between tangent lines, rates of change, and derivatives.

4. To master the techniques and rules of differentiation.

5. To become familiar with standard applications of the derivative in physics, civil/highway engineering, and economics.

6. To become familiar with key aspects of the theoretical framework appropriate for first-year engineering studies.

Indicative Contents

- **Revision:** Lines, equations of straight lines, functions and graphs, piecewise functions, absolute value function, graph shifting transformations (8 hours).

- **Transcendental Functions:** Power functions, exponential functions, logarithmic functions, natural logarithmic functions (10 hours).

- **Trigonometric Functions:** Graphs of trigonometric functions, periodicity, trigonometric identities, inverse trigonometric functions, hyperbolic functions, inverse hyperbolic functions (10 hours).
- **Limits and Continuity:** Limit properties, limits of trigonometric functions, limits involving infinity, limits of exponential functions (8 hours).

- **Derivatives:** Definition of derivative, differentiation rules, second and higher-order derivatives, applications of derivatives, implicit functions, chain rule, derivatives of trigonometric, hyperbolic, inverse hyperbolic, exponential, and logarithmic functions (24 hours).

4. Learning and Teaching Strategies

1. **Creating a Positive Learning Environment:** Foster a supportive and encouraging classroom atmosphere where students feel comfortable engaging in technical discussions and learning from mistakes.

2. **Using Authentic Engineering Examples:** Incorporate practical engineering problems and real-life geometric applications relevant to highway alignment, gradients, and infrastructure design.

3. **Differentiate Instruction:** Adapt teaching approaches to address diverse learning styles, providing individual guidance and supplementary practice as needed.

4. **Promote Active Learning:** Encourage student involvement in tutorial sessions, active problem-solving exercises, group discussions, and analytical assignments.

5. **Provide Regular Feedback:** Assess student performance continuously and deliver timely feedback to guide ongoing improvement.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	63	4
Unstructured SWL (h/sem)	87	5
Total SWL (h/sem)	**200**	**9**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	20% (20 marks)	Weeks 3, 5, 10, 12	LO #1, #2, #3, #4
Assignments	2	10% (10 marks)	Weeks 2, 6	All LOs
Seminar	1	5% (5 marks)	Week 8	All LOs
Projects / Reports	2	5% (5 marks)	Weeks 9, 12	LO #1–#3
Midterm Exam	2 hours	10% (10 marks)	Week 7	LO #1–#4
Final Exam	3 hours	50% (50 marks)	Week 15/16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Revision (lines, equation of straight line, functions, and graphs)
- **Week 2:** Revision (piecewise functions, absolute value function, graph shifting)
- **Week 3:** Transcendental functions (power functions, exponential functions)
- **Week 4:** Transcendental functions (logarithmic functions, natural logarithmic functions)
- **Week 5:** Trigonometric functions (graphs of trigonometric functions, periodicity)
- **Week 6:** Trigonometric functions (trigonometric functions, inverse trigonometric functions)
- **Week 7:** Trigonometric functions (hyperbolic trigonometric functions, inverse hyperbolic trigonometric functions)
- **Week 8:** Midterm Exam
- **Week 9:** Limits and continuity (properties, limits of trigonometric functions)

- **Week 10:** Limits and continuity (limits involving infinity, limits of exponential functions)
- **Week 11:** Derivatives (definition, differentiation rules, second and higher-order derivatives)
- **Week 12:** Derivatives (derivative applications, implicit functions, chain rule)
- **Week 13:** Derivatives (derivatives of trigonometric functions, hyperbolic functions, inverse hyperbolic functions)
- **Week 14:** Derivatives (derivatives of exponential and logarithmic functions)
- **Week 15:** Student Seminars & Presentations
- **Week 16:** Preparatory week before the Final Exam

8. Delivery Plan (Weekly Lab. Syllabus)

- *N/A (This module is theoretical with structured problem-solving tutorial sessions).*

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	George B. Thomas Jr., Maurice D. Weir, Joel R. Hass – *Thomas' Calculus: Early Transcendentals* (13th Edition), Pearson. *Thomas' Calculus Early Transcendentals Single Variable* 13th c2014 Solutions ISM.	No (Online)
Recommended Texts	*Advanced Engineering Mathematics*, 10th Edition, Erwin Kreyszig. *Solution Manual of Advanced Engineering Mathematics* by Erwin Kreyszig, 9th edition.	No

	Thomas' Calculus, 11th edition (textbook solutions).	
Websites	University Academic E-Learning Portals & Official Calculus Learning Resources.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors
	D - Satisfactory	60–69	Fair but with major shortcomings
	E - Sufficient	50–59	Work meets minimum criteria
Fail Group (0–49)	**FX - Fail**	(45–49)	More work required but credit awarded
	F - Fail	(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). University policy strictly prohibits condoning "near-pass fails".

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Engineering Drawing & AutoCAD I
Module Type	Core / Basic Engineering
Module Code	RE.112
ECTS Credits	7
SWL (hr/sem)	150
Module Level	Level 1

Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☑ Tutorial
Semester of Delivery	Semester 1
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant Lecturer Abdulsamad Adnan Lafta-assistant prof Hamsa Abbas Nayyef Zubaidi
Module Leader's e-mail	abdulsamed.adnan@qu.edu.iq hamsa.alzubaidi@qu.edu.iq
Module Leader's Acad. Title	Assistant Lecturer-assistant prof
Module Leader's Qualification	hiba.arif@qu.edu.iq
Module Tutor	Assistant LecturerHiba Aref Jasim AL.dolamie
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** None | **Semester:** -
- **Co-requisites module:** RE.113 (Engineering Drawing & AutoCAD II) | **Semester:** 2

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Fundamental Principles:** Introduce manual engineering drawing standards, sheet layouts, scales, line types, lettering, and geometric constructions.
2. **Orthographic Projection:** Develop the ability to construct and interpret multi-view orthographic projections (front, top, and side views) of 3D objects.
3. **CAD Software Proficiency:** Introduce the AutoCAD workspace environment, coordinate systems, precision drafting tools, and 2D drawing execution.
4. **Spatial Visualization:** Enhance spatial reasoning and the ability to mentally translate 3D physical components into standardized 2D technical drawings.
5. **Standardization & Dimensioning:** Teach international technical drawing standards (ISO/ANSI), dimensioning rules, annotation styles, and title block preparation.

Module Learning Outcomes

1. Apply standard engineering drawing conventions, line types, drawing scales, and geometric constructions manually.

2. Construct multi-view orthographic projections of 3D geometric solids and engineering components.

3. Navigate the AutoCAD interface, configure drawing units, limits, grid/snap modes, and coordinate systems (absolute, relative, and polar).

4. Utilize AutoCAD 2D drafting commands (Line, Circle, Arc, Polyline, Hatch) and modify commands (Trim, Extend, Offset, Mirror, Array, Scale).

5. Manage drawing organization using layers, linetypes, colors, and line weights.

6. Apply standard dimensioning, text formatting, layout setups, and title blocks to generate print-ready technical drawings.

Indicative Contents

- **Manual Drawing Fundamentals:** Drawing instruments, sheet formats (A0–A4), title blocks, line conventions, standard lettering, drawing scales, and geometric constructions (15 hours theory, 15 hours practical).

- **Orthographic Projection:** Principles of first-angle and third-angle orthographic projections, multi-view representation of geometric solids, auxiliary views, and missing view construction (15 hours theory, 15 hours lab).

- **Introduction to AutoCAD:** Workspace setup, dynamic input, status bar toggles (Ortho, Osnap, Tracking), coordinate entry systems, and display navigation (Zoom, Pan) (10 hours lab).

- **AutoCAD Drawing & Editing Commands:** Drawing tools, modification tools (Move, Copy, Rotate, Fillet, Chamfer, Stretch, Explode), object selection methods, and grip editing (20 hours lab).

- **Layer Management, Dimensioning & Plotting:** Layer properties, dimension styles, annotation text, hatch patterns, paper space layout setup, viewports, scale configuration, and plotting/PDF export (15 hours lab).

4. Learning and Teaching Strategies

1. **Hands-on Drafting Studio & Computer Labs:** Direct practical application on drawing boards during the first half of the semester, transitioning to individual CAD workstation practice in computer laboratories.

2. **Interactive Live Demonstrations:** Instructor-led step-by-step demonstrations projected on screen for both manual drafting techniques and AutoCAD software workflows.

3. **Problem-Based Worksheets:** Weekly drawing assignments and practical exercises focusing on engineering geometric shapes and infrastructure elements.

4. **Immediate In-Lab Feedback:** Continuous instructor review during practical studio hours to correct technique, line quality, dimensioning accuracy, and CAD commands efficiency.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	75	5
Unstructured SWL (h/sem)	75	5
Total SWL (h/sem)	**150**	**10**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1, #2, #3, #4
Lab Assignments & Classwork	10 sheets/files	15% (15 marks)	Weekly	All LOs
Midterm Practical Exam	2 hours	20% (20 marks)	Week 7	LO #1, #2
Final Practical CAD Exam	2 hours	20% (20 marks)	Week 15	LO #3–#6
Final Theoretical Exam	2 hours	30% (30 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory & CAD Concepts)

- **Week 1:** Introduction to engineering drawing, equipment, sheet layouts, border lines, and title block standard formats.
- **Week 2:** Standard lettering, numbering, and drawing scales (full scale, reduction, enlargement).
- **Week 3:** Geometric constructions (bisecting lines/angles, constructing polygons, tangent arcs, and curves).
- **Week 4:** Principles of orthographic projection, first-angle and third-angle projection theories.
- **Week 5:** Multi-view orthographic drawings of basic solids (prisms, pyramids, cylinders, cones).
- **Week 6:** Multi-view orthographic drawings of complex engineering blocks and missing view extraction.
- **Week 7:** Midterm Examination (Theory & Manual Drafting).
- **Week 8:** Introduction to CAD environment, user interface, screen navigation, drawing limits, and units setup.
- **Week 9:** Coordinate systems in AutoCAD (Absolute, Relative Rectangular, Relative Polar) and basic draw tools (Line, Circle, Arc).
- **Week 10:** Drawing entities (Polyline, Rectangle, Polygon, Ellipse) and precision drafting aids (Object Snaps, Ortho, Polar Tracking).
- **Week 11:** Modification tools Part I (Move, Copy, Rotate, Scale, Stretch, Trim, Extend).
- **Week 12:** Modification tools Part II (Offset, Mirror, Array, Fillet, Chamfer, Explode).
- **Week 13:** Layer management (layer properties, color, linetype, lineweight) and Hatch patterns for civil application.
- **Week 14:** Dimensioning rules, dimension style manager, text annotation, and title block template creation.
- **Week 15:** Paper space layout setup, viewports, plotting to scale, PDF generation, and student CAD presentation.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Manual Studio: Setting up drawing board, drawing sheet borders, and line-type exercises.
- **Week 2:** Manual Studio: Lettering practice sheet and scale exercises.
- **Week 3:** Manual Studio: Geometric construction drawing sheet.
- **Week 4:** Manual Studio: Basic orthographic projection exercises (front, top, side views).
- **Week 5:** Manual Studio: Orthographic projection of sloped and curved surfaces.
- **Week 6:** Manual Studio: Missing view determination and isometric-to-multiview conversion.
- **Week 7:** Practical Assessment: Manual Drafting Studio Exam.
- **Week 8:** Computer Lab: Starting AutoCAD, workspace customization, and coordinate entry practice.
- **Week 9:** Computer Lab: Executing basic geometric figures using line, circle, and snap tools.
- **Week 10:** Computer Lab: Drafting 2D engineering shapes using polylines and precision object snaps.
- **Week 11:** Computer Lab: Applying modification commands (Offset, Trim, Extend, Fillet, Chamfer) to mechanical/civil profiles.
- **Week 12:** Computer Lab: Constructing symmetrical profiles using Mirror, Rectangular, and Polar Array tools.
- **Week 13:** Computer Lab: Organizing complex drawings into layers, changing line properties, and adding cross-hatching.
- **Week 14:** Computer Lab: Adding linear, aligned, radial dimensions, and title block text fields.
- **Week 15:** Final Practical Exam: Full 2D CAD drafting test in computer laboratory.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Frederick E. Giesecke et al. – *Technical Drawing with Engineering Graphics* (15th Edition), Pearson. George Omura & Brian C. Benton – *Mastering AutoCAD 2024 and AutoCAD LT 2024*, Sybex.	Yes
Recommended Texts	Thomas E. French, Charles J. Vierck – *Engineering Drawing and Graphic Technology*, McGraw-Hill. Autodesk Official Training Guides – *AutoCAD Essentials*.	Yes
Websites	Autodesk Learning Network & Official University AutoCAD E-Learning Portal.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors
	D - Satisfactory	60–69	Fair but with major shortcomings
	E - Sufficient	50–59	Work meets minimum criteria
Fail Group (0–49)	**FX - Fail**	(45–49)	More work required but credit awarded
	F - Fail	(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). University policy strictly prohibits condoning "near-pass fails".

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Physics
Module Type	Basic Engineering / Support
Module Code	RE.113
ECTS Credits	7
SWL (hr/sem)	175
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☑ Tutorial
Semester of Delivery	Semester 1
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Dr. Haider Mohammed
Module Leader's e-mail	haider.aljelawy@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	PHD
Module Tutor	Lecturer Khawla Abbas Farhan khawla.abbas@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

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

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Core Physical Principles:** Provide students with a fundamental understanding of classical physics concepts, including thermodynamics, wave mechanics, optics, and electromagnetism.

2. **Engineering Applications:** Demonstrate the direct application of physical phenomena to civil and transportation engineering materials, structural thermal behavior, and non-destructive testing (NDT) methods.

3. **Experimental & Practical Skills:** Develop laboratory skills in physical measurement, data acquisition, error analysis, and experimental verification of physical laws.

4. **Quantitative Problem Solving:** Enhance analytical capabilities to mathematically formulate and solve physical problems relevant to modern engineering challenges.

Module Learning Outcomes

1. Apply fundamental principles of thermal physics, heat transfer, and expansion to engineering materials and structural joints.

2. Analyze wave motion, acoustics, and mechanical vibrations relevant to traffic noise control and structural dynamics.

3. Understand optical phenomena (reflection, refraction, wave optics) and their application in optical sensors and surveying instruments.

4. Apply laws of electrostatics, direct current circuits, and electromagnetism in civil infrastructure engineering.

5. Conduct physical experiments safely, measure physical quantities accurately, and evaluate experimental uncertainties.

Indicative Contents

- **Thermal Physics & Heat Transfer:** Temperature scales, thermal expansion of solids/liquids (asphalt, concrete, steel), heat transfer mechanisms (conduction, convection, radiation), and laws of thermodynamics (14 hours theory, 10 hours lab).

- **Oscillations, Waves & Acoustics:** Simple harmonic motion, damped and forced vibrations, mechanical wave propagation, wave equations, sound intensity, acoustics, and noise barrier design principles (14 hours theory, 10 hours lab).

- **Optics & Photonics:** Geometric optics, reflection, refraction, total internal reflection, fiber optics, wave optics, interference, diffraction, and optical sensing technologies (12 hours theory, 10 hours lab).

- **Electricity & Electromagnetism:** Electric charge, Coulomb's Law, electric fields, Gauss's Law, electric potential, capacitance, DC circuits, Kirchhoff's Laws, magnetic fields, and electromagnetic induction (14 hours theory, 12 hours lab).

4. Learning and Teaching Strategies

1. **Interactive Theoretical Lectures:** Deliver concepts using visual demonstrations, engineering simulations, and practical case studies.

2. **Hands-On Experimental Laboratories:** Pair theoretical concepts with structured laboratory experiments to foster measurement precision and data analysis skills.

3. **Problem-Solving Tutorials:** Conduct weekly problem sessions focusing on quantitative physics problems applicable to infrastructure and material performance.

4. **Continuous Feedback & Discussion:** Provide formative evaluations through post-lab reports, weekly homework assignments, and conceptual quizzes.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	75	5
Unstructured SWL (h/sem)	100	6.5
Total SWL (h/sem)	**175**	**11.5**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1, #2, #3, #4
Laboratory Reports & Work	10 experiments	15% (15 marks)	Weekly	LO #5
Midterm Written Exam	2 hours	15% (15 marks)	Week 7	LO #1, #2
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #5
Final Theoretical Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Measurement units, physical vectors, coordinate systems, and dimensional analysis.
- **Week 2:** Thermal physics: Temperature scales, linear and volumetric thermal expansion of civil materials (concrete, steel, asphalt).
- **Week 3:** Heat transfer: Thermal conduction, Fourier's Law, convection, and thermal radiation in infrastructure.
- **Week 4:** Thermodynamics: First Law of Thermodynamics, work, heat, internal energy, and heat engines.
- **Week 5:** Simple Harmonic Motion (SHM), mass-spring systems, simple pendulum, and energy in SHM.
- **Week 6:** Mechanical waves: Wave properties, wave equation, transverse vs. longitudinal waves, and sound acoustics.
- **Week 7:** Midterm Written Examination.
- **Week 8:** Wave optics: Light wave nature, interference, Thin Film phenomenon, and Young's Double Slit experiment.
- **Week 9:** Geometric optics: Snell's Law, total internal reflection, fiber optics, lenses, and optical instrumentation.
- **Week 10:** Electrostatics: Electric charge, Coulomb's Law, electric field intensity, and Gauss's Law.
- **Week 11:** Electric potential, potential difference, energy storage in capacitors, and dielectric materials.
- **Week 12:** Direct current circuits: Electric current, Ohm's Law, resistivity, temperature dependence, and Kirchhoff's Laws.
- **Week 13:** Magnetism: Magnetic field, Lorentz force, Biot-Savart Law, and Ampere's Law.
- **Week 14:** Electromagnetic induction: Faraday's Law, Lenz's Law, inductors, and electromagnetic wave spectrum.
- **Week 15:** Modern physics applications: Photoelectric effect, laser principles, and non-destructive testing (NDT) sensors.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Lab Safety Guidelines, measurement instruments (vernier caliper, micrometer screw gauge), and error estimation.
- **Week 2:** Experiment 1: Determination of linear thermal expansion coefficient of solid metals.
- **Week 3:** Experiment 2: Measurement of thermal conductivity of insulating and structural materials.
- **Week 4:** Experiment 3: Verification of ideal gas laws and thermal state relations.
- **Week 5:** Experiment 4: Experimental determination of acceleration due to gravity (g) using a simple pendulum.
- **Week 6:** Experiment 5: Velocity of sound measurement in air using resonance tubes.
- **Week 7:** Practical Evaluation / Midterm Laboratory Test.
- **Week 8:** Experiment 6: Refractive index determination of glass using a spectrometer/prism.
- **Week 9:** Experiment 7: Focal length measurement of convex and concave spherical lenses.
- **Week 10:** Experiment 8: Experimental verification of Ohm's Law and series/parallel resistor networks.
- **Week 11:** Experiment 9: Determination of an unknown resistance using a Wheatstone Bridge circuit.
- **Week 12:** Experiment 10: RC circuit time constant determination during charging and discharging.
- **Week 13:** Experiment 11: Magnetic field mapping around a current-carrying straight conductor and solenoid.
- **Week 14:** Experiment 12: Wavelength measurement of a light source using diffraction grating.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Raymond A. Serway & John W. Jewett – *Physics for Scientists and Engineers with Modern Physics* (10th Edition), Cengage Learning. David Halliday, Robert Resnick, & Jearl Walker – *Fundamentals of Physics* (11th or 12th Edition), Wiley.	Yes
Recommended Texts	Hugh D. Young & Roger A. Freedman – *Sears and Zemansky's University Physics with Modern Physics* (15th Edition), Pearson. Paul A. Tipler & Gene Mosca – *Physics for Scientists and Engineers* (6th Edition), W. H. Freeman.	Yes
Websites	PhET Interactive Simulations (University of Colorado Boulder) & Official Academic E-Learning Portals.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors
	D - Satisfactory	60–69	Fair but with major shortcomings
	E - Sufficient	50–59	Work meets minimum criteria
Fail Group (0–49)	**FX - Fail**	(45–49)	More work required but credit awarded

	F - Fail	(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). University policy strictly prohibits condoning "near-pass fails".

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Engineering Materials Properties
Module Type	Core / Basic Engineering
Module Code	RE.114
ECTS Credits	5
SWL (hr/sem)	125
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☑ Tutorial
Semester of Delivery	Semester 1
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant Professor. Dr Hasan Hadi Kraidi
Module Leader's e-mail	hasan.kraidi@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	Lecturer Khawla Abbas Farhan khawla.abbas@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

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

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Material Classification & Structure:** Introduce fundamental chemical, physical, and mechanical properties of civil and highway engineering materials (steel, cement, aggregates, asphalt, timber, polymers, and bricks).

2. **Standardized Testing Practices:** Familiarize students with standard laboratory procedures (ASTM, AASHTO, BS) for testing material performance and quality compliance.

3. **Mechanical Behavior Analysis:** Develop an understanding of stress-strain relationships, elasticity, plasticity, fatigue, ductility, and failure modes under different loading conditions.

4. **Durability & Environmental Response:** Evaluate material behavior under environmental degradation, corrosion, temperature fluctuations, and moisture effects in civil infrastructure.

5. **Material Selection Criteria:** Provide criteria for selecting appropriate engineering materials based on strength, durability, economic feasibility, and sustainability requirements.

Module Learning Outcomes

1. Identify and classify fundamental engineering materials and their physical/chemical properties.

2. Interpret stress-strain diagrams to determine mechanical parameters (yield strength, modulus of elasticity, ultimate tensile strength, ductility, and toughness).

3. Conduct standardized laboratory tests to evaluate physical and mechanical properties of metals, aggregates, cementitious binders, and asphalt.

4. Assess the quality, grading, and suitability of coarse and fine aggregates for concrete mixes and highway pavement layers.

5. Analyze material failure mechanisms, environmental corrosion, efflorescence, and degradation factors in civil structures.

6. Apply international specifications (AASHTO, ASTM, Iraqi Standard Specifications) to accept or reject construction materials.

Indicative Contents

- **General Introduction & Atomic Structure:** Classification of materials, atomic bonding, crystal structures, defects, and volumetric properties (density, porosity, void ratio, moisture content) (10 hours theory, 6 hours lab).

- **Mechanical Properties & Metals:** Stress, strain, Hooke's law, Poisson's ratio, tensile/compressive behavior, hardness, impact resistance, structural steel manufacturing, rebar grades, and metallic corrosion (12 hours theory, 12 hours lab).
- **Inorganic Binders & Aggregates:** Portland cement manufacturing, hydration reactions, setting times, aggregate sampling, sieve analysis, grading curves, specific gravity, absorption, Los Angeles abrasion, and aggregate impact value (14 hours theory, 14 hours lab).

- **Bituminous Binders & Masonry:** Origin of asphalt/bitumen, penetration grade, ductility, softening point, viscosity, flash point, clay bricks, concrete blocks, absorption, and compressive strength (12 hours theory, 12 hours lab).

- **Polymers, Timber & Composites:** Wood structure, moisture content effects, seasoning, polymers, geotextiles, fiber-reinforced composites, and sustainable building materials (12 hours theory, 6 hours lab).

4. Learning and Teaching Strategies

1. **Theoretical Conceptual Lectures:** Deliver core concepts through technical lectures supported by physical samples, visual media, and engineering case studies.

2. **Hands-On Experimental Testing:** Engage students in laboratory sessions operating universal testing machines (UTMs), Vicat apparatuses, sieves, and abrasion equipment.

3. **Standards-Based Data Analysis:** Teach students how to process experimental raw data, plot stress-strain curves, and write technical laboratory reports following ASTM/AASHTO formats.

4. **Interactive Problem Sessions:** Solve numerical problems regarding volumetric relations, aggregate blending, stress calculations, and material unit weights during tutorial hours.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	65	4.3
Total SWL (h/sem)	**125**	**8.3**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1, #2, #4, #5
Laboratory Reports & Work	10 reports	15% (15 marks)	Weekly	LO #3, #6
Midterm Written Exam	2 hours	15% (15 marks)	Week 7	LO #1, #2
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #3, #6
Final Theoretical Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to engineering materials, historical development, classification, and civil infrastructure applications.
- **Week 2:** Physical and volumetric properties: Mass, density, specific gravity, moisture content, absorption, porosity, and void ratio.
- **Week 3:** Fundamental mechanical properties: Elasticity, plasticity, stress-strain behavior, Hooke's law, and modulus of elasticity.
- **Week 4:** Mechanical behavior under load: Tensile strength, compressive strength, flexure, shear, hardness, toughness, and fatigue.

- **Week 5:** Metallic materials: Ferrous vs. non-ferrous metals, structural steel production, rebar types, stress-strain curve for steel, and yield point phenomena.

- **Week 6:** Metallic corrosion mechanisms, prevention methods, and thermal properties of engineering materials.

- **Week 7:** Midterm Examination.

- **Week 8:** Building masonry: Clay bricks, concrete blocks, manufacturing, classification, efflorescence, and absorption properties.
- **Week 9:** Inorganic binding materials: Lime, gypsum, hydraulic cements, Portland cement composition, and hydration reactions.

- **Week 10:** Physical properties of cement: Fineness, consistency, initial and final setting times, soundness, and compressive strength.

- **Week 11:** Aggregates in civil engineering: Classification, physical characteristics, particle shape, surface texture, and sieve analysis.

- **Week 12:** Aggregate mechanical properties: Toughness, hardness, Los Angeles abrasion resistance, and sound testing for road construction.

- **Week 13:** Bituminous materials: Production of asphalt binders, physical behavior, penetration grading, ductility, and softening point.

- **Week 14:** Timber and wood products: Anisotropy, moisture content, mechanical strength, seasoning, and preservation methods.

- **Week 15:** Advanced composites, geotextiles, polymers, non-destructive testing (NDT), and eco-friendly/recycled construction materials.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Laboratory safety protocols, introduction to testing machinery, calibration, and unit systems.

- **Week 2:** Experiment 1: Determination of physical properties (density, porosity, water absorption) of building stones and bricks.

- **Week 3:** Experiment 2: Tension test on structural steel rebar using the Universal Testing Machine (UTM).

- **Week 4:** Experiment 3: Hardness measurement (Brinell / Rockwell) and Impact resistance test (Charpy / Izod).

- **Week 5:** Experiment 4: Compressive strength test of clay bricks and hollow concrete masonry blocks.

- **Week 6:** Experiment 5: Efflorescence and dimension tolerance tests on clay bricks.

- **Week 7:** Practical Evaluation / Midterm Laboratory Exam.
- **Week 8:** Experiment 6: Standard consistency and setting time determination of Portland cement using the Vicat apparatus.

- **Week 9:** Experiment 7: Fineness test of cement (sieve analysis / Blaine air permeability) and Le Chatelier soundness test.

- **Week 10:** Experiment 8: Sieve analysis and particle size distribution curve for fine and coarse aggregates.

- **Week 11:** Experiment 9: Specific gravity, bulk density, and water absorption tests for aggregates.

- **Week 12:** Experiment 10: Aggregate Impact Value (AIV) and Los Angeles Abrasion test for highway aggregates.

- **Week 13:** Experiment 11: Penetration test and ductility test on asphalt binders.

- **Week 14:** Experiment 12: Softening point test (Ring and Ball apparatus) and Flash/Fire point tests for bitumen.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Michael S. Mamlouk & John P. Zaniewski – *Materials for Civil and Construction Engineers* (4th Edition), Pearson. S.K. Duggal – *Building Materials* (5th Edition), New Age International Publishers.	Yes

Recommended Texts	ASTM International – *Annual Book of ASTM Standards (Volume 04.01 Cement; Lime; Gypsum & Volume 04.03 Road and Paving Materials)*. AASHTO – *Standard Specifications for Transportation Materials and Methods of Sampling and Testing*.	Yes
Websites	ASTM International Digital Library & Official Academic E-Learning Portals.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors
	D - Satisfactory	60–69	Fair but with major shortcomings
	E - Sufficient	50–59	Work meets minimum criteria
Fail Group (0–49)	**FX - Fail**	(45–49)	More work required but credit awarded
	F - Fail	(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). University policy strictly prohibits condoning "near-pass fails".

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Computer I
Module Type	Basic Engineering / Support (B)
Module Code	QU04
ECTS Credits	3

SWL (hr/sem)	75
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 1
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant ProfessorSara Husein Toman-
Module Leader's e-mail	sarah.hussein@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	PHD
Module Tutor	Assistant Lecturer Rasha Muthana Jameel rasha.muthna.alfatlawy@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** None | **Semester:** -
- **Co-requisites module:** Computer II | **Semester:** 2

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Computer System Fundamentals:** Introduce fundamental concepts of computer hardware architecture, software classification, operating systems, and computer networks.
2. **Document Processing Skills:** Equip students with advanced word-processing capabilities to author structured engineering reports, technical documentation, and academic papers.
3. **Data Presentation & Visualization:** Train students in designing effective technical slide presentations for engineering projects using modern presentation software.
4. **Spreadsheet Application Basics:** Provide foundational skills in spreadsheet software for engineering data entry, basic mathematical calculations, and chart generation.

5. **Digital Literacy & Cybersecurity:** Enhance digital literacy, cloud collaboration, internet research methods, and awareness of basic cybersecurity practices.

Module Learning Outcomes

1. Identify and explain basic computer system components, hardware peripherals, operating system functions, and network architectures.

2. Create and format complex engineering reports using word processing tools (styles, automated tables of contents, equation editor, cross-referencing).

3. Design professional technical presentations incorporating animations, slide masters, embedded charts, and multimedia elements.

4. Apply spreadsheet software for managing numerical data, executing basic formulas, and plotting engineering charts.

5. Utilize cloud storage, online collaborative tools, academic search engines, and practice safe computing habits.

Indicative Contents

- **Computer System Fundamentals & Operating Systems:** System architecture (CPU, memory, storage, I/O devices), system vs. application software, operating system management (Windows environment, file systems, directory structure) (6 hours theory, 6 hours lab).

- **Word Processing (MS Word):** Document structure, text/paragraph formatting, headers/footers, inserting engineering equations, managing tables, graphics, automatic table of contents, and citation management (8 hours theory, 12 hours lab).

- **Presentation Software (MS PowerPoint):** Slide layout principles, custom templates, slide masters, graphic/chart integration, animation effects, and presentation delivery techniques (6 hours theory, 8 hours lab).

- **Spreadsheet Software (MS Excel Basics):** Worksheet environment, cell formatting, data types, relative/absolute cell referencing, basic formulas (SUM, AVERAGE, MIN, MAX, COUNT), and fundamental charting (6 hours theory, 8 hours lab).

- **Internet, Cloud Computing & Cybersecurity:** Web browsing, academic databases, cloud storage/collaboration (OneDrive, Google Drive), data backup, malware prevention, and password security (4 hours theory, 6 hours lab).

4. Learning and Teaching Strategies

1. **Theoretical Conceptual Lectures:** Introduce fundamental computing concepts and software functionalities using interactive screen projections and demonstrations.

2. **Hands-On Computer Laboratory Sessions:** Practical step-by-step application in computer labs, allowing students to execute assignments individually on PC workstations.

3. **Task-Based Assignments:** Assign practical engineering tasks (formatting technical reports, building presentation decks, creating spreadsheets) to reinforce learning.

4. **Continuous Practical Evaluation:** Provide real-time feedback during laboratory sessions to guide students on efficient software shortcuts and formatting techniques.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	30	2
Unstructured SWL (h/sem)	45	3
Total SWL (h/sem)	**75**	**5**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1, #2, #3, #4
Lab Assignments & Work	10 exercises	15% (15 marks)	Weekly	LO #2–#5
Midterm Practical Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #2–#5
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to computer systems: Hardware components (CPU, RAM, ROM, storage devices) and input/output peripherals.
- **Week 2:** Operating Systems: Fundamentals of Windows OS, file management systems, directory hierarchies, and system configuration.
- **Week 3:** Word Processing I: User interface, document creation, typography, paragraph alignment, line spacing, and page setup.
- **Week 4:** Word Processing II: Inserting and formatting tables, drawing tools, graphics, headers, footers, and page numbering.
- **Week 5:** Word Processing III: Mathematical equation editor, automated Table of Contents, captions, and cross-referencing.
- **Week 6:** Presentation Software I: Principles of visual presentation, slide layouts, text formatting, and theme selection.
- **Week 7:** Midterm Examination.
- **Week 8:** Presentation Software II: Customizing Slide Masters, slide transitions, animation paths, embedded media, and speaker notes.
- **Week 9:** Spreadsheet Fundamentals I: User interface, worksheets, cells, ranges, data types (text, numbers, dates), and cell formatting.
- **Week 10:** Spreadsheet Fundamentals II: Entering arithmetic operations, relative vs. absolute cell references ($), and basic statistical functions.
- **Week 11:** Spreadsheet Fundamentals III: Creating and styling charts (bar, column, line, pie), data sorting, and basic filtering.
- **Week 12:** Computer Networks & Internet: Network types (LAN, WAN, Wi-Fi), IP addresses, web browsers, and academic search strategies.
- **Week 13:** Cloud Services & Collaboration: Cloud storage platforms, real-time online document sharing, and collaborative editing.
- **Week 14:** Information Security Basics: Computer viruses, malware, phishing threats, firewalls, antivirus software, and data backup routines.

- **Week 15:** Review of practical productivity workflows and project formatting guidelines.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** PC assembly overview, peripheral connections, OS navigation, and user account setup.
- **Week 2:** File management practice: Creating folder structures, file search, compression (ZIP), and shortcuts.
- **Week 3:** MS Word Lab: Creating a basic document, adjusting margins, paragraph styling, and applying font formats.
- **Week 4:** MS Word Lab: Constructing complex data tables, inserting figures, applying captions, and page borders.
- **Week 5:** MS Word Lab: Formatting a complete engineering report with automated Table of Contents and equation formatting.
- **Week 6:** MS PowerPoint Lab: Designing a 5-slide technical presentation with structured layouts and imagery.
- **Week 7:** Practical Midterm Exam in Computer Laboratory.
- **Week 8:** MS PowerPoint Lab: Applying slide transitions, object animations, custom master templates, and exporting to PDF.
- **Week 9:** MS Excel Lab: Entering engineering dataset, formatting table cells, and adjusting row/column properties.
- **Week 10:** MS Excel Lab: Writing formulas, applying SUM, AVERAGE, MIN, MAX functions, and absolute referencing exercises.
- **Week 11:** MS Excel Lab: Plotting graphs from engineering data, customizing axes, titles, legends, and page print setups.
- **Week 12:** Internet Lab: Academic searching techniques, evaluating web sources, and downloading research papers.
- **Week 13:** Cloud Lab: Creating and sharing online documents using cloud platforms, setting access permissions.

- **Week 14:** Security Lab: Configuring browser security, password manager usage, and conducting system security scans.

- **Week 15:** Final Practical Examination in Computer Laboratory.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Joan Lambert – *Microsoft Office Step by Step (Office 2021 / Microsoft 365)*, Microsoft Press. Timothy J. O'Leary & Linda I. O'Leary – *Computing Essentials 2023*, McGraw-Hill.	Yes
Recommended Texts	Peter Norton – *Introduction to Computers* (7th Edition), McGraw-Hill. Autodesk & Microsoft Official Digital Courseware.	Yes
Websites	Microsoft Learn Platform & University Official E-Learning Portal.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors
	D - Satisfactory	60–69	Fair but with major shortcomings
	E - Sufficient	50–59	Work meets minimum criteria
Fail Group (0–49)	**FX - Fail**	(45–49)	More work required but credit awarded

	F - Fail	(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). University policy strictly prohibits condoning "near-pass fails".

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	English Language I
Module Type	Basic Engineering / Support (B)
Module Code	QU01
ECTS Credits	2
SWL (hr/sem)	50
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 1
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Lecturer Saba Mohammed Shaheed
Module Leader's e-mail	saba.shheed@qu.edu.iq
Module Leader's Acad. Title	Lecturer
Module Leader's Qualification	M.S.C
Module Tutor	-
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** None | **Semester:** -

- **Co-requisites module:** English Language II | **Semester:** 2

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **General & Academic Grammar:** Strengthen foundational English grammar, sentence structures, tenses, and academic writing conventions.

2. **Technical Vocabulary Development:** Build a robust repertoire of essential technical and civil engineering terminology.

3. **Reading Comprehension:** Improve comprehension of academic and technical texts, engineering articles, and instructional manuals.

4. **Professional Communication:** Enhance oral communication skills for technical discussions, presentations, and team collaboration.

5. **Academic Writing Skills:** Develop fundamental technical writing skills for composing structured paragraphs, summaries, and formal emails.

Module Learning Outcomes

1. Apply correct grammatical structures, verb tenses, passive voice, and prepositions in academic and professional communication.

2. Demonstrate an expanded vocabulary of general and engineering-specific terminology in context.

3. Extract key information, main ideas, and technical details from engineering texts and case studies.

4. Draft well-structured paragraphs, technical summaries, and formal business correspondence.

5. Express engineering ideas clearly and participate effectively in group discussions and short presentations.

Indicative Contents

- **Grammar Foundations & Tense System:** Review of present, past, and future tenses, subject-verb agreement, and active vs. passive voice in technical contexts (10 hours theory, 4 hours tutorial).

- **Technical & Engineering Vocabulary:** Vocabulary strategies, word formation (prefixes, suffixes, roots), and essential engineering jargon (6 hours theory, 4 hours tutorial).

- **Reading & Textual Analysis:** Reading techniques (skimming, scanning, critical reading) applied to engineering articles and technical specifications (6 hours theory, 4 hours tutorial).

- **Technical Writing & Correspondence:** Writing clear technical paragraphs, professional email etiquette, summary writing, and avoiding ambiguity (5 hours theory, 3 hours tutorial).

- **Listening & Speaking for Engineers:** Listening to academic lectures, note-taking strategies, and conducting brief oral technical presentations (3 hours theory, 5 hours tutorial).

4. Learning and Teaching Strategies

1. **Interactive Language Lectures:** Integrate communicative language teaching methods with structured grammar and vocabulary instruction.

2. **Practical Reading & Writing Studios:** Work on hands-on exercises analyzing engineering texts, editing technical documents, and practicing paragraph construction.

3. **Group Discussions & Presentations:** Conduct peer discussions on technical topics to boost speaking fluency and active listening skills.

4. **Formative Writing Exercises:** Provide continuous feedback on written assignments, summaries, and quizzes to target individual language weaknesses.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	30	2
Unstructured SWL (h/sem)	20	1.3
Total SWL (h/sem)	**50**	**3.3**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**

Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1, #2
Written Assignments & Essays	3	10% (10 marks)	Weeks 4, 9, 13	LO #2, #4
Oral Presentation	1	5% (5 marks)	Week 14	LO #3, #5
Midterm Written Exam	1.5 hours	20% (20 marks)	Week 7	LO #1–#3
Final Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory & Practice)

- **Week 1:** Introduction to academic English, course structure, diagnostic language assessment, and engineering dictionary usage.
- **Week 2:** Grammar focus: Present tenses (Simple and Continuous) and their application in scientific facts and ongoing processes.
- **Week 3:** Grammar focus: Past tenses (Simple and Continuous) and reporting experimental procedures/case histories.
- **Week 4:** Technical vocabulary: Word formation, prefixes, suffixes, and engineering roots (geo-, hydro-, thermo-, struct-).
- **Week 5:** Grammar focus: Future forms and modal verbs of obligation, probability, and technical capability (can, must, should).
- **Week 6:** Reading comprehension skills: Skimming and scanning techniques applied to civil engineering articles.
- **Week 7:** Midterm Examination.
- **Week 8:** Passive Voice in technical writing: Converting active to passive voice for objective scientific reporting.
- **Week 9:** Technical paragraph writing: Topic sentences, supporting details, transition words, and logical coherence.
- **Week 10:** Vocabulary expansion: Materials, tools, measurement units, and structural components terminology.

- **Week 11:** Technical correspondence: Writing formal emails, requests for information (RFI), and professional memos.
- **Week 12:** Complex sentence structures: Relative clauses (defining and non-defining) and conditional sentences in technical specifications.
- **Week 13:** Summarizing and paraphrasing: Extracting main points from engineering reports while avoiding plagiarism.
- **Week 14:** Listening comprehension, note-taking strategies, and delivery of short individual technical presentations.
- **Week 15:** Comprehensive review of grammar, technical writing models, and final exam preparation.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- *N/A (This module is theoretical with structured weekly practical tutorial sessions).*

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Mark Ibbotson – *Cambridge English for Engineering*, Cambridge University Press. Liz & John Soars – *New Headway Academic Skills / Intermediate*, Oxford University Press.	Yes
Recommended Texts	Raymond Murphy – *English Grammar in Use* (5th Edition), Cambridge University Press. David Bolton & Noel Goodey – *English Grammar in Steps*, Richmond.	Yes
Websites	BBC Learning English, Cambridge English Online, and University Academic E-Learning Portal.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors
	D - Satisfactory	60–69	Fair but with major shortcomings
	E - Sufficient	50–59	Work meets minimum criteria
Fail Group (0–49)	**FX - Fail**	(45–49)	More work required but credit awarded
	F - Fail	(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). University policy strictly prohibits condoning "near-pass fails".

First Stage

Semester 2

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Mathematics II
Module Type	Basic Engineering / Support (B)
Module Code	ENG.121
ECTS Credits	6
SWL (hr/sem)	150
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 2
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant Lecturer Dhuha Tuaimah Abdul Kadhim
Module Leader's e-mail	dhuha.tuaimah@qu.edu.iq
Module Leader's Acad. Title	Assistant Lecturer
Module Leader's Qualification	MSC
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** ENG.111 / RE.111 (Mathematics I) | **Semester:** 1
- **Co-requisites module:** None | **Semester:** -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Advanced Calculus Concepts:** Master definite/indefinite integration, integration techniques, and applications to engineering physical problems.

2. **Infinite Series & Sequences:** Evaluate convergence and divergence of numerical series and express functions using Taylor and Maclaurin power series.

3. **Multivariable & Partial Derivatives:** Understand partial derivatives, directional derivatives, gradient vectors, and optimization of multivariable functions.

4. **Vector Analysis & Spatial Geometry:** Apply vector algebra in 3D, lines, planes, and vector-valued functions to geometric and physical systems.

5. **Differential Equations Intro:** Introduce first-order ordinary differential equations (ODEs) and their application to basic civil engineering systems.

Module Learning Outcomes

1. Execute advanced integration techniques (integration by parts, trigonometric substitutions, partial fractions).

2. Calculate areas, volumes of revolution, arc lengths, and surface areas using definite integrals.

3. Determine the convergence of infinite series and expand functions into power series (Taylor/Maclaurin).

4. Compute partial derivatives, directional derivatives, gradients, and tangent planes for multivariable functions.

5. Apply 3D vector operations (dot/cross products) to model spatial geometric lines and surfaces.

6. Formulate and solve separable and linear first-order differential equations.

Indicative Contents

- **Advanced Integration Techniques:** Integration by parts, trigonometric integrals and substitutions, partial fractions decomposition, and improper integrals (12 hours theory, 8 hours tutorial).

- **Applications of Integration:** Areas between curves, volumes by disk/washer and cylindrical shell methods, arc length, surface area of revolution (10 hours theory, 6 hours tutorial).

- **Infinite Sequences and Series:** Convergence tests (integral, comparison, ratio, root tests), alternating series, power series, Taylor and Maclaurin series expansions (12 hours theory, 8 hours tutorial).

- **Vectors & Geometry of Space:** Vector operations in 3D, dot and cross products, equations of lines and planes, quadric surfaces (8 hours theory, 6 hours tutorial).

- **Partial Differentiation & First-Order ODEs:** Functions of several variables, partial derivatives, chain rule, directional derivatives, gradients, first-order separable and linear ODEs (10 hours theory, 10 hours tutorial).

4. Learning and Teaching Strategies

1. **Theoretical Conceptual Lectures:** Detailed delivery of mathematical principles, proofs, and analytical techniques.

2. **Interactive Tutorial Sessions:** Weekly small-group problem-solving tutorials focusing on engineering applications.

3. **Continuous Formative Evaluation:** Weekly homework sets and quizzes to reinforce analytical and computational mechanics.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	90	6
Total SWL (h/sem)	**150**	**10**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Assignments	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Review of basic integration, substitution rule, and fundamental theorem of calculus.
- **Week 2:** Integration by parts and reduction formulas.
- **Week 3:** Trigonometric integrals and trigonometric substitution techniques.
- **Week 4:** Integration of rational functions using partial fractions decomposition.
- **Week 5:** Applications of integration: Area between curves and volumes of solids of revolution (disk/washer methods).
- **Week 6:** Volumes of revolution (cylindrical shells) and arc length determination.
- **Week 7:** Midterm Examination.
- **Week 8:** Infinite sequences and numerical series; integral and comparison convergence tests.
- **Week 9:** Ratio test, root test, alternating series test, and absolute/conditional convergence.
- **Week 10:** Power series, interval/radius of convergence, and Taylor and Maclaurin series expansions.
- **Week 11:** 3D coordinate systems, vectors in space, dot product, and cross product operations.
- **Week 12:** Equations of lines and planes in 3D space, quadric surfaces.
- **Week 13:** Multivariable functions, limits, continuity, and partial derivatives calculation.
- **Week 14:** Chain rule for multivariable functions, directional derivatives, and gradient vectors.
- **Week 15:** First-order differential equations: Separable variables and first-order linear ODEs.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- *N/A (Theoretical module with weekly structured tutorials).*

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	George B. Thomas Jr. – *Thomas' Calculus: Early Transcendentals* (14th Edition), Pearson.	Yes
Recommended Texts	James Stewart – *Calculus: Early Transcendentals* (9th Edition), Cengage Learning.	Yes
Websites	MIT OpenCourseWare (Single and Multivariable Calculus) & University E-Learning Portal.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Engineering Drawing and AutoCAD II
Module Type	Basic Engineering / Support (B)
Module Code	RE.122
ECTS Credits	6
SWL (hr/sem)	150
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 2
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant Lecture Abdulsamad Adnan Lafta- Assistant Lecturer Hiba Aref Jasim AL.dolamie
Module Leader's e-mail	bdulsamed.adnan@qu.edu.iq hiba.arif@qu.edu.iq
Module Leader's Acad. Title	Assistant Lecture
Module Leader's Qualification	MSC.
Module Tutor	Lecturer Thulfiqar Salim Hussein thulfiqar.hussein@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.112 (Engineering Drawing & AutoCAD I) | **Semester:** 1
- **Co-requisites module:** None | **Semester:** -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Sectional Views & Conventions:** Teach full, half, offset, broken-out, and revolved sectional views according to standard drawing conventions.

2. **Isometric & Axonometric Drawing:** Develop skills to construct pictorial isometric drawings manually and in AutoCAD.

3. **Advanced 2D CAD & Blocks:** Master AutoCAD dynamic blocks, external references (Xrefs), attributes, and parametric drafting.

4. **Introduction to 3D Modeling:** Introduce 3D solid modeling, 3D operations (Extrude, Revolve, Sweep, Loft, Boolean operations), and render setups.

5. **Civil & Highway Engineering Graphics:** Train students in drafting road cross-sections, plan and profile views, structural details, and site plans.

Module Learning Outcomes

1. Construct correct sectioned views of complex mechanical and civil engineering structures.

2. Produce 3D isometric representations manually and within 2D isometric environments in AutoCAD.

3. Implement reusable dynamic blocks, attributes, and external references (Xrefs) for drawing efficiency.

4. Generate 3D solid models using extrusion, revolution, lofting, and boolean operations (Union, Subtract, Intersect).

5. Extract 2D production drawings, sections, and elevations from 3D CAD solid models.

6. Draft standardized civil engineering drawings including site plans, highway cross-sections, and structural details.

Indicative Contents

- **Sectional Views:** Full sections, half sections, offset sections, aligned sections, hatching standards, and sectional conventions (10 hours theory, 10 hours lab).

- **Isometric & Pictorial Drawings:** Isometric axes, isometric circles/arcs, non-isometric lines, manual and CAD isometric drafting (10 hours theory, 10 hours lab).

- **Advanced AutoCAD Features:** Dynamic blocks, attribute definition and extraction, external references (Xrefs), parametric constraints, and sheet set management (10 hours theory, 15 hours lab).

- **3D Solid Modeling in AutoCAD:** 3D coordinate systems (UCS), primitive solids, Extrude, Revolve, Sweep, Loft, Boolean operations, 3D Rotate, and Array (10 hours theory, 20 hours lab).

- **Civil & Highway Infrastructure Drafting:** Road profile layouts, typical pavement cross-sections, culvert details, and bridge pier drawings (5 hours theory, 10 hours lab).

4. Learning and Teaching Strategies

1. **Hands-On Studio & CAD Labs:** Practical execution of drawing assignments in studio tables and computer workstations.

2. **Live Screen Demonstrations:** Real-time demonstration of 3D modeling steps, boolean logic, and civil drafting standards.

3. **Project-Based Assignments:** Drafting comprehensive civil infrastructure sheet sets and 3D geometric models.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	75	5
Unstructured SWL (h/sem)	75	5
Total SWL (h/sem)	**150**	**10**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#4
Lab Sheets & Projects	10 sheets	15% (15 marks)	Weekly	All LOs
Midterm Practical Exam	2 hours	20% (20 marks)	Week 7	LO #1, #2
Final Practical CAD Exam	2 hours	20% (20 marks)	Week 15	LO #3–#6
Final Theoretical Exam	2 hours	30% (30 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory & CAD Concepts)

- **Week 1:** Sectional views theory: Cutting plane lines, full sections, and hatching standards.
- **Week 2:** Half sections, offset sections, revolved sections, and removed sections.
- **Week 3:** Principles of isometric projection, isometric scale vs. isometric drawing.
- **Week 4:** Constructing isometric drawings containing inclined lines, circles, and curved surfaces.
- **Week 5:** Advanced block creation, block attributes, and automated attribute extraction in AutoCAD.
- **Week 6:** Managing External References (Xrefs), image overlays, and parametric constraints.
- **Week 7:** Midterm Examination.
- **Week 8:** Introduction to 3D space in AutoCAD, User Coordinate System (UCS), and 3D primitives.
- **Week 9:** Creating solids from 2D profiles: Extrude and Presspull commands.
- **Week 10:** Advanced solid creation: Revolve, Sweep, and Loft commands.
- **Week 11:** Solid editing and Boolean operations (Union, Subtract, Intersect).
- **Week 12:** 3D transformations: 3D Move, 3D Rotate, 3D Align, and 3D Array.
- **Week 13:** Generating 2D drawings from 3D models (Flatshot, Solview, Soldraw, Sectionplane).
- **Week 14:** Highway and civil drawing standards: Road alignment plans, profile views, and cross-sections.
- **Week 15:** Plotting 3D models, visual styles, materials assignment, basic rendering, and layout viewports.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Manual/CAD Lab: Drafting full sectional views of engineering blocks.
- **Week 2:** Manual/CAD Lab: Drafting half and offset sectional views with standard hatching.
- **Week 3:** Manual/CAD Lab: Setting up isometric grid/snap, drawing 2D isometric shapes.
- **Week 4:** Manual/CAD Lab: Drawing isometric views featuring Isocircles and sloped faces.
- **Week 5:** Computer Lab: Creating custom dynamic blocks with action parameters and text attributes.
- **Week 6:** Computer Lab: Assembling composite project files using Xrefs and clip boundaries.
- **Week 7:** Practical Midterm Exam in Laboratory.
- **Week 8:** Computer Lab: Navigating 3D viewport, setting up 3D UCS, and drawing 3D basic primitives.
- **Week 9:** Computer Lab: Modeling 3D objects using Extrude and Presspull operations.
- **Week 10:** Computer Lab: Modeling axisymmetric components using Revolve and Sweep.
- **Week 11:** Computer Lab: Applying Boolean operations (Subtract, Union) to build complex 3D civil models.
- **Week 12:** Computer Lab: Modifying 3D solids using Fillet Edge, Chamfer Edge, and 3D Rotate.
- **Week 13:** Computer Lab: Extracting orthographic elevations and sections from a 3D solid model.
- **Week 14:** Computer Lab: Drafting a complete highway cross-section sheet with pavement layer details.
- **Week 15:** Final Practical CAD Examination in Laboratory.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Frederick E. Giesecke et al. – *Technical Drawing with Engineering Graphics* (15th Edition), Pearson. George Omura – *Mastering AutoCAD 2024*, Sybex.	Yes
Recommended Texts	James D. Bethune – *Engineering Graphics with AutoCAD 2023*, Macromedia Press.	Yes
Websites	Autodesk Knowledge Network & University AutoCAD E-Learning Portal.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Static Mechanics
Module Type	Core Engineering (C)
Module Code	RE.123
ECTS Credits	6
SWL (hr/sem)	150
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 2
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst.Haider M.K. Mahdi Al-Jelawy
Module Leader's e-mail	haider.aljelawy@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.113 (Engineering Mechanics I - Statics / Physics) | **Semester:** 1
- **Co-requisites module:** None | **Semester:** -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Advanced Rigid Body Equilibrium:** Extend statics equilibrium concepts to complex 2D and 3D structures, multi-body mechanisms, and support reactions.

2. **Internal Forces in Structural Members:** Teach procedures to determine internal axial force, shear force, and bending moment distributions in beams and frames.

3. **Shear & Bending Moment Diagrams:** Develop skills to construct Shear Force Diagrams (SFD) and Bending Moment Diagrams (BMD) for statically determinate beams.

4. **Frictional Forces & Applications:** Analyze dry friction in complex systems including wedges, screws, flat belts, and journal bearings.

5. **Virtual Work & Potential Energy:** Introduce the Principle of Virtual Work and stability criteria for mechanical systems in static equilibrium.

Module Learning Outcomes

1. Solve 3D equilibrium problems for rigid bodies under complex load combinations.

2. Calculate internal axial forces, shear forces, and bending moments at specified cross-sections in structural elements.

3. Draw complete Shear Force Diagrams (SFD) and Bending Moment Diagrams (BMD) for determinate beams subjected to point, distributed, and couple loads.

4. Apply Coulomb friction laws to analyze stability and motion resistance in wedges, belt drives, and screws.

5. Determine centroids, centers of gravity, and second moments of area for complex composite cross-sections.

6. Apply the Principle of Virtual Work to evaluate equilibrium and stability of interconnected mechanical systems.

Indicative Contents

- **Advanced Rigid Body Equilibrium in 3D:** Free-body diagrams in 3D, constraints, support reactions, vector equilibrium equations ($\sum \mathbf{F} = 0, \sum \mathbf{M} = 0$) (12 hours theory, 8 hours tutorial).

- **Internal Forces in Structural Members:** Internal loadings (axial force N, shear force V, bending moment M) in beams and frames, sign conventions, relationships between load, shear, and moment (15 hours theory, 10 hours tutorial).

- **Shear & Bending Moment Diagrams:** Constructing SFD and BMD using method of sections and graphical integration functions for simply supported, cantilever, and overhanging beams (15 hours theory, 10 hours tutorial).

- **Friction Applications:** Dry friction, impending motion, analysis of wedges, square-threaded screws, and flat belt friction (9 hours theory, 6 hours tutorial).

- **Principle of Virtual Work & Stability:** Virtual displacement, virtual work equation for rigid bodies and linkages, potential energy formulation, and equilibrium stability criteria (12 hours theory, 8 hours tutorial).

4. Learning and Teaching Strategies

1. **Problem-Solving Lectures:** Focus on step-by-step structural analysis, shear/moment diagram plotting, and 3D vector mechanics.

2. **Weekly Interactive Tutorials:** Conduct practical problem-solving sessions focusing on beam diagrams and frame mechanics.

3. **Formative Homework & Quizzes:** Issue weekly assignments to enforce rigor in drawing free-body diagrams and equilibrium equations.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	63	4
Unstructured SWL (h/sem)	87	5.8
Total SWL (h/sem)	**150**	**9.8**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Assignments & Homework	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Review of 2D equilibrium, reaction types, and vector force systems.
- **Week 2:** 3D rigid body equilibrium: Reaction supports, 3D free-body diagrams, and vector equilibrium equations.
- **Week 3:** 3D equilibrium problems involving ball-and-socket joints, journal bearings, and cable constraints.
- **Week 4:** Internal loadings in structural members: Concept of axial force N, shear force V, and bending moment M.
- **Week 5:** Method of sections for finding internal forces at specific points in beams and frames.
- **Week 6:** Differential relations between load intensity $w(x)$, shear force $V(x)$, and bending moment $M(x)$.
- **Week 7:** Midterm Examination.
- **Week 8:** Drawing Shear Force Diagrams (SFD) and Bending Moment Diagrams (BMD) for simply supported beams.
- **Week 9:** SFD and BMD for cantilever beams and beams with overhangs under combined loading.
- **Week 10:** Internal forces and diagram construction for simple structural frames.
- **Week 11:** Dry friction review and analysis of friction on wedges and inclined planes.
- **Week 12:** Belt friction: Friction analysis on flat belts, V-belts, and band brakes.
- **Week 13:** Sectional properties: Review of centroids, area moments of inertia, and polar moment of inertia for composite structural beams.
- **Week 14:** Principle of Virtual Work: Virtual displacements, virtual work done by forces and couples.
- **Week 15:** Potential energy method for equilibrium analysis and determination of stability (stable, unstable, neutral).

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- *N/A (Theoretical module with weekly structured tutorials).*

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	R. C. Hibbeler – *Engineering Mechanics: Statics* (14th or 15th Edition), Pearson. Ferdinand P. Beer et al. – *Vector Mechanics for Engineers: Statics* (12th Edition), McGraw-Hill.	Yes
Recommended Texts	J. L. Meriam, L. G. Kraige – *Engineering Mechanics: Statics* (9th Edition), Wiley.	Yes
Websites	MIT OpenCourseWare (Engineering Statics) & University E-Learning Portal.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Construction Materials
Module Type	Core Engineering (C)
Module Code	RE.124
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 2
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Lecturer. Dr.Hasan Hadi Kraidi
Module Leader's e-mail	hasan.kraidi@qu.edu.iq
Module Leader's Acad. Title	Lecturer
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.114 (Engineering Materials Properties) | **Semester:** 1
- **Co-requisites module:** None | **Semester:** -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Fresh Concrete Technology:** Understand the properties of fresh concrete including workability, consistency, slump, bleeding, segregation, and setting times.

2. **Hardened Concrete Performance:** Analyze compressive strength development, tensile strength, flexural strength, modulus of elasticity, creep, and shrinkage.

3. **Concrete Mix Design:** Train students in designing concrete mixes according to standard methods (ACI 211.1 / BS standards) for structural and pavement applications.

4. **Asphalt Pavement Materials:** Study bituminous mixtures, asphalt concrete properties, Marshall mix design method, and pavement binder specifications.

5. **Durability & Special Concretes:** Introduce durability issues (alkali-silica reaction, sulfate attack, carbonation) and modern concrete types (self-compacting, high-strength, fiber-reinforced).

Module Learning Outcomes

1. Evaluate fresh concrete properties (workability, slump, air content, density) and factors affecting consistency.

2. Perform concrete mix proportioning using ACI 211.1 standard procedures for specified strength and exposure conditions.

3. Conduct destructive and non-destructive tests (cube/cylinder compression, flexure, Schmidt hammer, ultrasonic pulse velocity) on hardened concrete.

4. Formulate hot mix asphalt (HMA) designs using the Marshall mix design procedure and evaluate volumetric properties.

5. Identify concrete degradation mechanisms and select appropriate chemical/mineral admixtures to enhance performance.

6. Apply ASTM, AASHTO, and Iraqi Standard Specifications (IQS) for construction quality control.

Indicative Contents

- **Fresh Concrete Properties:** Components of concrete, water-cement ratio law (Abrams' law), workability test methods (slump, compaction factor, Vebe), segregation, bleeding, mixing, placement, and curing (10 hours theory, 10 hours lab).

- **Hardened Concrete Mechanics:** Compressive strength testing (cubes vs. cylinders), splitting tensile strength, flexural strength, stress-strain behavior, creep, and drying shrinkage (10 hours theory, 10 hours lab).

- **Concrete Mix Design Methods:** Principles of mix design, ACI 211.1 mix design step-by-step procedure, aggregate blending, trial batches, and adjustment (10 hours theory, 6 hours lab).

- **Asphalt Concrete & Bituminous Mixtures:** Hot Mix Asphalt (HMA) ingredients, Marshall Mix Design method (specimen preparation, stability, flow, volumetric parameters: VMA, VFA, Pa) (10 hours theory, 10 hours lab).

- **Admixtures & Special Concretes:** Chemical admixtures (water reducers, superplasticizers, retarders, accelerators), mineral admixtures (fly ash, silica fume, slag), high-performance concrete, and durability mechanisms (5 hours theory, 4 hours lab).

4. Learning and Teaching Strategies

1. **Lectures & Visual Media:** Present material technology principles, hydration chemistry, and standard design specifications.

2. **Laboratory Practical Workshops:** Perform hands-on mixing of concrete batches, slump tests, cylinder compression tests, and Marshall asphalt testing.

3. **Mix Design Calculation Projects:** Conduct step-by-step design projects for concrete mixes and asphalt paving mixtures.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	**100**	**6.7**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1, #2, #4
Laboratory Reports & Work	8 reports	15% (15 marks)	Weekly	LO #1, #3, #4, #6
Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2

Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #3, #4, #6
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to concrete materials, historical background, role of cement paste, aggregate skeleton, and interfacial transition zone (ITZ).
- **Week 2:** Fresh concrete: Workability definition, factors affecting workability, and test methods (Slump, Compaction Factor).
- **Week 3:** Hydration process, setting times, mixing, transporting, placing, compacting, and curing methods for concrete.
- **Week 4:** Hardened concrete: Factors influencing compressive strength, water-cement ratio, gel-space ratio, age, and curing conditions.
- **Week 5:** Tensile and flexural strength of concrete, modulus of elasticity, Poisson's ratio, and stress-strain relationships.
- **Week 6:** Elasticity, shrinkage (plastic and drying shrinkage), creep phenomena, and thermal movement in concrete.
- **Week 7:** Midterm Examination.
- **Week 8:** Concrete Mix Design I: Principles of mix proportioning, target strength determination, water content selection, and w/c ratio selection.
- **Week 9:** Concrete Mix Design II: ACI 211.1 standard procedure, aggregate content estimation, trial batching, and yield adjustments.
- **Week 10:** Chemical admixtures: Accelerators, retarders, water reducers, superplasticizers, air-entraining agents, and their mechanisms.
- **Week 11:** Mineral admixtures (pozzolans): Silica fume, fly ash, ground granulated blast-furnace slag (GGBS), and high-performance concrete.
- **Week 12:** Asphalt Concrete Mixtures: Ingredients, aggregate grading for asphalt mixes, binder selection, and HMA manufacturing.

- **Week 13:** Marshall Mix Design method: Specimen preparation, bulk specific gravity, stability, flow, and air void analysis.

- **Week 14:** Durability of concrete: Sulfate attack, alkali-aggregate reaction (AAR), reinforcement corrosion, freezing and thawing, and carbonation.

- **Week 15:** Non-destructive testing (NDT) of concrete: Rebound (Schmidt) hammer, ultrasonic pulse velocity (UPV), and core sampling.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Lab orientation, safety rules, review of testing equipment, and aggregate batching.

- **Week 2:** Experiment 1: Workability measurement of fresh concrete using Slump Test and Vebe Consistometer.

- **Week 3:** Experiment 2: Mixing trial concrete batches and casting compressive strength cubes/cylinders.

- **Week 4:** Experiment 3: Compressive strength test of concrete cubes and cylinders at 7 and 28 days using UTM.

- **Week 5:** Experiment 4: Splitting tensile strength test on concrete cylinders and flexural strength test (third-point loading) on concrete beams.

- **Week 6:** Experiment 5: Non-destructive testing of concrete using Schmidt Rebound Hammer and Ultrasonic Pulse Velocity (UPV).

- **Week 7:** Practical Evaluation / Midterm Lab Exam.

- **Week 8:** Experiment 6: Full ACI 211.1 concrete mix design trial batch preparation and yield verification.

- **Week 9:** Experiment 7: Testing the effect of superplasticizers and retarders on fresh concrete workability and slump retention.

- **Week 10:** Experiment 8: Bituminous mix preparation and specimen compaction using the Marshall Hammer.

- **Week 11:** Experiment 9: Marshall Stability and Flow test on hot mix asphalt specimens.

- **Week 12:** Experiment 10: Density, air voids (Pa), voids in mineral aggregate (VMA), and voids filled with asphalt (VFA) calculations for asphalt specimens.

- **Week 13:** Experiment 11: Extraction of bitumen from asphalt paving mixtures using centrifuge extractor.

- **Week 14:** Experiment 12: Core drilling demonstration and indirect tensile strength test of asphalt cores.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	A. M. Neville – *Properties of Concrete* (5th Edition), Pearson. Michael S. Mamlouk & John P. Zaniewski – *Materials for Civil and Construction Engineers* (4th Edition), Pearson.	Yes
Recommended Texts	P. Kumar Mehta & Paulo J. M. Monteiro – *Concrete: Microstructure, Properties, and Materials* (4th Edition), McGraw-Hill.	Yes
Websites	American Concrete Institute (ACI) Resources & Asphalt Institute Technical Publications.	-

10. Grading Scheme

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

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Geology
Module Type	Basic Engineering / Support (B)
Module Code	RE.125
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 2
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Sura Ali Saadoon
Module Leader's e-mail	sura.saadoon@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	MSC.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

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

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Physical Geology Principles:** Introduce Earth structure, plate tectonics, geological time scales, weathering, and surface landforms.

2. **Rock & Mineral Identification:** Teach identification of major rock-forming minerals and classification of Igneous, Sedimentary, and Metamorphic rocks.

3. **Structural Geology & Discontinuities:** Analyze geological structures (faults, folds, joints, unconformities) and their impact on engineering stability.

4. **Engineering Applications in Transportation:** Apply geological principles to road cut slopes, tunneling, foundation bearing capacities, aggregate sourcing, and subgrade soil formation.

5. **Geohazards & Groundwater:** Evaluate geological hazards (landslides, sinkholes, earthquakes, soil liquefaction) and hydrogeology principles.

Module Learning Outcomes

1. Identify major rock-forming minerals and classify igneous, sedimentary, and metamorphic rock specimens.

2. Read and interpret geological maps, topographic contours, geological cross-sections, and strike/dip symbols.

3. Evaluate structural geological features (faults, folds, joints) and assess their effects on highway slope stability and tunnel excavation.

4. Analyze physical and chemical weathering processes and their influence on subgrade soil formation and aggregate quality.

5. Assess geohazards (landslides, karst sinkholes, seismic risks) and recommend engineering mitigation strategies for transportation corridors.

6. Understand groundwater occurrence, water table fluctuation, seepage, and drainage requirements in highway engineering.

Indicative Contents

- **Introduction & Earth Materials:** Earth interior, plate tectonics, mineralogy (physical properties, Mohs hardness scale), rock cycles (10 hours theory, 6 hours lab).

- **Rock Types & Aggregate Sources:** Igneous, Sedimentary, and Metamorphic rock classification, engineering properties, suitability as highway aggregates and riprap (10 hours theory, 10 hours lab).

- **Structural Geology & Maps:** Strike and dip concepts, fold classification (anticlines, synclines), fault types (normal, reverse, strike-slip), joints, reading geological maps and cross-sections (10 hours theory, 10 hours lab).

- **Weathering, Soils & Landforms:** Mechanical/chemical weathering, erosion, soil profile formation, river landforms, coastal geological processes, karst topography (8 hours theory, 4 hours lab).

- **Engineering Geohazards & Hydrogeology:** Mass wasting/landslides along highways, sinkholes, seismic ground shaking, hydrogeology, groundwater movement, and subdrainage design (7 hours theory, 5 hours lab).

4. Learning and Teaching Strategies

1. **Lectures & Visual Case Studies:** Deliver geological concepts using visual maps, rock collections, and real-world infrastructure failure case studies.

2. **Hands-On Rock & Map Laboratory:** Practice identifying physical rock samples and constructing geological cross-sections from maps.

3. **Fieldwork Demonstration / Mapping Exercises:** Interpret strike, dip, and fault lines on civil topographical maps.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	**100**	**6.7**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**

Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1, #2, #3
Laboratory Work & Map Sheets	8 exercises	15% (15 marks)	Weekly	LO #1, #2, #3
Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #1, #2
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to Engineering Geology, Earth structure, Earth layers, and plate tectonics theory.
- **Week 2:** Crystallography and mineralogy: Chemical composition, Mohs hardness scale, cleavage, luster, and rock-forming minerals.
- **Week 3:** Igneous rocks: Magma origin, intrusive/extrusive rocks, textures, mineral composition, and engineering characteristics.
- **Week 4:** Sedimentary rocks: Weathering, transport, deposition, lithification, clastic vs. non-clastic sedimentary rocks (limestone, sandstone, shale).
- **Week 5:** Metamorphic rocks: Metamorphic processes, contact/regional metamorphism, foliated vs. non-foliated rocks (slate, schist, gneiss, marble).
- **Week 6:** Weathering processes: Physical and chemical weathering, rock decay, soil profile development, and subgrade formation.
- **Week 7:** Midterm Examination.
- **Week 8:** Structural Geology I: Crustal deformation, stress and strain in rocks, orientation of structures (Strike and Dip).
- **Week 9:** Structural Geology II: Folds (anticlines, synclines, domes) and engineering implications for tunneling and dam foundations.
- **Week 10:** Structural Geology III: Faults (normal, reverse, thrust, strike-slip) and joints; fault zone hazards in highway engineering.

- **Week 11:** Surface geological processes: River mechanics, erosion, sediment transport, deposition, and floodplain stability for bridges.
- **Week 12:** Hydrogeology: Aquifers, aquitards, water table, permeability, seepage, and groundwater impact on road subgrades.
- **Week 13:** Mass wasting: Landslide mechanisms, rockfalls, mudflows, slope stability analysis, and highway slope stabilization techniques.
- **Week 14:** Karst topography: Solution of limestone, sinkhole formation, cavity detection, and foundation remediation.
- **Week 15:** Engineering geological site investigation: Geophysical methods, core drilling, and quarry selection for construction aggregate.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Introduction to mineral identification techniques and physical property testing.
- **Week 2:** Mineral Lab I: Identification of quartz, feldspar, mica, calcite, and gypsum specimens.
- **Week 3:** Mineral Lab II: Identification of ore minerals, clay minerals, and iron oxides.
- **Week 4:** Rock Lab I: Identification and engineering classification of Igneous Rock specimens (granite, basalt, diorite, pumice).
- **Week 5:** Rock Lab II: Identification of Sedimentary Rock specimens (sandstone, limestone, shale, conglomerate, gypsum).
- **Week 6:** Rock Lab III: Identification of Metamorphic Rock specimens (slate, marble, quartzite, gneiss, schist).
- **Week 7:** Practical Evaluation / Midterm Lab Exam.
- **Week 8:** Map Lab I: Reading topographic contours, calculating slope gradients, and drawing elevation profiles.
- **Week 9:** Map Lab II: Interpretation of strike and dip symbols on geological maps.

- **Week 10:** Map Lab III: Constructing geological cross-sections for horizontal and inclined rock strata.
- **Week 11:** Map Lab IV: Interpreting folded geological structures (anticlines/synclines) on geological maps.
- **Week 12:** Map Lab V: Identifying faulted strata and calculating fault displacement on maps.
- **Week 13:** Aerial photography and satellite imagery interpretation for highway route selection.
- **Week 14:** Aggregate quality assessment: Petrographic examination principles for road construction aggregates.
- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	F. G. H. Blyth & M. H. de Freitas – *A Geology for Engineers* (7th Edition), CRC Press. Alan C. McLean & C. D. Gribble – *Geology for Civil Engineers* (3rd Edition), Routledge.	Yes
Recommended Texts	Tony Waltham – *Foundations of Engineering Geology* (3rd Edition), Spon Press.	Yes
Websites	US Geological Survey (USGS) Educational Resources & British Geological Survey (BGS) Portals.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors

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	F - Fail	(0–44)	Considerable amount of work required

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Arabic Language I
Module Type	Basic Engineering / Support (B)
Module Code	QU06
ECTS Credits	2
SWL (hr/sem)	50
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 2
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	assistant professor Kholoud Abbas Hussein
Module Leader's e-mail	khlood.husin@qu.edu.iq
Module Leader's Acad. Title	assistant professor
Module Leader's Qualification	
Module Tutor	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Peer Reviewer Name	
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** None | **Semester:** -

- **Co-requisites module:** None | **Semester:** -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Linguistic & Grammatical Correctness:** Enhance students' mastery of classical and contemporary Arabic grammar rules, sentence construction, and syntax.

2. **Professional Technical Writing:** Train students to draft formal engineering correspondence, official administrative letters, reports, and proposals in standard Arabic.

3. **Common Linguistic Errors:** Identify and correct common grammatical, orthographic, and morphological errors prevalent in academic and professional writing.

4. **Literary & Rhetorical Appreciation:** Develop text analysis skills, reading comprehension, and appreciation of scientific and literary prose.

Module Learning Outcomes

1. Apply correct Arabic grammatical rules (parsing, verb conjugation, noun states) in writing and speech.

2. Avoid common orthographic and grammatical mistakes (*Hamza* rules, *Tā' Marbūṭa* vs. *Hā'*, punctuation).

3. Draft official correspondence, administrative memos, engineering technical reports, and contracts in clear Arabic.

4. Analyze academic and literary texts for rhetorical structure, linguistic accuracy, and scientific clarity.

5. Deliver structured oral presentations in standard Arabic with proper articulation and fluency.

Indicative Contents

- **Orthography & Writing Rules:** *Hamzat Al-Waṣl* and *Al-Qaṭ‘*, *Tā' Marbūṭa* and *Maftūḥa*, Alif Maqṣūra, punctuation marks, and paragraph structure (6 hours theory, 4 hours tutorial).

- **Grammar Foundations:** Nominal and verbal sentence structures, subject-verb agreement, accusative and genitive cases, numbers and counted nouns rules (10 hours theory, 6 hours tutorial).

- **Common Errors in Writing:** Analysis of common morphological, syntax, and semantic errors in official university and engineering documents (5 hours theory, 3 hours tutorial).

- **Administrative & Technical Writing:** Drafting formal letters, meeting minutes, technical engineering summaries, official emails, and project reports (5 hours theory, 3 hours tutorial).

- **Textual Analysis & Oral Skills:** Reading and discussing selected scientific and literary texts to enhance vocabulary and oral delivery (4 hours theory, 4 hours tutorial).

4. Learning and Teaching Strategies

1. **Interactive Lectures:** Present linguistic rules using clear examples, visual slides, and comparative texts.

2. **Practical Writing Studios:** Weekly practical exercises focusing on correcting texts, drafting formal letters, and punctuation practice.

3. **Continuous Editing Tasks:** Analyze authentic official documents to identify and correct linguistic flaws.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	30	2
Unstructured SWL (h/sem)	20	1.3
Total SWL (h/sem)	**50**	**3.3**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1, #2
Written Writing Exercises	3	10% (10 marks)	Weeks 4, 9, 13	LO #2, #3
Oral Delivery / Participation	1	5% (5 marks)	Week 14	LO #4, #5
Midterm Written Exam	1.5 hours	20% (20 marks)	Week 7	LO #1–#3

Final Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to academic Arabic, importance of language accuracy in engineering documentation, orthography fundamentals.
- **Week 2:** Rules of *Hamza*: *Hamzat Al-Waṣl* and *Hamzat Al-Qaṭ‘* in nouns, verbs, and particles.
- **Week 3:** Rules of Medial and Terminal *Hamza* (*Al-Hamza Al-Mutawassiṭa* and *Al-Mutatarrifa*).
- **Week 4:** Distinguishing between *Tā' Marbūṭa*, *Tā' Maftūḥa*, and *Hā'*, and rules of *Al-Alif Al-Layyina*.
- **Week 5:** Punctuation marks (*‘Alāmāt Al-Tarqīm*) and their proper utilization in technical writing.
- **Week 6:** The Nominal Sentence (*Al-Jumla Al-Ismiyya*), subject and predicate, and abrogating verbs/particles (*Kāna* and *Inna* families).
- **Week 7:** Midterm Examination.
- **Week 8:** The Verbal Sentence (*Al-Jumla Al-Fi‘liyya*), verb tenses, subject, and object rules.
- **Week 9:** Accusatives in Arabic: *Al-Mafā‘īl* (Direct object, Absolute object, Object of purpose, Cognate accusative).
- **Week 10:** Dual and Sound Plurals (Masculine and Feminine) parsing rules.
- **Week 11:** Rules of Numbers (*Aḥkām Al-‘Adad wa Al-Ma‘dūd*) in technical and statistical reporting.
- **Week 12:** Common linguistic and grammatical errors in official university administrative letters (*Aghlāṭ Shā’i‘a*).
- **Week 13:** Technical and administrative writing: Drafting official requests, memos, and administrative correspondence.

- **Week 14:** Technical report writing: Structure, clarity, conciseness, and summary drafting for engineering projects.
- **Week 15:** Literary and scientific text analysis, vocabulary enrichment, and public speaking techniques.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- *N/A (Theoretical module with structured weekly tutorials).*

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	جامع *الدروس العربية*، دار الكتب العلمية – د. مصطفى الغلاييني. *تطبيقات نحوية ولغوية في الكتابة الإدارية والهندسية*. – د. جلال الدين السيوطي	Yes
Recommended Texts	*موسوعة النحو والصرف والإعراب*، دار العلم – د. إميل بديع يعقوب للملايين.	Yes
Websites	Arabic Language Academy Portals & University Digital E-Learning Hub.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors
	D - Satisfactory	60–69	Fair but with major shortcomings
	E - Sufficient	50–59	Work meets minimum criteria
Fail Group (0–49)	**FX - Fail**	(45–49)	More work required but credit awarded

	F - Fail	(0–44)	Considerable amount of work required

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	English Language II
Module Type	Basic Engineering / Support (B)
Module Code	QU02
ECTS Credits	2
SWL (hr/sem)	50
Module Level	Level 1
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 2
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Saba Mohammed Shaheed
Module Leader's e-mail	saba.shheed@qu.edu.iq
Module Leader's Acad. Title	Lecturer
Module Leader's Qualification	MSC
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** QU01 (English Language I) | **Semester:** 1
- **Co-requisites module:** None | **Semester:** -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Advanced Technical Vocabulary:** Expand technical vocabulary tailored to civil, structural, and highway transportation engineering.

2. **Engineering Report Writing:** Master the structure of formal engineering technical reports, research proposals, and technical specifications.

3. **Professional Presentations:** Develop effective oral presentation skills using visual aids for technical project defenses.

4. **Advanced Academic Reading:** Improve critical analysis of peer-reviewed engineering papers and technical manuals.

5. **Complex Sentence Structures:** Apply advanced grammar (conditionals, cause-and-effect connectors, passive reporting) in technical communication.

Module Learning Outcomes

1. Draft structured technical report sections (Introduction, Methodology, Results, Discussion, Conclusion).

2. Utilize Cause-and-Effect transition words, complex conditionals, and impersonal passive structures accurately.

3. Critically read and synthesize technical engineering research articles and code specifications.

4. Deliver formal oral presentations on engineering topics using structured slides and clear delivery.

5. Write formal business correspondence including project proposals, technical progress reports, and cover letters.

Indicative Contents

- **Technical Report Writing:** Anatomy of an engineering report, executive summaries, writing methodology and result sections (10 hours theory, 4 hours tutorial).

- **Grammar for Technical Precision:** Complex conditionals (2nd and 3rd), cause-and-effect clauses, passive voice for processes, and nominalization (8 hours theory, 4 hours tutorial).

- **Specialized Highway Vocabulary:** Terminology for pavement design, traffic engineering, soil mechanics, surveying, and bridge construction (6 hours theory, 4 hours tutorial).

- **Professional Communication & Proposals:** Writing project proposals, progress reports, cover letters, and technical correspondence (3 hours theory, 3 hours tutorial).

- **Presentation Skills & Seminars:** Slide design principles, oral delivery techniques, handling Q&A sessions, and technical seminar presentations (3 hours theory, 5 hours tutorial).

4. Learning and Teaching Strategies

1. **Interactive Seminars:** Language workshops integrating academic instruction with technical engineering topics.

2. **Writing Clinics:** Hands-on review of student-drafted technical report sections and proposals.

3. **Presentation & Peer Review:** Individual technical presentations evaluated with feedback on speech delivery and slide clarity.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	30	2
Unstructured SWL (h/sem)	20	1.3
Total SWL (h/sem)	**50**	**3.3**

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1, #2
Written Report Drafts	2	10% (10 marks)	Weeks 6, 12	LO #1, #2, #5
Technical Presentation	1	5% (5 marks)	Week 14	LO #4
Midterm Written Exam	1.5 hours	20% (20 marks)	Week 7	LO #1–#3
Final Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to advanced technical communication in engineering, course objectives, and diagnostic writing test.
- **Week 2:** Structure of a formal engineering report: Title page, abstract, table of contents, and executive summary.
- **Week 3:** Writing the Introduction and Literature Review sections: Citation styles, referencing, and synthesis.
- **Week 4:** Cause and Effect language: Connectors (*consequently, due to, as a result of, leads to*) in technical analysis.
- **Week 5:** Advanced Passive Voice: Process descriptions, experimental setups, and impersonal reporting styles.
- **Week 6:** Writing Methodology and Results sections: Presenting data, describing figures, tables, and graphs.
- **Week 7:** Midterm Examination.
- **Week 8:** Writing Discussion and Conclusion sections: Interpreting engineering findings and stating limitations/recommendations.
- **Week 9:** Specialized vocabulary I: Highway materials, pavement layers, traffic volume, and geometric design terms.
- **Week 10:** Specialized vocabulary II: Structural mechanics, foundations, bridge engineering, and geotechnical terms.
- **Week 11:** Complex conditionals in engineering design: Hypothetical failure analysis (*If the load exceeds...*).
- **Week 12:** Professional writing: Preparing engineering project proposals, cost estimates, and cover letters.
- **Week 13:** Effective presentation skills: Slide layout, visual data presentation, and managing time limit constraints.
- **Week 14:** Individual student technical presentations on civil/transportation engineering topics with peer feedback.

- **Week 15:** Final review of technical writing guidelines, common grammatical errors, and exam preparation.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- *N/A (Theoretical module with structured weekly practical tutorials).*

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Mark Ibbotson – *Cambridge English for Engineering*, Cambridge University Press. David F. Beer & David A. McMurrey – *A Guide to Writing as an Engineer* (5th Edition), Wiley.	Yes
Recommended Texts	Michael Alley – *The Craft of Scientific Presentations*, Springer. Raymond Murphy – *English Grammar in Use* (5th Edition), Cambridge.	Yes
Websites	Purdue Online Writing Lab (OWL) Engineering Section & University Academic E-Learning Hub.	-

10. Grading Scheme

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

Second Stage

Semester 3

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Mathematics III
Module Type	Basic Engineering / Support (B)
Module Code	ENG.211
ECTS Credits	3
SWL (hr/sem)	75
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 3
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	lecturer Dr Mohanad Mohamed Mahdie
Module Leader's e-mail	mohanad.mohammed@qu.edu.iq
Module Leader's Acad. Title	lecturer
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** ENG.121 (Mathematics II) | Semester: 2
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Fourier Series Expansion:** Enable students to represent periodic functions using trigonometric Fourier series and analyze harmonic frequency spectra.

2. **Laplace Transforms & Applications:** Master Laplace transforms, inverse transforms, and apply them to solve linear initial-value ordinary differential equations.

3. **Partial Differential Equations (PDEs):** Formulate and solve second-order PDEs (heat, wave, and Laplace equations) using separation of variables.

4. **Vector Differential Calculus:** Train students in vector field operations including gradient, divergence, curl, and directional derivatives.

5. **Vector Integral Calculus:** Apply line integrals, surface integrals, Green's Theorem, Divergence Theorem, and Stokes' Theorem to engineering systems.

Module Learning Outcomes

1. Expand periodic signals and functions into Fourier trigonometric series and half-range Fourier sine/cosine series.

2. Calculate Laplace transforms and inverse Laplace transforms using standard properties, convolution, and step functions.

3. Solve linear initial value ordinary differential equations using Laplace transform methods.

4. Derive analytical solutions for classical partial differential equations (1D wave, 1D heat, and 2D Laplace equations).

5. Compute gradient, divergence, and curl of vector fields in Cartesian and cylindrical coordinate systems.

6. Evaluate line and surface integrals and apply Green's, Gauss's Divergence, and Stokes' theorems to vector fields.

Indicative Contents

- **Fourier Series:** Periodic functions, Fourier trigonometric series, Euler formulas, even and odd functions, half-range sine and cosine series expansions (8 hours theory, 4 hours tutorial).

- **Laplace Transforms:** Definition, standard transforms, operational properties (shifting, differentiation, integration), unit step and Dirac delta functions, inverse transforms, convolution theorem, solving linear ODEs (10 hours theory, 6 hours tutorial).

- **Partial Differential Equations:** Basic concepts of PDEs, classification of 2nd-order linear PDEs, method of separation of variables, 1D wave equation, 1D heat conduction equation, 2D Laplace equation (10 hours theory, 5 hours tutorial).

- **Vector Calculus:** Vector fields, gradient of a scalar field, divergence and curl of vector fields, directional derivatives, physical interpretations (6 hours theory, 3 hours tutorial).

- **Vector Integration Theorems:** Line integrals, conservative vector fields and potential functions, Green's Theorem in the plane, surface integrals, Gauss Divergence Theorem, and Stokes' Theorem (11 hours theory, 12 hours tutorial).

4. Learning and Teaching Strategies

1. **Theoretical Analytical Lectures:** Detailed derivation of mathematical theorems, integral transformations, and differential equations.

2. **Weekly Interactive Tutorials:** Guided problem-solving exercises focusing on Laplace, Fourier, and vector integral applications.

3. **Continuous Evaluation:** Homework sets and frequent formative quizzes to reinforce computational fluency.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	45	3
Unstructured SWL (h/sem)	30	2
Total SWL (h/sem)	75	5

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Assignments	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Fourier series: Periodic functions, orthogonality, Fourier coefficients, and Euler formulas.
- **Week 2:** Fourier expansion of even and odd functions, half-range sine and cosine expansions.
- **Week 3:** Definition of Laplace transform, properties, transforms of elementary functions, and shifting theorems.
- **Week 4:** Transforms of derivatives and integrals, unit step function (Heaviside), and impulse function.
- **Week 5:** Inverse Laplace transform methods, partial fraction decomposition, and convolution theorem.
- **Week 6:** Application of Laplace transforms to solve ordinary differential equations with initial values.
- **Week 7:** Midterm Examination.
- **Week 8:** Introduction to Partial Differential Equations (PDEs), classification, and separation of variables method.
- **Week 9:** Solving the 1D wave equation (vibrating string problem) using Fourier series boundary conditions.
- **Week 10:** Solving the 1D heat conduction equation and 2D Laplace equation in steady-state heat transfer.
- **Week 11:** Vector differential calculus: Scalar and vector fields, gradient vector operator, directional derivative.
- **Week 12:** Divergence and curl of vector fields, physical significance, and vector identities.
- **Week 13:** Line integrals, path independence, conservative vector fields, and scalar potential functions.
- **Week 14:** Green's Theorem in the plane, flux, and circulation applications.
- **Week 15:** Surface integrals, Gauss Divergence Theorem, and Stokes' Theorem in engineering field applications.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Erwin Kreyszig – *Advanced Engineering Mathematics* (10th Edition), Wiley.	Yes
Recommended Texts	Dennis G. Zill – *Advanced Engineering Mathematics* (7th Edition), Jones & Bartlett Learning.	Yes
Websites	MIT OpenCourseWare (Differential Equations & Vector Calculus) & University E-Learning Portal.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Asphalt Technology I
Module Type	Core Engineering (C)
Module Code	RE.211
ECTS Credits	5
SWL (hr/sem)	125
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 3
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Lecturer Osamah Hasan Chafat
Module Leader's e-mail	osamah.h.chafat@qu.edu.iq
Module Leader's Acad. Title	Lecturer
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.124 (Construction Materials) | Semester: 2
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Bituminous Binders Fundamentals:** Understand origin, refining process, chemical composition, and classification of petroleum asphalt, cutback asphalts, and asphalt emulsions.

2. **Physical & Rheological Testing:** Master standard laboratory tests to determine physical, safety, and temperature-viscosity characteristics of asphalt binders.

3. **Binder Grading Systems:** Comprehend asphalt binder grading systems including Penetration Grading, Viscosity Grading, and Performance Grading (PG / Superpave).

4. **Aging Mechanisms:** Study physical and chemical hardening, oxidation, volatile loss, and age-hardening testing (TFOT / RTFO).

5. **Pavement Aggregate Characteristics:** Evaluate aggregate physical properties, consensus properties, and gradation requirements for asphalt concrete paving mixtures.

Module Learning Outcomes

1. Identify types, production processes, and chemical structures of bituminous binder materials used in highway engineering.

2. Perform standard laboratory tests for asphalt binders (Penetration, Softening Point, Ductility, Viscosity, Flash Point) according to ASTM and AASHTO standards.

3. Evaluate temperature susceptibility, temperature-viscosity curves, and mixing/compaction temperature ranges for asphalt binders.

4. Classify asphalt cements using Penetration, Viscosity, and Superpave Performance Grading (PG) specifications.

5. Quantify binder aging properties and evaluate the impact of oxidation on pavement performance.

6. Select appropriate aggregate blend gradations and aggregate physical specifications for hot mix asphalt.

Indicative Contents

- **Introduction & Asphalt Refining:** Geological origins of petroleum, refining process, asphalt cement, cutback asphalts (RC, MC, SC), emulsified asphalts (anionic, cationic) (8 hours theory, 4 hours lab).

- **Physical & Rheological Properties:** Consistency tests (Penetration, Softening Point, Ductility, Float test), Safety tests (Flash and Fire Point by Cleveland Open Cup), Density and Specific Gravity (10 hours theory, 10 hours lab).

- **Viscosity & Temperature Susceptibility:** Absolute dynamic viscosity (vacuum capillary), Kinematic viscosity, Rotational Viscometer (RV), Penetration Index (PI), Viscosity-Temperature Susceptibility (VTS) (10 hours theory, 10 hours lab).

- **Asphalt Aging & Grading Systems:** Short-term and long-term aging mechanisms, Thin Film Oven Test (TFOT/RTFO), Penetration grading, Viscosity grading (AC/AR), Superpave PG binder specification (10 hours theory, 10 hours lab).

- **Aggregates for Bituminous Mixtures:** Aggregate types, physical requirements, gradation charts (0.45 power chart), blending procedures, consensus properties (coarse aggregate angularity, uncompacted void content, flat/elongated particles) (7 hours theory, 6 hours lab).

4. Learning and Teaching Strategies

1. **Lectures & Visual Demonstrations:** Classroom instruction covering bituminous material science, refining technology, and standard specifications.

2. **Standardized Hands-On Laboratory:** Execution of standard binder tests according to ASTM/AASHTO specifications by student groups.

3. **Data Analysis & Technical Reporting:** Processing experimental testing data, constructing viscosity-temperature curves, and preparing formal laboratory engineering reports.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	65	4.3
Total SWL (h/sem)	125	8.3

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Weight (Marks)**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1–#4
Laboratory Reports & Performance	8 reports	15% (15 marks)	Weekly	LO #2, #3, #5, #6

Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2, #3
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #2, #3
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to bituminous materials, historical context in highway engineering, and terminology definitions.
- **Week 2:** Petroleum refining processes, fractional distillation, asphalt cement production, and chemical composition (asphaltenes, resins, oils).
- **Week 3:** Liquid asphalts: Cutback asphalts (Rapid Curing, Medium Curing, Slow Curing) and asphalt emulsions (Anionic vs. Cationic).
- **Week 4:** Physical properties of asphalt binders: Consistency, cohesion, adhesion, durability, and temperature susceptibility concepts.
- **Week 5:** Penetration test mechanics, Ductility test, and Softening Point (Ring and Ball method) procedures and engineering significance.
- **Week 6:** Safety properties: Flash point and Fire point determination using Cleveland Open Cup apparatus; Specific gravity determination.
- **Week 7:** Midterm Examination.
- **Week 8:** Rheological behavior of asphalt: Absolute dynamic viscosity, kinematic viscosity, and rotational viscometer (RV) theory.
- **Week 9:** Viscosity-temperature relationships, Penetration Index (PI) calculation, and determining mixing/compaction temperature windows.
- **Week 10:** Aging of asphalt binders: Short-term aging during mixing/placing, long-term field aging, and Thin Film Oven Test (TFOT/RTFO).
- **Week 11:** Traditional asphalt grading systems: Penetration grading system and Viscosity grading system (AC and AR lines).

- **Week 12:** Modern Superpave Performance Grading (PG) system: Principles, climate-based binder selection ($PG\ High - Low$).

- **Week 13:** Mineral aggregates for asphalt concrete: Physical properties, toughness, soundness, cleanliness, and particle shape.

- **Week 14:** Aggregate blending techniques: Sieve analysis interpretation, mathematical blending, and 0.45 power gradation charts.

- **Week 15:** Quality control, Iraqi Standard Specifications (SORB) for asphalt binders and aggregates in road construction.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Safety rules, lab orientation, preparation and heating procedures for asphalt binder samples.

- **Week 2:** Experiment 1: Determination of Specific Gravity and Density of Asphalt Cement (ASTM D70).

- **Week 3:** Experiment 2: Penetration Test of Bituminous Materials at 25°C (ASTM D5).

- **Week 4:** Experiment 3: Softening Point of Bituminous Materials - Ring and Ball Apparatus (ASTM D36).

- **Week 5:** Experiment 4: Ductility Test of Bituminous Materials at 25°C (ASTM D113).

- **Week 6:** Experiment 5: Flash and Fire Points by Cleveland Open Cup Tester (ASTM D92).

- **Week 7:** Practical Midterm Laboratory Evaluation.

- **Week 8:** Experiment 6: Determination of Rotational Viscosity using Brookfield Viscometer (ASTM D4402).

- **Week 9:** Experiment 7: Dynamic and Kinematic Viscosity testing of asphalt binders.

- **Week 10:** Experiment 8: Thin Film Oven Test (TFOT) for evaluate short-term age hardening (ASTM D1754).

- **Week 11:** Experiment 9: Post-TFOT testing: Retained penetration and ductility determination.

- **Week 12:** Experiment 10: Specific gravity and absorption testing of coarse and fine aggregates (ASTM C127 / C128).
- **Week 13:** Experiment 11: Particle shape and angularity testing of coarse aggregates (Flat and Elongated particles).
- **Week 14:** Experiment 12: Aggregate sieve analysis and mathematical blend proportioning for wearing course specifications.
- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Asphalt Institute – *MS-4 The Asphalt Handbook* (7th Edition), Asphalt Institute. E.R. Brown et al. – *Hot Mix Asphalt Materials, Mixture Design, and Construction* (3rd Edition), NAPA.	Yes
Recommended Texts	Freddy L. Roberts et al. – *Hot Mix Asphalt Materials, Mixture Design, and Construction*, NAPA Research and Education Foundation.	Yes
Websites	Asphalt Institute Technical Library & AASHTO/ASTM Specification Standards.	-

10. Grading Scheme

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

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Concrete Technology I
Module Type	Core Engineering (C)
Module Code	RE.212
ECTS Credits	5
SWL (hr/sem)	125
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 3
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Lecturer Samir Hamed Malik
Module Leader's e-mail	Samer.hamed@qu.edu.iq
Module Leader's Acad. Title	Lecturer
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.124 (Construction Materials) | Semester: 2

- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Cement Chemistry & Hydration:** Study Portland cement manufacturing, Bogue's compounds, hydration reactions, microstructure development, and hydration heat.

2. **Cement Types & Specifications:** Examine physical and chemical properties of different Portland cement types (Type I–V) and blended cements according to ASTM/IQS.

3. **Aggregates for Concrete:** Evaluate aggregate classifications, sampling, physical testing, particle size distribution, fineness modulus, and deleterious substances.

4. **Mixing Water & Admixtures:** Analyze water quality requirements and the physical/chemical impacts of chemical admixtures on fresh and hardened concrete.

5. **Fresh Concrete Physics:** Master rheology, workability, segregation, bleeding, consolidation, setting process, and temperature effects.

Module Learning Outcomes

1. Describe Portland cement manufacturing, Bogue's chemical compositions (C_3S, C_2S, C_3A, C_4AF), and hydration reactions.

2. Select appropriate cement types for specific environmental exposure conditions and structural requirements.

3. Conduct standard laboratory tests on cement (fineness, normal consistency, setting time, soundness, compressive strength).

4. Analyze aggregate gradation curves, combine aggregate fractions, and calculate Fineness Modulus (FM) according to ASTM standards.

5. Identify deleterious substances in aggregates and assess their impact on concrete durability.

6. Evaluate fresh concrete properties and optimize chemical admixture dosage to satisfy job site requirements.

Indicative Contents

- **Portland Cement Chemistry:** Raw materials, manufacturing, Bogue's compounds, hydration products (C-S-H gel, $Ca(OH)_2$), heat of hydration, setting phenomena (10 hours theory, 10 hours lab).

- **Cement Types & Standards:** Standard Portland cement types (Type I Ordinary, Type II Moderate, Type III High Early, Type IV Low Heat, Type V Sulfate Resisting), blended cements, IQS/ASTM requirements (8 hours theory, 6 hours lab).

- **Aggregates for Concrete:** Geological origin, shape, surface texture, bulk density, specific gravity, moisture content, absorption, particle size distribution, Fineness Modulus (12 hours theory, 12 hours lab).

- **Deleterious Substances in Aggregates:** Clay lumps, friable particles, organic impurities, sulfates, chlorides, alkali-reactivity, impact on durability (8 hours theory, 6 hours lab).

- **Mixing Water & Chemical Admixtures:** Water quality limits, plasticizers, superplasticizers, accelerators, retarders, air-entraining agents, dosage and mechanisms (7 hours theory, 6 hours lab).

4. Learning and Teaching Strategies

1. **Interactive Theoretical Lectures:** Explaining chemical hydration, aggregate physics, and standards using visual media and diagrams.

2. **Laboratory Practical Workshops:** Performing standard physical and mechanical tests on cements and aggregates in accordance with ASTM/IQS standards.

3. **Data Analysis & Laboratory Reporting:** Processing experimental data, drawing grain size distribution curves, and preparing technical reports.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	65	4.3
Total SWL (h/sem)	125	8.3

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**

Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1, #2, #4
Laboratory Reports & Work	8 reports	15% (15 marks)	Weekly	LO #3, #4, #5
Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2, #3
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #3, #4, #5
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to concrete technology; role of cement paste, aggregate matrix, and interfacial transition zone (ITZ).
- **Week 2:** Cement manufacturing process: Raw materials, rotary kiln reactions, clinker formation, and gypsum addition.
- **Week 3:** Chemical composition of Portland cement: Main Bogue compounds (C_3S, C_2S, C_3A, C_4AF) and minor oxides.
- **Week 4:** Hydration of cement: Hydration reaction mechanisms, hydration products (C-S-H, Calcium Hydroxide, Ettringite), and microstructural evolution.
- **Week 5:** Heat of hydration, stage development, setting process (initial vs. final set), and false set vs. flash set.
- **Week 6:** Standard Types of Portland Cement (ASTM C150 / IQS No. 5): Types I, II, III, IV, V, and special cements.
- **Week 7:** Midterm Examination.
- **Week 8:** Aggregate classification, geological origin, particle shape, surface texture, and physical density parameters.
- **Week 9:** Aggregate moisture states: Oven dry, air dry, saturated surface dry (SSD), wet, and moisture correction computations.
- **Week 10:** Sieve analysis of coarse and fine aggregates: Grading curves, ASTM C33 grading limits, and Fineness Modulus calculation.

- **Week 11:** Combining aggregate gradations, maximum density curves, Fuller's parabola, and gap-graded aggregates.

- **Week 12:** Harmful and deleterious substances in aggregates: Clay, silt, organic impurities, sulfates, chlorides, and soundness test.

- **Week 13:** Alkali-Aggregate Reactions (AAR / ASR): Reaction mechanisms, factors affecting reactivity, and preventative measures.

- **Week 14:** Mixing water for concrete: Impurities, total dissolved solids, sulfate/chloride limits, and suitability standards.

- **Week 15:** Chemical admixtures: Water reducers, superplasticizers, retarders, accelerators, air-entraining agents, mechanisms, and dosage.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Lab orientation, safety rules, review of balances, sieves, and standard testing equipment.

- **Week 2:** Experiment 1: Determination of Fineness of Portland Cement using Blaine Air Permeability Apparatus and Sieve No. 200 (ASTM C204).

- **Week 3:** Experiment 2: Determination of Normal Consistency of Hydraulic Cement Paste using Vicat Needle (ASTM C187).

- **Week 4:** Experiment 3: Determination of Initial and Final Setting Times of Cement using Vicat Needle (ASTM C191).

- **Week 5:** Experiment 4: Determination of Soundness of Portland Cement using Le Chatelier Apparatus / Autoclave Expansion (ASTM C151).

- **Week 6:** Experiment 5: Compressive Strength Testing of Standard Cement Mortar Cubes (50 mm $\times$ 50 mm) (ASTM C109).

- **Week 7:** Practical Midterm Laboratory Evaluation.

- **Week 8:** Experiment 6: Sieve Analysis and Grain Size Distribution of Fine Aggregate (Sand) and Fineness Modulus determination (ASTM C136).

- **Week 9:** Experiment 7: Sieve Analysis and Gradation curve plotting for Coarse Aggregate (Gravel) (ASTM C136).

- **Week 10:** Experiment 8: Specific Gravity and Water Absorption determination for Fine Aggregates (Pycnometer Method) (ASTM C128).

- **Week 11:** Experiment 9: Specific Gravity and Water Absorption determination for Coarse Aggregates (Buoyancy Method) (ASTM C127).

- **Week 12:** Experiment 10: Bulk Density (Unit Weight) and Voids calculation for Aggregates (Loose and Rodded states) (ASTM C29).

- **Week 13:** Experiment 11: Determination of Organic Impurities in Fine Aggregates for Concrete (Colorimetric Method) (ASTM C40).

- **Week 14:** Experiment 12: Determination of Silt and Clay Content in Fine Aggregates by Washing Sieve No. 200 (ASTM C117).

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	A. M. Neville – *Properties of Concrete* (5th Edition), Pearson. Sidney Mindess, J. Francis Young, David Darwin – *Concrete* (2nd Edition), Prentice Hall.	Yes
Recommended Texts	P. Kumar Mehta & Paulo J. M. Monteiro – *Concrete: Microstructure, Properties, and Materials* (4th Edition), McGraw-Hill.	Yes
Websites	American Concrete Institute (ACI) Technical Portal & ASTM International Standards.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Strength of Materials I
Module Type	Core Engineering (C)
Module Code	RE.213
ECTS Credits	5
SWL (hr/sem)	125
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 3
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Dr. Hawraa Sami Malik
Module Leader's e-mail	hawraa.sami@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor

Module Leader's Qualification	Ph.D.
Module Tutor	Assistant Lecturer Rand Mohammed Jassim rand.mohammed.eng@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.123 (Static Mechanics) | Semester: 2
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Fundamental Concepts of Stress & Strain:** Understand normal stress, shear stress, normal strain, shear strain, mechanical properties, and Hooke's Law.
2. **Axially Loaded Members:** Analyze elastic axial deformation, thermal stresses, stress concentration, and statically indeterminate axial systems.
3. **Torsion of Circular Shafts:** Formulate torsional shear stresses, angle of twist, and power transmission in solid and hollow circular shafts.
4. **Flexural Stresses in Beams:** Derive flexural formula ($\sigma = -My/I$) and analyze normal bending stresses in symmetric and unsymmetric beam sections.
5. **Transverse Shear Stresses in Beams:** Determine transverse shear stress distribution ($\tau = VQ/Ib$) and shear flow in built-up beam cross-sections.

Module Learning Outcomes

1. Calculate normal and shear stresses and strains in structural elements under axial, direct shear, and bearing loads.
2. Evaluate elastic deformations, Poisson's ratio, modulus of elasticity (E), and shear modulus (G) for engineering materials.
3. Solve statically indeterminate axially loaded structures and analyze thermal stress effects.
4. Compute torsional shear stress and angle of twist in circular solid and hollow shafts.

5. Apply the flexural formula to calculate maximum bending stresses in beams with varied cross-sectional geometries.

6. Determine transverse shear stress distribution and shear flow in solid and built-up structural beams.

Indicative Contents

- **Concepts of Stress & Strain:** Normal and shear stress, bearing stress, stress on inclined planes, normal strain, shear strain, stress-strain diagram, Hooke's law, Poisson's ratio (12 hours theory, 6 hours tutorial).

- **Axially Loaded Members & Thermal Stresses:** Elastic deformation ($\delta = PL/AE$), statically indeterminate axially loaded bars, force method, thermal expansion stresses ($\delta_T = \alpha \Delta TL$), stress concentration factors (12 hours theory, 6 hours tutorial).

- **Torsion in Circular Shafts:** Torsion formula ($\tau = Tr/J$), angle of twist ($\phi = TL/GJ$), power transmission, statically indeterminate circular shafts (10 hours theory, 5 hours tutorial).

- **Flexural Stress in Beams:** Mechanics of pure bending, strain distribution, flexural formula ($\sigma = -My/I$), section modulus (S), symmetric and unsymmetric beams, composite beams (12 hours theory, 6 hours tutorial).

- **Transverse Shear Stress in Beams:** Shear in beam elements, transverse shear formula ($\tau = VQ/Ib$), shear stress distribution across rectangular, I-shaped, and circular sections, shear flow in built-up beams (10 hours theory, 5 hours tutorial).

4. Learning and Teaching Strategies

1. **Rigorous Analytical Lectures:** Deriving internal force-stress mathematical relationships and deformation compatibility equations.

2. **Weekly Problem-Solving Tutorials:** Conduct weekly tutorials focusing on structural calculations, stress distributions, and beam sections.

3. **Continuous Homework & Quizzes:** Issue weekly numerical problem sets to develop structural intuition and computational precision.

4. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	65	4.3

Total SWL (h/sem)	125	8.3

5. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Assignments	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

6. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to Strength of Materials; concept of stress, normal stress, shear stress, and bearing stress.
- **Week 2:** Stress on inclined planes under uniaxial loading; concept of strain: Normal strain and shear strain.
- **Week 3:** Mechanical properties of materials: Tensile test, stress-strain diagram, proportional limit, yield point, ultimate strength, Hooke's law, Poisson's ratio, and generalized Hooke's law.
- **Week 4:** Axial load deformation ($\delta = PL/AE$), principle of superposition, members subjected to varying axial forces and cross-sections.
- **Week 5:** Statically indeterminate axially loaded structures: Equilibrium equations and compatibility condition formulations.
- **Week 6:** Thermal stress analysis: Free thermal expansion, constrained thermal stresses, and combined mechanical-thermal loading.
- **Week 7:** Midterm Examination.

- **Week 8:** Torsion of circular shafts: Torsional deformations, elastic torsion formula ($\tau = Tr/J$), polar moment of inertia (J).

- **Week 9:** Angle of twist ($\phi = TL/GJ$) in circular shafts, solid vs. hollow thin-walled shafts, and power transmission equations.

- **Week 10:** Statically indeterminate torsional members and stress concentrations in shafts under torsion.

- **Week 11:** Flexural stress in beams: Pure bending assumptions, flexural strain distribution, flexural formula ($\sigma = -My/I$).

- **Week 12:** Section modulus (S), elastic bending analysis of rectangular, I-beam, and T-shaped cross-sections.

- **Week 13:** Bending stresses in unsymmetric cross-sections and composite (reinforced) beams.

- **Week 14:** Transverse shear stress in beams: Shear force-moment relationships, shear stress formula ($\tau = VQ/Ib$), calculation of first moment of area (Q).

- **Week 15:** Shear stress distribution across rectangular, circular, and flange-web beam sections; shear flow and fastener spacing in built-up beams.

- **Week 16:** Final Examination.

7. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical module with weekly structured tutorials).

8. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	R. C. Hibbeler – *Mechanics of Materials* (10th or 11th Edition), Pearson. Ferdinand P. Beer et al. – *Mechanics of Materials* (8th Edition), McGraw-Hill.	Yes
Recommended Texts	James M. Gere, Barry J. Goodno – *Mechanics of Materials* (9th Edition), Cengage Learning.	Yes

Websites	MIT OpenCourseWare (Mechanics of Materials) & NPTEL Engineering Mechanics Portals.	-

9. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Engineering Surveying I
Module Type	Core Engineering (C)
Module Code	RE.214
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 3
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Lecturer Sahar Basim Jawad

Module Leader's e-mail	sahar.jawad@qu.edu.iq
Module Leader's Acad. Title	lecturer
Module Leader's Qualification	MSC
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

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

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Distance & Angle Measurement:** Teach fundamental surveying concepts, distance measuring techniques (taping, electronic distance measurement EDM), and angle units.
2. **Leveling Principles & Equipment:** Train students on optical levels, automatic levels, leveling rods, collimation errors, and elevation determination.
3. **Differential & Profile Leveling:** Master differential leveling loops, profile leveling for highway alignments, cross-section leveling, and earthwork computation concepts.
4. **Contour Mapping:** Introduce contour properties, interpolation methods, and generation of topographic contour maps for site civil design.
5. **Traverse & Compass Surveying:** Teach magnetic declination, true and magnetic bearings, azimuths, and closed compass traverse adjustments.

Module Learning Outcomes

1. Apply distance measurement procedures with tapes and electronic distance meters (EDM), applying corrections for slope, temperature, and sag.
2. Operate optical automatic levels and field staffs to establish Benchmark (BM) elevations and temporary benchmarks (TBM).
3. Conduct differential leveling loops, record field notes, and perform Height of Instrument (HI) and Rise & Fall reduction arithmetic checks.

4. Execute profile and cross-section leveling along highway centerline alignments to generate ground profile plots.

5. Construct topographic contour maps and interpolate ground elevations for engineering site layouts.

6. Measure bearings and azimuths using magnetic compass and compute closed traverse angular misclosures.

Indicative Contents

- **Introduction & Distance Measurement:** Principles of plane surveying, scale, error sources, horizontal and slope tape measurements, slope and temperature corrections (8 hours theory, 6 hours practical).

- **Leveling Theory & Operations:** Datum, benchmark, curvature and refraction corrections, automatic optical level components, leveling rod reading, two-peg test (10 hours theory, 10 hours practical).

- **Leveling Reductions & Loops:** Height of Instrument (HI) method, Rise and Fall method, closed differential leveling loops, allowable closure error, loop adjustment (10 hours theory, 10 hours practical).

- **Profile & Cross-Section Leveling:** Profile leveling along highway centerlines, cross-sectional stationing, plotting profile drawings, cut/fill line determination (10 hours theory, 10 hours practical).

- **Angles, Bearings & Contours:** Bearings and azimuths, magnetic declination, compass traverse, contour line properties, contour intervals, elevation interpolation, topographic mapping (7 hours theory, 9 hours practical).

4. Learning and Teaching Strategies

1. **Theoretical Conceptual Lectures:** Classroom delivery of geometric surveying principles, error adjustment mathematics, and mapping procedures.

2. **Field Practical Exercises:** Outdoor campus fieldwork in small groups operating automatic levels, leveling rods, tapes, and compasses.

3. **Field Book Records & Mapping Projects:** Individual keeping of standardized surveying field logbooks and drafting scaled profile and contour drawings.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1–#4
Field Work & Logbooks	10 reports	15% (15 marks)	Weekly	All LOs
Midterm Practical Field Exam	2 hours	15% (15 marks)	Week 7	LO #1, #2, #3
Final Practical Field Exam	2 hours	10% (10 marks)	Week 15	All LOs
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to plane surveying: Definitions, units of measurement, scales, classification of surveys, and error types (systematic vs. random).
- **Week 2:** Direct distance measurement: Taping instruments, pacing, taping on level and sloping ground, slope reduction formulas.
- **Week 3:** Tape corrections: Temperature, tension, sag, alignment, and tape standardization corrections.
- **Week 4:** Theory of leveling: Definitions (level surface, horizontal line, datum, benchmark), earth curvature and atmospheric refraction.
- **Week 5:** Leveling instruments: Automatic levels, digital levels, tilting levels, leveling rods, and optical collimation principles.

- **Week 6:** Two-Peg Test: Instrument error evaluation and line of sight (collimation error) adjustment.

- **Week 7:** Midterm Examination.

- **Week 8:** Differential leveling: Field procedure, turning points (TP), Height of Instrument (HI) method, Rise and Fall method.

- **Week 9:** Arithmetic checks, allowable closure errors for engineering leveling, and leveling loop misclosure distribution.

- **Week 10:** Profile leveling: Purpose in highway engineering, field procedures, stationing $(0 + 000)$, and recording field notes.

- **Week 11:** Cross-section leveling: Field layout, offset distance measurements, cross-section plotting, and subgrade profile integration.

- **Week 12:** Earthwork volume estimation concepts: End area method and prismoidal formula from cross-sectional profiles.

- **Week 13:** Topographic surveying & Contours: Definition, characteristics of contour lines, contour interval selection, and interpolation methods.

- **Week 14:** Angles and directions: Reference meridians (True, Magnetic, Grid), Azimuths (0° to 360°), and Whole Circle / Quadrantal Bearings.

- **Week 15:** Magnetic compass surveying: Forward and back bearings, local attraction detection, magnetic declination adjustment, closed traverse basics.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Field orientation: Care and handling of surveying equipment, setting up tripod, and leveling the instrument base plate.

- **Week 2:** Field Exercise 1: Distance measurement using steel tape on level ground and sloped terrain; applying slope corrections.

- **Week 3:** Field Exercise 2: Setting up an automatic level, reading the leveling rod, eliminating parallax error, and taking backsight/foresight readings.

- **Week 4:** Field Exercise 3: Performing the Two-Peg Test to detect and calculate instrument line of sight collimation error.

- **Week 5:** Field Exercise 4: Differential leveling loop between two distant benchmark points using Height of Instrument (HI) method.

- **Week 6:** Field Exercise 5: Differential leveling loop using Rise and Fall reduction method and executing arithmetic page checks.

- **Week 7:** Practical Midterm Field Examination.

- **Week 8:** Field Exercise 6: Running a closed differential leveling circuit; computing misclosure error and adjusting intermediate elevations.

- **Week 9:** Field Exercise 7: Profile leveling along a proposed highway alignment route centerline (150 m line with 10 m station intervals).

- **Week 10:** Field Exercise 8: Cross-section leveling at perpendicular station offsets along the centerline alignment.

- **Week 11:** Field Exercise 9: Plotting long-section ground profile and cross-sectional views on millimeter grid sheets.

- **Week 12:** Field Exercise 10: Spot level grid survey (grid method) for elevation collection across a selected project site area.

- **Week 13:** Field Exercise 11: Constructing a topographic contour map from field grid spot elevations using manual linear interpolation.

- **Week 14:** Field Exercise 12: Measuring forward and back bearings of a closed polygon field traverse using a Surveyor's Compass.

- **Week 15:** Final Practical Field Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Charles D. Ghilani & Paul R. Wolf – *Elementary Surveying: An Introduction to Geomatics* (15th Edition), Pearson.	Yes

	B. C. Punmia – *Surveying Vol. I & II*, Laxmi Publications.	
Recommended Texts	Jack C. McCormac – *Surveying* (6th Edition), Wiley.	Yes
Websites	RICS Surveying Standards & US Army Corps of Engineers Surveying Manuals.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Fluid Mechanics
Module Type	Basic Engineering / Support (B)
Module Code	RE.215
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 2

Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☑ Tutorial
Semester of Delivery	Semester 3
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant Lecturer Faten Fahem
Module Leader's e-mail	fatin.alkhuzaai@qu.edu.iq
Module Leader's Acad. Title	Assistant Lecturer
Module Leader's Qualification	MSC
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.123 (Static Mechanics) / ENG.121 (Mathematics II) | Semester: 2

- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Fluid Properties Fundamentals:** Define fluid density, specific weight, viscosity, surface tension, bulk modulus, and continuum concepts.

2. **Hydrostatics & Fluid Statics:** Analyze pressure variation in static fluids, pressure measurement devices (manometers), hydrostatic forces on plane and curved surfaces.

3. **Buoyancy & Floating Stability:** Apply Archimedes' principle to evaluate buoyancy, center of buoyancy, metacentric height (GM), and stability of floating bodies.

4. **Fluid Dynamics & Energy Equations:** Understand fluid kinematics, pathlines, streamlines, continuity equation, and apply Bernoulli's equation ($p/\gamma + z + v^2/2g = C$) to fluid flow systems.

5. **Impulse-Momentum Principle:** Apply linear momentum and energy conservation equations to calculate forces on pipe bends, nozzles, and hydraulic structures.

Module Learning Outcomes

1. Compute fluid physical properties including dynamic/kinematic viscosity, shear stress distributions, and capillarity.

2. Determine static fluid pressures and pressure heads using piezometers, differential U-tube manometers, and pressure gauges.

3. Calculate resultant hydrostatic forces and centers of pressure on submerged planar and curved structural gates/retaining walls.

4. Evaluate buoyant forces, metacentric height (GM), and rotational equilibrium stability of floating structures.

5. Formulate continuity and Bernoulli equations to compute flow rates, pressure head losses, and velocity distributions in closed conduits.

6. Apply impulse-momentum principles to compute hydrodynamic forces exerted by fluid jets on vanes, pipe reducers, and channel bends.

Indicative Contents

- **Fluid Properties:** Fluid continuum, density, specific volume, specific weight, specific gravity, dynamic/kinematic viscosity, Newton's law of viscosity, surface tension, bulk modulus of elasticity (8 hours theory, 3 hours lab/tutorial).

- **Fluid Statics & Hydrostatic Forces:** Pascal's law, hydrostatic pressure distribution ($dp/dz = -\gamma$), absolute vs. gauge pressure, manometers, hydrostatic force on plane submerged surfaces, center of pressure (y_{cp}), forces on curved surfaces (12 hours theory, 5 hours lab/tutorial).

- **Buoyancy & Floating Body Stability:** Archimedes' principle, buoyant force, center of buoyancy, stability of submerged and floating bodies, metacentric height (GM) formulation (8 hours theory, 3 hours lab/tutorial).

- **Fluid Kinematics & Bernoulli Equation:** Velocity field, streamlines, streaklines, pathlines, steady vs. unsteady flow, 1D/2D continuity equation, Euler's equation of motion, Bernoulli equation derivation, stagnation pressure, Venturi meter, Orifice meter, Pitot tube applications (10 hours theory, 4 hours lab/tutorial).

- **Linear Momentum Equation & Flow Applications:** Control volume concept, Reynolds transport theorem, impulse-momentum equation, hydrodynamic forces on pipe bends, nozzles, stationary and moving vanes, impact of fluid jets (7 hours theory, 3 hours lab/tutorial).

4. Learning and Teaching Strategies

1. **Lectures & Visual Animations:** Interactive classroom teaching covering fluid physics, fluid continuum mechanics, and energy equations.

2. **Laboratory Work & Experiments:** Laboratory testing on bench apparatus to measure hydrostatic forces, flow discharge, and metacentric heights.

3. **Tutorial Problem-Solving:** Weekly problem-solving tutorials covering manometer calculations, hydrostatic gate forces, and energy equation applications.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	45	3
Unstructured SWL (h/sem)	55	3.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1–#4
Laboratory Reports & Work	6 reports	15% (15 marks)	Alternating	LO #1, #2, #4, #5
Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2, #3
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #2, #4, #5
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to Fluid Mechanics: Liquids vs. gases, fluid continuum hypothesis, density, specific weight, specific gravity.

- **Week 2:** Dynamic viscosity (μ), kinematic viscosity (ν), Newton's law of viscosity, Newtonian vs. non-Newtonian fluids.

- **Week 3:** Surface tension, capillary action, vapor pressure, and bulk modulus of elasticity (compressibility).

- **Week 4:** Fluid Statics: Pascal's law, pressure at a point, basic hydrostatic equation ($p = \rho g h$), absolute, gauge, and atmospheric pressure.

- **Week 5:** Pressure measurement: Piezometers, single U-tube manometers, differential U-tube manometers, and inclined manometers.

- **Week 6:** Hydrostatic forces on plane submerged surfaces: Total force magnitude, center of pressure (y_{cp}), second moment of area (I_{xc}).

- **Week 7:** Midterm Examination.

- **Week 8:** Hydrostatic forces on curved submerged surfaces: Horizontal and vertical force components, line of action.

- **Week 9:** Buoyancy and Archimedes' principle, center of buoyancy, rotational stability of submerged bodies.

- **Week 10:** Metacentric height (GM) formulation and rotational stability evaluation of floating bodies (ships/barges).

- **Week 11:** Fluid kinematics: Velocity field, acceleration of fluid particle, streamlines, streaklines, pathlines, 1D/2D continuity equation.

- **Week 12:** Conservation of mass, control volume formulation, steady vs. unsteady, uniform vs. non-uniform flow classification.

- **Week 13:** Derivation of Euler's equation along a streamline and integration to derive the Bernoulli Equation ($p/\gamma + z + v^2/2g = C$).

- **Week 14:** Applications of Bernoulli Equation: Venturi meter, Orifice meter, Pitot-static tube, free jet energy calculations.

- **Week 15:** Linear momentum equation for control volume; computing hydrodynamic forces on pipe bends, nozzles, and stationary vanes.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Hydraulics laboratory orientation, fluid bench apparatus overview, and safety procedures.
- **Week 2:** Experiment 1: Determination of fluid density, specific gravity, and viscosity using falling sphere viscometer.
- **Week 3:** Experiment 2: Calibration of pressure gauges and measurement of hydrostatic pressure head using U-tube manometers.
- **Week 4:** Experiment 3: Determination of center of pressure and total hydrostatic thrust force on a partially and fully submerged plane surface.
- **Week 5:** Experiment 4: Buoyancy and Metacentric Height (GM) determination for a floating pontoon model under varying tilting moments.
- **Week 6:** Midterm Practical Laboratory Evaluation.
- **Week 7:** Experiment 5: Demonstration of Bernoulli's Theorem apparatus: Pressure head distribution along a convergent-divergent duct.
- **Week 8:** Experiment 6: Flow measurement using Venturi Meter and determination of coefficient of discharge (C_d).
- **Week 9:** Experiment 7: Flow measurement through an Orifice Meter and determination of hydraulic coefficients (C_c, C_v, C_d).
- **Week 10:** Experiment 8: Impact of a Fluid Jet: Measuring hydrodynamic forces exerted by a vertical water jet on flat and hemispherical vanes.
- **Week 11:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Frank M. White – *Fluid Mechanics* (9th Edition), McGraw-Hill. R. C. Hibbeler – *Fluid Mechanics* (2nd Edition), Pearson.	Yes

Recommended Texts	Bruce R. Munson, Alric P. Rothmayer et al. – *Fundamentals of Fluid Mechanics* (8th Edition), Wiley.	Yes
Websites	MIT OpenCourseWare (Fluid Mechanics) & Engineering Toolbox Portals.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	English Language II
Module Type	Basic Engineering / Support (B)
Module Code	QU21
ECTS Credits	2
SWL (hr/sem)	50
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 3
Administering Department	Department of Highway and Transportation Engineering

College	College of Engineering
Module Leader	Lecturer. Dr. Hasan Hadi Kraidi
Module Leader's e-mail	hasan.kraidi@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** QU11 (English Language I) | Semester: 1
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Technical Vocabulary Development:** Expand specialized English terminology in civil, highway, and transportation engineering.
2. **Intermediate-Advanced Grammar:** Master complex sentence structures, passive voice in technical writing, conditionals, and cause-effect connectors.
3. **Engineering Communication & Report Writing:** Train students to write technical memos, executive summaries, laboratory reports, and technical descriptions.
4. **Academic Reading Comprehension:** Develop skills to read, analyze, and summarize technical journal papers, engineering standards, and specifications.
5. **Oral Technical Presentation Skills:** Enhance ability to present engineering project findings orally using effective visual aids and technical register.

Module Learning Outcomes

1. Utilize intermediate-advanced civil and transportation engineering vocabulary accurately in context.
2. Apply formal passive voice structures and objective tone required for engineering research and report writing.

3. Construct clear executive summaries, formal project progress reports, and technical memos.

4. Extract key scientific insights and analytical data from technical journal publications and engineering codes.

5. Deliver structured oral presentations on civil engineering topics with clear verbal signposting.

Indicative Contents

- **Technical Vocabulary & Grammar:** Highway and civil engineering terminology, passive voice usage in lab methods, complex conditional clauses, relative clauses, cause and effect expressions (10 hours theory, 5 hours practical).

- **Engineering Writing Mechanics:** Writing formal engineering emails, technical memos, executive summaries, structure of technical reports (Introduction, Methodology, Results, Discussion) (10 hours theory, 5 hours practical).

- **Reading Comprehension & Critical Analysis:** Reading technical texts on pavement materials, bridge design, and traffic flow; scanning for data, summarizing research papers (5 hours theory, 5 hours practical).

- **Oral Presentations & Technical Communication:** Structure of technical slide presentations, describing charts/graphs/tables, handling Q&A, professional register (5 hours theory, 5 hours practical).

4. Learning and Teaching Strategies

1. **Interactive Language Workshops:** Peer work, guided writing exercises, and technical grammar drills.

2. **Technical Reading & Writing Tasks:** Writing laboratory report sections, project memos, and summarizing technical journal articles.

3. **Oral Presentation Sessions:** Student-led short technical presentations evaluated on content, clarity, structure, and professional delivery.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	30	2
Unstructured SWL (h/sem)	20	1.3
Total SWL (h/sem)	50	3.3

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	3	15% (15 marks)	Weeks 4, 8, 12	LO #1, #2
Technical Writing Assignments	3 reports	15% (15 marks)	Weeks 3, 9, 13	LO #2, #3, #4
Oral Presentation	10 mins	10% (10 marks)	Week 14	LO #1, #5
Midterm Exam	1 hour	20% (20 marks)	Week 7	LO #1, #2, #3
Final Exam	2 hours	40% (40 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Course orientation; review of technical communication principles vs. general English writing.
- **Week 2:** Specialized technical vocabulary in civil, structural, and highway transportation engineering.
- **Week 3:** Grammar for technical writing: Passive voice in experimental procedures and methodologies.
- **Week 4:** Cause and effect connectors (*due to, as a result of, consequently, leads to*) in failure analysis reports.

- **Week 5:** Writing formal engineering memos, emails, and professional correspondence.
- **Week 6:** Structure of technical reports: Title page, Abstract/Executive Summary, Introduction, and Objectives.
- **Week 7:** Midterm Examination.
- **Week 8:** Technical Reading Comprehension: Reading highway infrastructure case studies and extracting core findings.
- **Week 9:** Writing the "Methodology" and "Results" sections of engineering laboratory reports objectively.
- **Week 10:** Describing graphic data: Vocabulary for line graphs, bar charts, pie charts, and data trends (*increase rapidly, plateau, fluctuate*).
- **Week 11:** Writing formal conclusions, recommendations, and referencing engineering standards (ASTM, AASHTO, ACI).
- **Week 12:** Complex sentence structures: Relative clauses and participle clauses in technical specification descriptions.
- **Week 13:** Preparing effective PowerPoint presentation slides for technical engineering projects.
- **Week 14:** Student oral technical presentations: Group presentations on selected highway engineering topics.
- **Week 15:** Review of academic writing principles, editing technical drafts, and final course review.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical language module with practical writing workshops).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**

Required Texts	Mark Ibbotson – *Cambridge English for Engineering*, Cambridge University Press. David F. Beer & David A. McMurrey – *A Guide to Writing as an Engineer* (5th Edition), Wiley.	Yes
Recommended Texts	Raymond Murphy – *English Grammar in Use* (5th Edition), Cambridge University Press.	Yes
Websites	Purdue Online Writing Lab (OWL) Engineering Writing Resources & BBC Learning English.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	The Crimes of the Ba'ath Regime in Iraq
Module Type	Institutional / Support (S)
Module Code	ENG.08
ECTS Credits	2

SWL (hr/sem)	50
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 3
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant Lecturer Hossam Aziz Mutashar
Module Leader's e-mail	Hussam.aziz@qu.edu.iq
Module Leader's Acad. Title	Assistant Lecturer
Module Leader's Qualification	MSC
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

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

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Historical Documentation & Awareness:** Document historical human rights violations, political repression, and authoritarian practices during the Ba'ath regime era in Iraq (1968–2003).
2. **Analysis of Major Human Rights Crimes:** Analyze major state-sponsored crimes including chemical attacks (Halabja), the Anfal campaign, suppression of the 1991 Sha'ban Intifada, and the draining of the Iraqi Marshes.
3. **Institutional & Infrastructure Impact:** Examine the destruction of social institutions, civil infrastructure, forced demographic displacements, and mass grave phenomena.
4. **Transitional Justice & Legal Memory:** Understand legal mechanisms of accountability, the Supreme Iraqi Criminal Tribunal, reparation laws, and preservation of national collective memory.

5. **Ethics & Human Rights Advocacy:** Promote democratic values, constitutional rule of law, non-repetition principles, and human rights protection among engineering graduates.

Module Learning Outcomes

1. Identify historical phases, authoritarian political structures, and institutional apparatuses of the Ba'ath regime in Iraq.

2. Analyze human rights violations, international law breaches, and genocide campaigns (e.g., Anfal, Halabja chemical attacks).

3. Evaluate the environmental, socio-economic, and infrastructural destruction resulting from regime policies (e.g., Marshland draining, forced displacements).

4. Examine the legal proceedings and evidence documented by the Iraqi Special Tribunal regarding major regime crimes.

5. Apply principles of transitional justice, human rights respect, and ethical civic responsibility in modern Iraqi society.

Indicative Contents

- **Totalitarian State Apparatus:** Rise of the regime, single-party authoritarianism, security apparatus, suppression of civil liberties, and political executions (6 hours theory, 3 hours tutorial).

- **Genocidal Campaigns & Chemical Warfare:** The Anfal campaign against the Kurdish population, chemical bombardment of Halabja, targeting of political dissidents and religious scholars (8 hours theory, 4 hours tutorial).

- **Suppression of the 1991 Intifada & Mass Graves:** Post-Gulf War Sha'ban uprising, extrajudicial mass executions, discovery and forensic documentation of mass graves across Iraq (8 hours theory, 4 hours tutorial).

- **Environmental & Socio-Economic Crimes:** Draining of the Southern Marshes (Ahwar), forced population displacement, destruction of rural villages, and economic destruction (4 hours theory, 2 hours tutorial).

- **Transitional Justice & Legal Accountability:** High Iraqi Criminal Tribunal, post-2003 transitional justice laws, political victim compensation, and democratic rule of law safeguards (4 hours theory, 2 hours tutorial).

4. Learning and Teaching Strategies

1. **Lectures & Historical Documentaries:** Presenting documented historical facts, archival video materials, and legal case summaries.

2. **Classroom Seminars & Group Discussions:** Structured discussions on transitional justice, human rights protections, and constitutional safeguards against tyranny.

3. **Research Reports & Case Studies:** Supervised student research projects analyzing specific historical documentation, mass grave reports, or environmental impact assessments.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	30	2
Unstructured SWL (h/sem)	20	1.3
Total SWL (h/sem)	50	3.3

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes & Assignments	3	20% (20 marks)	Weeks 4, 8, 12	LO #1–#4
Research Project / Seminar	1 project	10% (10 marks)	Week 13	LO #2–#5
Midterm Exam	1.5 hours	20% (20 marks)	Week 7	LO #1, #2
Final Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to modern Iraqi political history: Rise of the Ba'ath party (1968) and consolidation of totalitarian power.

- **Week 2:** State security apparatus and mechanisms of political control, censorship, and suppression of basic freedoms.

- **Week 3:** Political trials, extrajudicial executions, and targeting of political opposition groups and religious figures during the 1970s and 1980s.

- **Week 4:** The Faili Kurd deportation campaign: Forced displacement, citizenship revocation, and property confiscation.
- **Week 5:** The Anfal Campaign (1987–1988): Systematic military operation, village destructions, and human rights documentation.
- **Week 6:** Use of chemical weapons against civilian populations: Halabja chemical attack and international legal classifications (genocide).
- **Week 7:** Midterm Examination.
- **Week 8:** The 1991 Sha'ban Uprising (Intifada): Historical context, regime suppression tactics, and destruction of urban centers.
- **Week 9:** The Mass Graves phenomenon: Location, forensic discovery, identification protocols, and human rights organization findings.
- **Week 10:** Environmental crimes: Systematic draining of the Iraqi Southern Marshes (Ahwar), ecological collapse, and Marsh Arab displacement.
- **Week 11:** Forced demographic engineering: Compulsory population displacement, border zone clearing, and internal exile policies.
- **Week 12:** Socio-economic impact: Destruction of national civil infrastructure, education systems, and institutional integrity under dictatorship.
- **Week 13:** Transitional Justice in post-2003 Iraq: High Iraqi Criminal Tribunal setup, international legal standards, and trial proceedings.
- **Week 14:** National legislation supporting victims of the former regime: Martyrs' Foundation, Political Prisoners Foundation, and compensation laws.
- **Week 15:** Lessons for modern democratic Iraq: Constitutional guarantees, non-repetition principles, institutional transparency, and human rights ethics.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical institutional requirement module with structured seminars).

9. Learning and Teaching Resources

Learning and Teaching Resources

Resource Type	**Details**	**Available in Library?**
Required Texts	High Iraqi Criminal Tribunal Archives – *Official Reports on Regime Crimes*. Human Rights Watch – *Iraq's Crime of Genocide: The Anfal Campaign Against the Kurds*, Yale University Press.	Yes
Recommended Texts	Kanan Makiya – *Republic of Fear: The Politics of Modern Iraq*, University of California Press.	Yes
Websites	Supreme Iraqi Criminal Tribunal Archives & Human Rights Watch Iraq Reports.	-

10. Grading Scheme

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

Second Stage

Semester 4

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Mathematics IV
Module Type	Basic Engineering / Support (B)
Module Code	ENG.221
ECTS Credits	3
SWL (hr/sem)	75
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 4
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Lecturer Mohanad Mohamed Mahdie
Module Leader's e-mail	mohanad.mohammed@qu.edu.iq
Module Leader's Acad. Title	lecturer
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** ENG.211 (Mathematics III) | Semester: 3
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Numerical Root-Finding & Linear Systems:** Master numerical methods for solving non-linear algebraic equations and systems of linear equations.

2. **Numerical Interpolation, Integration & Differentiation:** Apply finite difference formulas, numerical integration (Trapezoidal, Simpson's rules), and numerical differentiation to discrete engineering datasets.

3. **Numerical Solutions of ODEs:** Develop numerical techniques (Euler's method, Runge-Kutta 4th order) to solve ordinary differential equations.

4. **Complex Variable Analysis:** Understand complex functions, Cauchy-Riemann equations, analytic functions, contour integration, and residue theory.

5. **Probability & Applied Engineering Statistics:** Apply probability distributions, hypothesis testing, linear regression, and correlation analysis to highway engineering data.

Module Learning Outcomes

1. Solve non-linear roots using Bisection, Newton-Raphson, and Secant numerical methods.

2. Formulate and solve large systems of linear algebraic equations using Gauss Elimination, Gauss-Jordan, and Gauss-Seidel iterative methods.

3. Compute numerical integrals and derivatives from discrete field data using Simpson's $1/3$, Simpson's $3/8$, and Trapezoidal rules.

4. Implement Runge-Kutta 4th order numerical schemes to solve initial-value problems in civil engineering modeling.

5. Evaluate complex function analyticity and compute complex line integrals using Cauchy's Integral Formula and Residue Theorem.

6. Analyze transportation engineering data using Normal, Binomial, and Poisson probability distributions and perform linear regression modeling.

Indicative Contents

- **Numerical Methods for Non-Linear Equations & Linear Systems:** Errors in numerical computing, Bisection method, Newton-Raphson method, Secant method; Direct methods (Gauss Elimination, LU Decomposition), Iterative methods (Gauss-Seidel) (10 hours theory, 5 hours tutorial).

- **Numerical Interpolation, Integration & Differentiation:** Newton's forward/backward difference interpolation, Lagrange interpolation, Numerical integration (Trapezoidal rule, Simpson's $1/3$ and $3/8$ rules, Gauss Quadrature), Numerical differentiation (8 hours theory, 4 hours tutorial).

- **Numerical Solution of ODEs:** Initial-value problems, Euler's method, Modified Euler's method, 4th-Order Runge-Kutta (RK4) method for first and second-order differential equations (6 hours theory, 3 hours tutorial).

- **Complex Variable Analysis:** Complex numbers, polar representation, analytic functions, Cauchy-Riemann equations, elementary complex functions, complex integration, Cauchy-Goursat theorem, Cauchy's integral formula, Residue theorem (11 hours theory, 5 hours tutorial).

- **Probability & Statistics in Engineering:** Continuous and discrete random variables, Normal, Binomial, and Poisson distributions, sample mean and variance, confidence intervals, linear regression, coefficient of determination (R^2), and correlation analysis (10 hours theory, 3 hours tutorial).

4. Learning and Teaching Strategies

1. **Analytical & Algorithmic Lectures:** Deriving numerical algorithms, complex variable theorems, and statistical distributions.

2. **Weekly Interactive Tutorials:** Guided numerical problem-solving sessions focusing on algorithm execution and statistical data fitting.

3. **Computational Homework Assignments:** Assignments involving manual step-by-step algorithm calculation and statistical estimation.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	45	3
Unstructured SWL (h/sem)	30	2
Total SWL (h/sem)	75	5

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5

Homework / Assignments	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to numerical computation, truncation and round-off errors, convergence criteria; Bisection method.
- **Week 2:** Newton-Raphson method and Secant method for single variable non-linear equations.
- **Week 3:** Systems of linear equations: Gauss Elimination with partial pivoting, LU Decomposition.
- **Week 4:** Iterative linear solvers: Jacobi method and Gauss-Seidel iteration method with relaxation factors.
- **Week 5:** Interpolation: Finite differences, Newton's forward and backward difference formulas, Lagrange interpolation polynomials.
- **Week 6:** Numerical Integration: Trapezoidal rule, Simpson's $1/3$ rule, Simpson's $3/8$ rule, error bounds.
- **Week 7:** Midterm Examination.
- **Week 8:** Numerical solution of ordinary differential equations: Euler's method, Heun's method (Modified Euler).
- **Week 9:** Fourth-Order Runge-Kutta method (RK4) for 1st-order and 2nd-order ODE systems.
- **Week 10:** Complex variables: Complex algebra, polar form, functions of a complex variable, limits, derivative, and analyticity.
- **Week 11:** Cauchy-Riemann equations in Cartesian and polar coordinates, harmonic functions and harmonic conjugates.

- **Week 12:** Complex contour integration, Cauchy-Goursat theorem, Cauchy's Integral Formula.
- **Week 13:** Residue Theorem: Singularities, poles, residue calculation, and application to real definite integrals.
- **Week 14:** Engineering Statistics: Discrete and continuous probability distributions (Binomial, Poisson, Normal distribution).
- **Week 15:** Simple linear regression analysis, method of least squares, correlation coefficient, and engineering data applications.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Steven C. Chapra & Raymond P. Canale – *Numerical Methods for Engineers* (8th Edition), McGraw-Hill. Erwin Kreyszig – *Advanced Engineering Mathematics* (10th Edition), Wiley.	Yes
Recommended Texts	Richard L. Burden & J. Douglas Faires – *Numerical Analysis* (10th Edition), Cengage Learning.	Yes
Websites	MIT OpenCourseWare (Numerical Methods & Complex Analysis) & NPTEL Engineering Mathematics.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Asphalt Technology II
Module Type	Core Engineering (C)
Module Code	RE.221
ECTS Credits	5
SWL (hr/sem)	125
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 4
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Lecturer. Dr.Osamah Hasan Chafat
Module Leader's e-mail	osamah.h.chafat@qu.edu.iq
Module Leader's Acad. Title	Lecturer
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.211 (Asphalt Technology I) | Semester: 3
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Volumetric Phase Relationships:** Master volumetric calculations of asphalt concrete mixtures including air voids (V_a), voids in mineral aggregate (VMA), voids filled with asphalt (VFA), and effective binder content (P_{be}).

2. **Marshall Mix Design Method:** Train students to design Hot Mix Asphalt (HMA) using the Marshall mix design procedure according to MS-2 specifications.

3. **Superpave Gyratory Mix Design:** Comprehend Superpave volumetric mix design, compaction using the Superpave Gyratory Compactor (SGC), and aggregate consensus requirements.

4. **Pavement Distresses & Moisture Damage:** Evaluate asphalt pavement distress mechanisms (rutting, fatigue cracking, thermal cracking) and moisture sensitivity (stripping/TSR).

5. **Modified Binders & Sustainable Asphalt Technologies:** Introduce polymer-modified asphalts (PMA), Warm Mix Asphalt (WMA), and Reclaimed Asphalt Pavement (RAP) recycling.

Module Learning Outcomes

1. Calculate theoretical maximum specific gravity (G_{mm}), bulk specific gravity (G_{mb}), and volumetric parameters (V_a, VMA, VFA, P_{be}) for HMA mixtures.

2. Execute Marshall mix design steps, plot stability/flow curves, and determine Optimum Asphalt Content (OAC).

3. Analyze Superpave mix design criteria, compaction levels ($N_{ini}, N_{des}, N_{max}$), and dust-to-effective binder ratio.

4. Perform indirect tensile strength (ITS) testing and evaluate moisture susceptibility using Tensile Strength Ratio (TSR) (AASHTO T283).

5. Identify primary flexible pavement failure modes and specify corrective modified binder additives (SBS, crumb rubber).

6. Evaluate environmental and economic advantages of Warm Mix Asphalt (WMA) and recycled pavement mixtures (RAP).

Indicative Contents

- **Volumetric Phase Relationships:** Definitions and formulas for bulk specific gravity (G_{sb}), effective specific gravity (G_{se}), maximum theoretical density (G_{mm}), air voids (V_a), VMA, VFA, absorbed asphalt (P_{ba}), effective asphalt (P_{be}) (10 hours theory, 6 hours lab).

- **Marshall Mix Design Method:** Standard Marshall specimen preparation (75 blows/face), compaction, bulk density testing, Marshall Stability and Flow testing, plotting criteria curves, selecting Optimum Asphalt Content (OAC) per Iraqi SORB / Asphalt Institute MS-2 (12 hours theory, 12 hours lab).

- **Superpave Mix Design Methodology:** Superpave volumetric design, Superpave Gyratory Compactor (SGC), gyration levels ($N_{ini}, N_{des}, N_{max}$), densification curves, dust proportion calculation (10 hours theory, 8 hours lab).

- **Moisture Sensitivity & Pavement Distresses:** Asphalt stripping mechanism, anti-stripping additives (hydrated lime, liquid agents), Indirect Tensile Strength (ITS) test, Tensile Strength Ratio (TSR); Overview of permanent deformation (rutting), fatigue cracking, and low-temperature thermal cracking (10 hours theory, 8 hours lab).

- **Modified & Sustainable Asphalt:** Polymer Modification (SBS, EVA, Crumb Rubber), Warm Mix Asphalt (WMA) technologies (foaming, chemical additives), Reclaimed Asphalt Pavement (RAP) processing and mix recycling (8 hours theory, 6 hours lab).

4. Learning and Teaching Strategies

1. **Interactive Lectures & Technical Case Studies:** Detailed instruction on mix design calculations, SORB specifications, and flexible pavement failure mechanics.

2. **Supervised Laboratory Practicals:** Hands-on fabrication of Marshall and Superpave asphalt specimens, density measurements, stability testing, and tensile strength evaluations.

3. **Mix Design Project Work:** Student teams perform a complete Marshall mix design project from aggregate blending to final OAC recommendation.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**

Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	65	4.3
Total SWL (h/sem)	125	8.3

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1–#4
Laboratory Reports & Mix Project	8 reports	15% (15 marks)	Weekly	LO #1, #2, #3, #4
Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #1, #2, #4
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Review of asphalt binder and aggregate physical properties; introduction to hot mix asphalt (HMA) structure.
- **Week 2:** Volumetric phase diagram of compacted asphalt mixture; definitions of mass and volume components.
- **Week 3:** Derivation and computation of specific gravities ($G_{mb}, G_{mm}, G_{sb}, G_{se}$) and absorbed asphalt (P_{ba}).
- **Week 4:** Formulation and calculation of air voids (V_a), voids in mineral aggregate (VMA), and voids filled with asphalt (VFA).
- **Week 5:** Marshall Mix Design principles: Specimen preparation, heating temperatures, compaction energy, and density testing.
- **Week 6:** Marshall Stability and Flow testing apparatus, load corrections, and graphical plotting of volumetric vs. binder content curves.

- **Week 7:** Midterm Examination.
- **Week 8:** Selection of Optimum Asphalt Content (OAC) based on Iraqi General Specification for Roads and Bridges (SORB) and MS-2.
- **Week 9:** Superpave Mix Design philosophy: Comparison between Marshall and Superpave methods.
- **Week 10:** Superpave Gyratory Compactor (SGC) mechanics, gyration levels ($N_{ini}, N_{des}, N_{max}$), and compaction control.
- **Week 11:** Moisture damage mechanisms in asphalt mixtures: Water action, stripping, and anti-stripping additives (hydrated lime).
- **Week 12:** Indirect Tensile Strength (ITS) testing and Tensile Strength Ratio (TSR) determination (AASHTO T283 / ASTM D4867).
- **Week 13:** Major flexible pavement distresses: Permanent deformation (rutting), fatigue cracking, and low-temperature thermal cracking.
- **Week 14:** Asphalt modification: Elastomers (SBS), Plastomers (EVA), Crumb Rubber Modifier (CRM), and performance impacts.
- **Week 15:** Sustainable asphalt paving: Warm Mix Asphalt (WMA) technologies, Reclaimed Asphalt Pavement (RAP) processing and mix proportioning.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Laboratory safety orientation, review of asphalt mix equipment, balances, ovens, and water baths.
- **Week 2:** Batching aggregates according to target job mix formula (JMF) gradation for wearing course.
- **Week 3:** Experiment 1: Determination of Theoretical Maximum Specific Gravity (G_{mm}) of loose asphalt mixtures (Rice Method) (ASTM D2041).
- **Week 4:** Experiment 2: Preparation and compaction of Marshall specimens across 5 different binder contents (ASTM D6926).

- **Week 5:** Experiment 3: Determination of Bulk Specific Gravity (G_{mb}) of compacted HMA specimens using saturated surface-dry method (ASTM D2726).

- **Week 6:** Experiment 4: Marshall Stability and Flow testing of compacted asphalt specimens at 60°C (ASTM D6927).

- **Week 7:** Practical Midterm Laboratory Evaluation.

- **Week 8:** Experiment 5: Volumetric analysis calculations and construction of Marshall evaluation charts (V_a, VMA, VFA, Density, Stability, Flow).

- **Week 9:** Determination of Optimum Asphalt Content (OAC) for the trial Job Mix Formula (JMF).

- **Week 10:** Experiment 6: Compaction of asphalt specimens using the Superpave Gyratory Compactor (SGC) (AASHTO T312).

- **Week 11:** Experiment 7: Fabrication of unconditioned and moisture-conditioned specimens for indirect tensile testing.

- **Week 12:** Experiment 8: Indirect Tensile Strength (ITS) testing and evaluation of Tensile Strength Ratio (TSR) for moisture susceptibility (AASHTO T283).

- **Week 13:** Experiment 9: Bitumen extraction test from pavement samples using centrifuge extractor to determine binder content (ASTM D2172).

- **Week 14:** Experiment 10: Sieve analysis of extracted mineral aggregates from asphalt pavement samples.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Asphalt Institute – *MS-2 Asphalt Mix Design Methods* (7th Edition), Asphalt Institute. E.R. Brown et al. – *Hot Mix Asphalt Materials, Mixture Design, and Construction* (3rd Edition), NAPA.	Yes
Recommended Texts	Paul H. Wright & Karen Dixon – *Highway Engineering* (7th Edition), Wiley.	Yes

Websites	Asphalt Institute Technical Manuals & Federal Highway Administration (FHWA) Pavement Resources.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Concrete Technology II
Module Type	Core Engineering (C)
Module Code	RE.222
ECTS Credits	5
SWL (hr/sem)	125
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 4
Administering Department	Department of Highway and Transportation Engineering

College	College of Engineering
Module Leader	Lecturer Dr.Samir Hamed Malik
Module Leader's e-mail	Samer.hamed@qu.edu.iq
Module Leader's Acad. Title	Lecturer
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.212 (Concrete Technology I) | Semester: 3
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Concrete Mix Proportions Design:** Master standard concrete mix proportioning methods using ACI 211.1 and British (BS/DOE) methods.
2. **Hardened Concrete Mechanical Properties:** Analyze compressive strength development, splitting tensile strength, flexural strength (modulus of rupture), and elastic modulus.
3. **Time-Dependent & Volume Changes:** Study elasticity, creep deformation, drying shrinkage, thermal movement, and micro-cracking in concrete structures.
4. **Concrete Durability & Environmental Attack:** Evaluate durability mechanisms including sulfate attack, chloride penetration, carbonation, alkali-silica reaction (ASR), and freeze-thaw cycles.
5. **Special Concretes & Non-Destructive Testing:** Introduce Self-Compacting Concrete (SCC), Roller-Compacted Concrete (RCC), Fiber-Reinforced Concrete (FRC), and Non-Destructive Testing (NDT) techniques.

Module Learning Outcomes

1. Design normal and high-strength concrete trial mixes using ACI 211.1 standard practice.

2. Perform laboratory mechanical testing on hardened concrete (compressive, splitting tensile, and flexural strength tests).

3. Evaluate time-dependent mechanical behavior including creep, shrinkage, and elastic modulus according to ACI equations.

4. Identify degradation mechanisms affecting concrete durability and specify protective measures (low w/c ratio, mineral admixtures).

5. Apply Non-Destructive Testing (NDT) methods (Rebound Hammer, Ultrasonic Pulse Velocity UPV) to evaluate in-situ concrete quality.

6. Select suitable special concretes (SCC, RCC for rigid pavements, FRC) based on structural and construction demands.

Indicative Contents

- **Concrete Mix Design:** ACI 211.1 mix design method step-by-step: Target strength calculation, w/c ratio selection, water content, aggregate volumes, trial batch adjustment; British (BS) mix design method (12 hours theory, 10 hours lab).

- **Mechanical Properties of Hardened Concrete:** Compressive strength testing (150 mm cubes vs. 150×300 mm cylinders), tensile strength (splitting cylinder test), flexural strength (third-point loading), Modulus of Elasticity (E_c) (10 hours theory, 10 hours lab).

- **Elasticity, Creep & Shrinkage:** Stress-strain relationship, secant/tangent modulus, plastic deformation, drying shrinkage, autogenous shrinkage, creep mechanisms, and structural impacts (8 hours theory, 6 hours lab).

- **Durability of Concrete:** Permeability, water absorption, sulfate attack (external/internal), seawater attack, carbonation depth, chloride ion ingress, reinforcement corrosion, alkali-silica reaction (ASR), freezing and thawing resistance (10 hours theory, 8 hours lab).

- **Special Concretes & Non-Destructive Evaluation:** Self-Compacting Concrete (SCC slump flow, V-funnel, L-box), Roller-Compacted Concrete (RCC) for paving, Fiber-Reinforced Concrete (FRC); Non-Destructive Testing: Rebound (Schmidt) Hammer, Ultrasonic Pulse Velocity (UPV), and Core extraction testing (10 hours theory, 6 hours lab).

4. Learning and Teaching Strategies

1. **Interactive Lectures & Technical Calculations:** Step-by-step mix proportioning calculations, chemical durability formulation, and ACI standard guidelines.

2. **Hands-On Concrete Laboratory Workshops:** Trial mixing, fresh concrete slump checking, casting test specimens, curing, and destructive/non-destructive testing.

3. **Mix Design Project & Data Processing:** Designing, mixing, and testing a trial batch in the laboratory, comparing predicted vs. actual 28-day compressive strengths.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	65	4.3
Total SWL (h/sem)	125	8.3

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1, #3, #4
Laboratory Reports & Mix Project	8 reports	15% (15 marks)	Weekly	LO #1, #2, #5
Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #2, #5
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to concrete mix design goals: Strength, durability, workability, and economy considerations.

- **Week 2:** ACI 211.1 Mix Design Method: Step-by-step procedure, required margin (f'_{cr} calculation), slump selection, maximum aggregate size.

- **Week 3:** ACI 211.1: Water-cement ratio selection, water content estimation, coarse aggregate volume fraction, fine aggregate calculation, and trial batching.

- **Week 4:** British (BS 8539 / DOE) mix design method: Principles, target strength, reference curves, and proportioning steps.

- **Week 5:** Hardened concrete compressive strength: Factors affecting strength (w/c ratio, curing age, temperature, specimen shape/size).

- **Week 6:** Tensile strength of concrete: Direct tension, splitting cylinder tensile strength (f_{ct}), and flexural strength / modulus of rupture (f_r).

- **Week 7:** Midterm Examination.

- **Week 8:** Stress-strain behavior of concrete under compression; Static modulus of elasticity ($E_c = 4700\sqrt{f'_c}$), dynamic modulus.

- **Week 9:** Time-dependent deformations: Drying shrinkage, autogenous shrinkage, plastic shrinkage, and thermal shrinkage mechanisms.

- **Week 10:** Creep of concrete: Elastic strain vs. creep strain, factors influencing creep (stress level, humidity, maturity), and structural effects.

- **Week 11:** Concrete durability & transport phenomena: Permeability, capillary absorption (sorptivity), water-cement ratio influence.

- **Week 12:** Chemical attacks: External and internal sulfate attack, delayed ettringite formation (DEF), acid attack, seawater exposure.

- **Week 13:** Reinforcement corrosion: Carbonation mechanism, chloride ion ingress, threshold concentration, passive film destruction.

- **Week 14:** Non-Destructive Testing (NDT): Rebound (Schmidt) hammer surface hardness, Ultrasonic Pulse Velocity (UPV) wave transmission, core extraction.

- **Week 15:** Special Concretes: Self-Compacting Concrete (SCC), Roller-Compacted Concrete (RCC) in highway pavements, Fiber-Reinforced Concrete (FRC).

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Safety rules, review of concrete mixers, specimen molds, curing tanks, and compression testing machines.

- **Week 2:** Concrete Trial Batching 1: Performing ACI 211.1 calculations and preparing concrete mix trial in lab.

- **Week 3:** Testing fresh concrete properties of trial mix: Slump test, air content, fresh density, and casting standard cubes/cylinders.

- **Week 4:** Experiment 1: Compressive Strength Testing of Concrete Cubes (150 mm) at 7, 14, and 28 days (BS EN 12390-3).

- **Week 5:** Experiment 2: Compressive Strength Testing of Concrete Cylinders (150×300 mm) and evaluating f_{cube} vs. $f_{cylinder}$ conversion ratio (ASTM C39).

- **Week 6:** Experiment 3: Splitting Tensile Strength Test of Concrete Cylinders (Brazilian Test) (ASTM C496).

- **Week 7:** Practical Midterm Laboratory Evaluation.

- **Week 8:** Experiment 4: Flexural Strength Test of Concrete Beams under Third-Point Loading (Modulus of Rupture) (ASTM C78).

- **Week 9:** Experiment 5: Determination of Static Modulus of Elasticity (E_c) and Poisson's ratio of concrete using compressometer (ASTM C469).

- **Week 10:** Experiment 6: Water Absorption and Apparent Porosity testing of hardened concrete samples (ASTM C642).

- **Week 11:** Experiment 7: Non-Destructive Testing Part I - Surface Hardness Evaluation using Rebound Schmidt Hammer (ASTM C805).

- **Week 12:** Experiment 8: Non-Destructive Testing Part II - Pulse Velocity Measurement using Ultrasonic Pulse Velocity (UPV) tester (ASTM C597).

- **Week 13:** Experiment 9: Core Drilling and Compressive Testing of Concrete Core Samples (ASTM C42).

- **Week 14:** Experiment 10: Testing workability of Self-Compacting Concrete (SCC) using Slump Flow, V-funnel, and L-box.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	A. M. Neville – *Properties of Concrete* (5th Edition), Pearson. ACI Committee 211 – *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete (ACI 211.1-91)*, American Concrete Institute.	Yes
Recommended Texts	P. Kumar Mehta & Paulo J. M. Monteiro – *Concrete: Microstructure, Properties, and Materials* (4th Edition), McGraw-Hill.	Yes
Websites	American Concrete Institute (ACI) Knowledge Center & Concrete Society Technical Resources.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Strength of Materials II
Module Type	Core Engineering (C)
Module Code	RE.223
ECTS Credits	5
SWL (hr/sem)	125
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 4
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Dr. Hawraa Sami Malik
Module Leader's e-mail	hawraa.sami@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.213 (Strength of Materials I) | Semester: 3
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Stress & Strain Transformation:** Master 2D stress transformation equations, principal stresses, maximum shear stress, and Mohr's Circle construction.

2. **Combined Stresses:** Analyze structural elements subjected to combined loading conditions (axial force, bending moment, torsion, transverse shear).

3. **Beam Deflections:** Calculate slope and elastic deflection curves of determinate beams using Double Integration, Moment-Area, and Conjugate Beam methods.

4. **Column Buckling:** Derive Euler's column buckling formula, evaluate effective length factors for different boundary conditions, and design slender structural columns.

5. **Strain Energy & Energy Methods:** Introduce strain energy concepts and Castigliano's theorem for calculating deflections in structural elements.

Module Learning Outcomes

1. Construct Mohr's Circle for plane stress and compute principal stresses, principal planes, and maximum in-plane shear stress.

2. Analyze stress states under combined axial, bending, torsional, and transverse shear loads.

3. Derive differential equations of beam deflection and solve slope/deflection using the Double Integration method.

4. Compute beam slopes and deflections using Moment-Area theorems and Conjugate Beam method.

5. Calculate critical buckling loads (P_{cr}) and critical stresses (σ_{cr}) for slender columns with various end supports.

6. Apply strain energy formulas and Castigliano's theorem to compute elastic deflections in beams and frames.

Indicative Contents

- **Plane Stress & Strain Transformation:** General equations for 2D stress transformation, principal stresses, principal planes, maximum shear stress, Mohr's Circle for plane stress, strain transformation, strain rosette measurements (12 hours theory, 6 hours tutorial).

- **Combined Loadings Analysis:** Superposition of stresses, biaxial bending, combined axial and bending stresses, combined flexure and torsion, pressure vessels (thin-walled cylinders and spheres) (10 hours theory, 5 hours tutorial).

- **Beam Deflection Methods:** Elastic curve equation $EI(d^2y/dx^2) = M(x)$, Double Integration method, Singularity functions (Macaulay's method), Moment-Area Method (Theorems I & II), Conjugate Beam Method (14 hours theory, 8 hours tutorial).

- **Column Buckling & Stability:** Stability of structures, Euler's critical buckling load ($P_{cr} = \pi^2 EI/L_e^2$), effective length factor (K), slenderness ratio (λ), Secant formula for eccentric column loading, design curves (12 hours theory, 6 hours tutorial).

- **Strain Energy & Castigliano's Theorem:** Strain energy due to axial, bending, shear, and torsional loads, Castigliano's second theorem, application to beam deflections (12 hours theory, 5 hours tutorial).

4. Learning and Teaching Strategies

1. **Rigorous Mathematical Lectures:** Theoretical derivations of Mohr's circle geometry, differential deflection equations, and Euler buckling proofs.

2. **Weekly Analytical Tutorials:** Problem-solving workshops focused on complex multi-load stress states and beam deflection calculations.

3. **Weekly Practice Assignments:** Numerical problem sets reinforcing structural mechanics formulation and computational accuracy.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	65	4.3
Total SWL (h/sem)	125	8.3

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Assignments	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Plane stress transformation: Transformation equations for stress on inclined planes.
- **Week 2:** Principal stresses, principal planes, maximum in-plane shear stress, and average normal stress calculations.
- **Week 3:** Mohr's Circle for plane stress: Step-by-step graphical and analytical construction, absolute maximum shear stress.
- **Week 4:** Plane strain transformation, principal strains, Mohr's circle for strain, strain rosette calculations.
- **Week 5:** Thin-walled pressure vessels: Circumferential (hoop) stress and longitudinal stress in cylindrical and spherical vessels.
- **Week 6:** Combined loading state analysis: Superposition of normal and shear stresses caused by axial load, bending, torsion, and transverse shear.
- **Week 7:** Midterm Examination.
- **Week 8:** Beam deflection theory: Differential equation of the elastic curve, boundary conditions, and support conditions.
- **Week 9:** Double Integration method for computing slope $\theta(x)$ and elastic deflection $y(x)$ in statically determinate beams.
- **Week 10:** Macaulay's method (Singularity functions) for beams subjected to multiple point loads and discontinuous distributed loads.
- **Week 11:** Moment-Area Method: First and second Moment-Area theorems, tangent deviation calculations, slope and deflection computations.
- **Week 12:** Conjugate Beam Method: Real beam vs. conjugate beam support mappings, shear/moment-slope/deflection analogies.
- **Week 13:** Buckling of columns: Concept of elastic stability, Euler's column formula for pinned-pinned ends.
- **Week 14:** Column buckling with various end conditions (fixed-free, fixed-fixed, fixed-pinned), effective length factor (K), slenderness ratio (L/r).

- **Week 15:** Strain energy formulation for axial, flexural, and torsional loads; Castigliano's theorem for computing beam deflections.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	R. C. Hibbeler – *Mechanics of Materials* (10th or 11th Edition), Pearson. Ferdinand P. Beer et al. – *Mechanics of Materials* (8th Edition), McGraw-Hill.	Yes
Recommended Texts	James M. Gere, Barry J. Goodno – *Mechanics of Materials* (9th Edition), Cengage Learning.	Yes
Websites	MIT OpenCourseWare (Solid Mechanics) & NPTEL Structural Mechanics Portals.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Engineering Surveying II
Module Type	Core Engineering (C)
Module Code	RE.224
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 4
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	lecturerSahar Basim Jawad
Module Leader's e-mail	sahar.jawad@qu.edu.iq
Module Leader's Acad. Title	lecturer
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.214 (Engineering Surveying I) | Semester: 3
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Horizontal Alignment Curves:** Master geometric design, element computation, and field setting-out procedures for simple, compound, reverse, and transition (spiral) horizontal curves.

2. **Vertical Alignment Curves:** Formulate symmetric and asymmetric parabolic vertical curves, calculate high/low points, and determine minimum sight distances.

3. **Earthwork & Mass Haul Diagrams:** Calculate cross-sectional areas, earthwork volumes (cut and fill), and optimize haul distances using Mass Haul Diagrams.

4. **Total Station Operations:** Train students to operate electronic Total Stations for angle/distance measurements, coordinate positioning, and field setting out.

5. **Modern Geomatic Technologies:** Introduce Global Navigation Satellite Systems (GNSS/GPS), Real-Time Kinematic (RTK) positioning, and Geographic Information System (GIS) integration.

Module Learning Outcomes

1. Compute geometric parameters (R, T, L, E, M, LC) and deflection angles for simple circular horizontal curves.

2. Calculate superelevation runoff transitions, compound curves, reverse curves, and spiral transition curves for highway alignments.

3. Formulate parabolic vertical summit and sag curves and determine exact elevations at required highway stationing.

4. Compute earthwork cut/fill volumes using Average End Area and Prismoidal formulas and construct a Mass Haul Diagram.

5. Operate Total Station instruments for topographic data collection and precise coordinate layout/setting out of roadway structures.

6. Describe GNSS/GPS satellite surveying principles, differential GPS (DGPS), RTK techniques, and GIS data import.

Indicative Contents

- **Horizontal Curve Geometry:** Simple circular curves, elements ($R, \Delta, T, L, E, M, LC$), stationing equations (PC, PT, PI), deflection angle method, setting out with tape and Total Station (10 hours theory, 8 hours practical).

- **Special Horizontal Curves & Transitions:** Compound curves, reverse curves, spiral transition curves, length of spiral, superelevation runoff, widening on curves (10 hours theory, 8 hours practical).

- **Vertical Alignment Curves:** Parabolic vertical curves, symmetric vs. asymmetric curves, k-value, highest/lowest point computation, sight distance requirements (stopping and passing) (10 hours theory, 8 hours practical).

- **Earthwork Computation & Mass Haul Diagram:** End areas determination (level, two-level, three-level sections), volume calculations (Average End Area, Prismoidal formula), free haul, overhaul, balance lines, Mass Haul Diagram optimization (10 hours theory, 8 hours practical).

- **Total Station & Modern Satellite Surveying:** Electronic Distance Measurement (EDM), Total Station orientation, resection, setting-out modes, GNSS positioning concepts, RTK-GPS, introduction to Geographic Information Systems (GIS) (10 hours theory, 8 hours practical).

4. Learning and Teaching Strategies

1. **Geometric Design Lectures:** Classroom instruction using horizontal/vertical alignment equations, earthwork balance graphics, and field layout algorithms.

2. **Supervised Total Station Field Practicals:** Outdoor campus fieldwork in small teams practicing curve layout, coordinate setting out, and electronic data collection.

3. **Engineering Layout Projects:** Group projects focused on computing complete horizontal curve geometry and setting out stakes in the field.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1–#4
Field Work Reports & Logbooks	10 reports	15% (15 marks)	Weekly	All LOs
Midterm Practical Field Exam	2 hours	15% (15 marks)	Week 7	LO #1, #2, #5

Final Practical Field Exam	2 hours	10% (10 marks)	Week 15	All LOs
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to highway alignment geometry; horizontal vs. vertical alignment principles.
- **Week 2:** Simple circular horizontal curve geometry: Elements, radius (R), degree of curve (D), tangent length (T), length of curve (L).
- **Week 3:** Calculation of PC, PT, PI stationing and computation of deflection angles for curve layout.
- **Week 4:** Obstacles on circular curves; setting out circular curves using tape-only methods (offsets from long chord/tangent).
- **Week 5:** Compound curves: Geometric properties, double-center calculation, and intermediate stationing.
- **Week 6:** Reverse curves and transition (spiral) curves: Euler spiral (clothoid) properties, length of transition curve, superelevation runoff.
- **Week 7:** Midterm Examination.
- **Week 8:** Vertical parabolic curves: Mathematical equation of vertical parabola, symmetric vertical curves.
- **Week 9:** Calculation of vertical curve elevations, grades (g_1, g_2), rate of change of grade (r), and stationing of high/low points.
- **Week 10:** Asymmetric vertical curves and vertical sight distance criteria (stopping sight distance SSD and passing sight distance PSD).
- **Week 11:** Earthwork calculations: Cross-sectional areas for level, two-level, three-level, and irregular ground sections.
- **Week 12:** Earthwork volumes: Average End Area method, Prismoidal formula, and prismoidal correction calculations.
- **Week 13:** Mass Haul Diagram (MHD): Definition, properties, balance line selection, free haul distance, overhaul distance, and economic haulage.

- **Week 14:** Total Station instrumentation: Electronic angle measurement, EDM, coordinate systems, resection, and remote elevation measurement (REM).

- **Week 15:** Satellite positioning: GNSS/GPS principles, DGPS, Real-Time Kinematic (RTK) surveying, and integration with GIS highway databases.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Total Station orientation: Leveling, centering over a ground point, electronic tilt sensors, and menu navigation.

- **Week 2:** Field Exercise 1: Horizontal angle and distance measurement using Total Station; establishing baseline coordinates.

- **Week 3:** Field Exercise 2: Setting out a simple circular horizontal curve using Total Station deflection angle and chord method.

- **Week 4:** Field Exercise 3: Setting out a circular curve using Total Station direct coordinate system (N, E, Z) mode.

- **Week 5:** Field Exercise 4: Total Station Resection method: Determining instrument coordinates from unknown setup points.

- **Week 6:** Field Exercise 5: Establishing and setting out a compound horizontal curve in the field.

- **Week 7:** Practical Midterm Field Examination.

- **Week 8:** Field Exercise 6: Staking out vertical alignment elevations on terrain using Total Station vertical trigonometric leveling.

- **Week 9:** Field Exercise 7: Collecting profile and cross-sectional point cloud data for earthwork volume estimation using Total Station.

- **Week 10:** Field Exercise 8: Processing field cross-sectional data, computing cut/fill areas, and calculating net earthwork volumes.

- **Week 11:** Field Exercise 9: Constructing a Mass Haul Diagram from field earthwork volume data and locating optimum balance lines.

- **Week 12:** Field Exercise 10: Introduction to GNSS/GPS receiver setup, static positioning, and base-rover RTK initialization.

- **Week 13:** Field Exercise 11: Topographic site data collection using RTK-GPS rover unit and logging point feature codes.

- **Week 14:** Field Exercise 12: Exporting Total Station and GPS raw data into CAD software, generating alignment profiles and 3D terrain surface.

- **Week 15:** Final Practical Field Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Charles D. Ghilani & Paul R. Wolf – *Elementary Surveying: An Introduction to Geomatics* (15th Edition), Pearson. AASHTO – *A Policy on Geometric Design of Highways and Streets* (Green Book), AASHTO.	Yes
Recommended Texts	B. C. Punmia – *Surveying Vol. II & III*, Laxmi Publications.	Yes
Websites	Federal Highway Administration (FHWA) Surveying & Mapping Guidelines.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Construction of Roads and Bridges
Module Type	Core Engineering (C)
Module Code	RE.225
ECTS Credits	3
SWL (hr/sem)	75
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 4
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Dr. Ihsan Ali Obaid
Module Leader's e-mail	ihsan.obaid@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.124 (Construction Materials) | Semester: 2
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Earthmoving & Heavy Construction Machinery:** Understand operating principles, productivity, and selection of earthmoving equipment (dozers, excavators, scrapers, motor graders, rollers).

2. **Road Subgrade & Base Construction:** Master site clearing, subgrade compaction, soil stabilization (lime, cement, bitumen), and aggregate subbase/base course construction.

3. **Asphalt Paving Operations:** Study asphalt plant operations (batch vs. drum mix), transport, asphalt paver operation, screed control, and roller compaction sequences.

4. **Concrete Pavement Construction:** Examine fixed-form paving, slip-form paving, joint cutting, dowel bar placement, and curing of rigid pavements.

5. **Bridge Construction Techniques:** Comprehend bridge substructure foundations (driven piles, bored shafts), abutments, piers, precast girder erection, and deck slab casting.

Module Learning Outcomes

1. Calculate earthmoving machinery cycle times, hourly productivity, and fleet matching requirements.

2. Formulate subgrade preparation protocols, compaction moisture control, and field density verification methods.

3. Explain asphalt concrete production in batch/drum plants and paving placement/compaction techniques according to Iraqi SORB specifications.

4. Distinguish between construction methods for jointed plain concrete pavements (JPCP) and slip-form concrete paving.

5. Identify bridge foundation construction processes including pile driving, bored cast-in-place shafts, and cofferdams.

6. Outline bridge superstructure construction methods including precast prestressed beam launch, cast-in-place decks, and expansion joints.

Indicative Contents

- **Earthmoving Equipment & Productivity:** Earthmoving mechanics, dozers, hydraulic excavators, wheel loaders, scrapers, motor graders, compaction equipment (smooth drum, padfoot, pneumatic tire rollers), equipment productivity formulas (8 hours theory, 4 hours practical).

- **Subgrade Preparation & Stabilization:** Clearing and grubbing, excavation, subgrade compaction, moisture-density control (Proctor test application), soil stabilization methods (lime, cement, asphalt emulsion stabilization), aggregate subbase placement (10 hours theory, 4 hours practical).

- **Asphalt Pavement Construction:** Batch asphalt plants vs. drum plants, hot storage silos, haul trucks, asphalt paver mechanics, electronic screed leveling, rolling sequence

(breakthrough, intermediate, finish rolling), compaction temperature control (10 hours theory, 4 hours practical).

- **Rigid Concrete Pavement Construction:** Concrete batching, delivery, slip-form paving vs. fixed-form paving, dowel bar inserters (DBI), tie bars, transverse contraction joint sawing, curing compounds, joint sealant application (7 hours theory, 3 hours practical).

- **Bridge Substructure & Superstructure Construction:** Bridge foundations (shallow footings, driven precast/steel piles, bored shafts/drilled piers), pier and abutment construction, precast pre-tensioned girder transportation and crane erection, cast-in-place deck slabs, expansion joints, bearings (10 hours theory, 5 hours practical).

4. Learning and Teaching Strategies

1. **Visual Technical Lectures:** Utilizing construction site videos, machinery animation, structural execution drawings, and technical specifications.

2. **Construction Site Technical Visits:** Guided site visits to active road construction projects, asphalt batch plants, and bridge construction sites.

3. **Equipment Productivity Case Studies:** Engineering calculations of equipment cycle times, cost estimation, and fleet balancing.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	45	3
Unstructured SWL (h/sem)	30	2
Total SWL (h/sem)	75	5

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	3	15% (15 marks)	Weeks 4, 8, 12	LO #1–#5
Site Reports & Case Studies	2 reports	10% (10 marks)	Weeks 6, 13	LO #1, #3, #5, #6
Midterm Written Exam	1.5 hours	25% (25 marks)	Week 7	LO #1, #2, #3

Final Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100%** **(100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to road and bridge construction engineering; project lifecycle and site organization.
- **Week 2:** Earthmoving machinery: Bulldozer capabilities, blade types, production estimation, and excavating equipment.
- **Week 3:** Scrapers, loaders, and haul trucks: Cycle time breakdown, volumetric capacity, and haul fleet balance calculations.
- **Week 4:** Site preparation: Clearing, grubbing, topsoil stripping, subgrade excavation, and fill embankment placement.
- **Week 5:** Soil compaction mechanics: Heavy compaction equipment, moisture control, field nuclear density testing, and sand cone verification.
- **Week 6:** Soil stabilization in road bases: Mechanical stabilization, lime stabilization, Portland cement stabilization, and asphalt emulsion treatment.
- **Week 7:** Midterm Examination.
- **Week 8:** Aggregate base course construction: Unbound aggregate spreading, grading, moisture conditioning, and density acceptance (Iraqi SORB).
- **Week 9:** Asphalt concrete production: Batch plant operation (cold feeds, dryer drum, hot screening, pugmill mixing) vs. continuous drum plants.
- **Week 10:** Asphalt paving operations: Prime coat and tack coat application, asphalt paver components, augers, vibrating screed, auto-leveling sensors.
- **Week 11:** Asphalt compaction sequence: Breakdown rolling (steel wheel), intermediate rolling (pneumatic-tired), finish rolling, density testing (core cutting).
- **Week 12:** Rigid concrete pavement construction: Slip-form paving process, dowel bar inserter (DBI), joint cutting timing, and curing protection.
- **Week 13:** Bridge substructure construction: Deep foundations, pile driving rigs, bored cast-in-place drilled shafts, slurry trenching, pier cap construction.

- **Week 14:** Bridge superstructure construction: Precast prestressed concrete girder fabrication, transport, crane lifting, gantry erection methods.

- **Week 15:** Cast-in-place reinforced concrete deck slabs, bridge bearings (elastomeric pads), expansion joints, waterproofing, and wearing surface installation.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical construction module supplemented with field site visits).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Robert L. Peurifoy, Clifford J. Schexnayder et al. – *Construction Planning, Equipment, and Methods* (9th Edition), McGraw-Hill. Ministry of Housing and Construction (Iraq) – *General Specification for Roads and Bridges (SORB)*.	Yes
Recommended Texts	Frank Harris & John McCaffer – *Modern Construction Management* (8th Edition), Wiley-Blackwell.	Yes
Websites	Federal Highway Administration (FHWA) Construction & Materials Office & Caterpillar Performance Handbook Resources.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Computer II
Module Type	Basic Engineering / Support (B)
Module Code	QU24
ECTS Credits	3
SWL (hr/sem)	75
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 4
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Dr. Sara Husein Toman
Module Leader's e-mail	sarah.hussein@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** QU14 (Computer I) | Semester: 1

- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Advanced Civil CAD & Drafting:** Master advanced Computer-Aided Design (AutoCAD 2D/3D) techniques for highway cross-sections, structural drawings, and 3D solid modeling.

2. **Introduction to Civil 3D Roadway Modeling:** Learn the basics of Autodesk Civil 3D for terrain surface creation, alignment design, profile plotting, and corridor modeling.

3. **Numerical Computing with MATLAB/Python:** Train students to write algorithms in MATLAB/Python for solving engineering equations, matrix operations, and curve fitting.

4. **Spreadsheet Engineering Applications:** Utilize Microsoft Excel advanced features, array formulas, Solver optimization, and Visual Basic for Applications (VBA) for highway data analysis.

Module Learning Outcomes

1. Draft detailed civil engineering structural plans, highway cross-sections, and 3D solid models using AutoCAD software.

2. Create digital terrain models (DTM), horizontal alignments, and vertical profiles in Civil 3D.

3. Develop MATLAB/Python scripts for matrix manipulation, numerical root finding, and polynomial data fitting.

4. Plot 2D and 3D scientific data graphs using computational software packages.

5. Construct spreadsheet optimization models using Excel Solver for transportation data fitting and structural design.

6. Write basic VBA macros to automate repetitive civil engineering spreadsheet calculations.

Indicative Contents

- **Advanced CAD & 3D Drafting:** AutoCAD dynamic blocks, external references (Xrefs), dimension styles, 3D solid primitives, extrude, revolve, boolean operations, rendering civil structures (10 hours theory, 10 hours lab).

- **Civil 3D Roadway Modeling Basics:** Point clouds, importing surveying data, creating TIN surfaces, generating horizontal alignments, profile views, assembly creation, and simple corridor building (10 hours theory, 10 hours lab).

- **Engineering Computing (MATLAB / Python):** Variables, vectors, matrices, matrix arithmetic, conditionally executed blocks (if-else), loops (for, while), user-defined functions, plotting 2D/3D graphs, numerical root finding algorithms (10 hours theory, 10 hours lab).

- **Advanced Spreadsheet & VBA Automation:** Excel advanced functions (VLOOKUP, INDEX/MATCH), Data Tables, Goal Seek, Solver optimization tool for engineering design, writing VBA subroutines and user-defined functions for civil engineering calculations (15 hours theory, 10 hours lab).

4. Learning and Teaching Strategies

1. **Lectures & Software Demonstrations:** Interactive lectures in computer laboratory showing live software execution and code development.

2. **Hands-On Computer Laboratory Sessions:** Practical exercises where students independently model highway elements, write code, and solve engineering design problems.

3. **Applied Computational Project:** Individual student mini-project requiring complete CAD drafting, numerical scripting, and spreadsheet optimization.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	45	3
Unstructured SWL (h/sem)	30	2
Total SWL (h/sem)	75	5

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	3	10% (10 marks)	Weeks 4, 8, 12	LO #1–#5
Practical Lab Exercises	8 exercises	15% (15 marks)	Weekly	All LOs
Midterm Practical Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2, #3

Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	All LOs
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Review of 2D CAD drafting; advanced layer management, layouts, viewports, dynamic blocks, and attribute extraction.
- **Week 2:** Introduction to 3D CAD modeling: UCS manipulation, 3D wireframe, surface modeling, and 3D solid primitives.
- **Week 3:** 3D Solid operations: Extrude, Revolve, Sweep, Loft, Union, Subtract, and Intersect operations on highway structures.
- **Week 4:** Introduction to Autodesk Civil 3D interface: Point data management, creating Topographic TIN surfaces from survey data.
- **Week 5:** Civil 3D horizontal alignment creation: Tangent design, curve insertion, and alignment stationing labels.
- **Week 6:** Civil 3D vertical alignment design: Generating surface profiles, design profiles, sag/summit vertical curve parameters.
- **Week 7:** Midterm Examination.
- **Week 8:** Introduction to MATLAB/Python environment: Command window, script files (.m / .py), scalar and vector variables.
- **Week 9:** Matrix operations in MATLAB/Python: Transpose, inverse, determinant, matrix multiplication, and solving linear systems ($Ax = b$).
- **Week 10:** Programming logic: Relational operators, logical operators, conditional statements (if-elseif-else), and loop structures (for, while).
- **Week 11:** Writing custom functions in MATLAB/Python; 2D line plotting (plot, xlabel, ylabel, legend) and 3D surface plotting.
- **Week 12:** Implementing numerical methods in MATLAB/Python: Newton-Raphson root finder and numerical integration routines.

- **Week 13:** Advanced Excel for civil engineers: Dynamic array functions, INDEX/MATCH, statistical analysis tools, and trendline curve fitting.

- **Week 14:** Excel Goal Seek and Solver add-in: Constrained optimization of civil engineering cost and design models.

- **Week 15:** Introduction to Visual Basic for Applications (VBA) in Excel: Developer tab, VBA editor, writing custom User-Defined Functions (UDFs).

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** AutoCAD Lab 1: Drafting multi-lane highway cross-sections with annotations, dimensions, and hatch patterns.

- **Week 2:** AutoCAD Lab 2: 3D modeling of a reinforced concrete culvert / bridge pier structure using extrude and boolean operations.

- **Week 3:** Civil 3D Lab 1: Importing field Total Station survey points (E, N, Z) and generating a 3D ground surface (TIN).

- **Week 4:** Civil 3D Lab 2: Laying out a road horizontal alignment and generating ground profile views along alignment centerline.

- **Week 5:** Civil 3D Lab 3: Creating road assemblies (lanes, shoulders, curbs, side slopes) and generating a basic road corridor model.

- **Week 6:** MATLAB/Python Lab 1: Matrix algebra exercises and solving linear system equations for structural truss forces.

- **Week 7:** Practical Midterm Laboratory Evaluation.

- **Week 8:** MATLAB/Python Lab 2: Developing a script to execute Bisection and Newton-Raphson non-linear root finding algorithms.

- **Week 9:** MATLAB/Python Lab 3: Plotting experimental traffic volume data, polynomial curve fitting, and R^2 evaluation.

- **Week 10:** Excel Lab 1: Constructing an automated spreadsheet for Marshall Asphalt Mix Volumetric calculations.

- **Week 11:** Excel Lab 2: Utilizing Excel Solver to optimize aggregate blend proportions matching target specification curves.

- **Week 12:** Excel Lab 3: Writing a VBA macro function to compute horizontal curve geometric parameters (R, T, L, E).

- **Week 13:** Integrated Project Workshop: Combining CAD layout, Civil 3D profile data, and Excel calculations into a technical submission.

- **Week 14:** Comprehensive practical project review and laboratory performance assessment.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Sybex – *Mastering AutoCAD and AutoCAD LT*, Wiley. Autodesk – *Autodesk Civil 3D Official Training Guide*, Autodesk Press. Stormy Attaway – *MATLAB: A Practical Introduction to Programming and Problem Solving* (5th Edition), Butterworth-Heinemann.	Yes
Recommended Texts	Steven C. Chapra – *Applied Numerical Methods with MATLAB for Engineers and Scientists* (4th Edition), McGraw-Hill.	Yes
Websites	Autodesk Learning Network & MathWorks MATLAB Documentation Portals.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	English
Module Type	Basic Engineering / Support (B)
Module Code	QU26
ECTS Credits	2
SWL (hr/sem)	50
Module Level	Level 2
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 4
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Lecturer Saba Mohammed Shaheed
Module Leader's e-mail	saba.shheed@qu.edu.iq
Module Leader's Acad. Title	Lecturer
Module Leader's Qualification	M.S.C
Module Tutor	-
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** QU21 (English Language II) | Semester: 3

- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Academic Research Writing:** Train students in structuring technical research papers, literature reviews, abstracts, and engineering project proposals.

2. **Professional Engineering Correspondence:** Develop mastery in formal business correspondence, contract dispute letters, feasibility summaries, and tender bids.

3. **Advanced Scientific Reading & Analysis:** Enhance critical reading of technical research journals, AASHTO/ASTM specification codes, and international engineering standards.

4. **Professional Technical Presentations:** Develop public speaking, presentation structure, visual slide design, and handling technical questions in professional environments.

5. **Ethics & Professional Vocabulary:** Expand specialized engineering vocabulary related to ethics, sustainability, contract management, and project execution.

Module Learning Outcomes

1. Write structured academic abstracts, research introductions, and literature synthesis for engineering reports.

2. Draft formal professional correspondence including project proposals, technical memorandums, and progress reports.

3. Analyze technical journal publications and extract methodologies, analytical data, and engineering conclusions.

4. Deliver confident oral technical presentations supported by clear visual aids and logical transitions.

5. Apply professional register, precise technical vocabulary, and formal tone in engineering documentation.

Indicative Contents

- **Academic Research & Abstract Writing:** Elements of a scientific paper, writing informative vs. indicative abstracts, literature review synthesis techniques, proper citation and referencing styles (10 hours theory, 5 hours practical).

- **Professional Engineering Documentation:** Writing technical feasibility reports, contract letters, bidding documents, progress status reports, and executive summaries (10 hours theory, 5 hours practical).

- **Critical Reading of Engineering Literature:** Reading and summarizing peer-reviewed journal papers (e.g., ASCE, ScienceDirect), parsing complex ASTM/AASHTO standard specifications (5 hours theory, 5 hours practical).

- **Advanced Technical Presentation & Oral Defense:** Effective technical slide design, presenting data and trends, handling technical audience Q&A, professional delivery register (5 hours theory, 5 hours practical).

4. Learning and Teaching Strategies

1. **Interactive Language Workshops:** Writing labs, peer review sessions, and editing engineering technical drafts.

2. **Critical Reading & Summarization:** Practical exercises analyzing real-world civil engineering journal articles and extracting core technical conclusions.

3. **Oral Defense & Presentation Practice:** Student individual technical presentations on highway engineering topics evaluated on delivery, clarity, and slide structure.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	30	2
Unstructured SWL (h/sem)	20	1.3
Total SWL (h/sem)	50	3.3

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	3	15% (15 marks)	Weeks 4, 8, 12	LO #1, #2, #5
Writing Assignments & Abstract	3 reports	15% (15 marks)	Weeks 3, 9, 13	LO #1, #2, #3
Oral Presentation	10 mins	10% (10 marks)	Week 14	LO #4, #5

Midterm Written Exam	1 hour	20% (20 marks)	Week 7	LO #1, #2, #3
Final Exam	2 hours	40% (40 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Orientation: Advanced English for civil engineers; expectations for academic research and professional workplace communication.
- **Week 2:** Structure of a scientific paper: Title selection, Abstract, Introduction, Methodology, Results, Discussion, Conclusion (IMRaD framework).
- **Week 3:** Writing concise and effective academic abstracts $(150 - 250$ words$)$ for civil engineering research.
- **Week 4:** Conducting literature searches, synthesizing research findings, and drafting literature review paragraphs.
- **Week 5:** Citation ethics, avoiding plagiarism, and using standard referencing formats (IEEE, ASCE, APA).
- **Week 6:** Writing professional engineering proposals: Problem statement, scope of work, timeline, budget, and deliverables.
- **Week 7:** Midterm Examination.
- **Week 8:** Technical correspondence: Formal letters regarding contract modifications, site delay notifications, and dispute resolution.
- **Week 9:** Writing Executive Summaries for large-scale transportation infrastructure feasibility studies.
- **Week 10:** Critical reading of international standards (AASHTO, ASTM, ACI): Vocabulary of specifications (*shall, should, may, mandatory*).
- **Week 11:** Analyzing peer-reviewed journal papers: Extracting research objectives, experimental setups, and core findings.
- **Week 12:** Describing complex experimental data, statistical trends, and comparative charts using formal academic vocabulary.

- **Week 13:** Designing effective technical PowerPoint presentation slides: Data visualization, typography, and layout principles.
- **Week 14:** Student oral technical presentations: Individual research project presentations with visual aids.
- **Week 15:** Peer review, editing technical writing drafts, self-correction strategies, and final course summary.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical language module with practical writing workshops).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	David F. Beer & David A. McMurrey – *A Guide to Writing as an Engineer* (5th Edition), Wiley. Mark Ibbotson – *Cambridge English for Engineering*, Cambridge University Press.	Yes
Recommended Texts	Michael Alley – *The Craft of Scientific Writing* (4th Edition), Springer.	Yes
Websites	ASCE Author Resources & Purdue Online Writing Lab (OWL) Engineering Writing Resources.	-

10. Grading Scheme

Grading Scheme			
Group	**Grade**	**Mark (%)**	**Definition**
Success Group (50–100)	**A - Excellent**	90–100	Outstanding Performance
	B - Very Good	80–89	Above average with some errors
	C - Good	70–79	Sound work with notable errors

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

Third Stage

Semester 5

MODULE DESCRIPTION FORM

Module Information

Module Information	
Field	**Details**
Module Title	Advanced Mathematics and Engineering Analysis
Module Type	Basic Engineering / Support (B)
Module Code	RE.311
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 5
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Shuruq Abd Al-ameer Jawaad
Module Leader's e-mail	shuruq.khafaji@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	MSC.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

Relation with Other Modules

- **Prerequisite module:** ENG.221 (Mathematics IV) | Semester: 4
- **Co-requisites module:** None | Semester: -

Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Fourier Series & Integral Transforms:** Formulate Fourier series expansions for periodic functions and master Laplace and Fourier transform techniques for solving continuous engineering systems.

2. **Partial Differential Equations (PDEs):** Classify second-order linear PDEs and apply separation of variables to derive closed-form solutions for heat, wave, and Laplace equations.

3. **Linear Algebra & Matrix Eigen-Analysis:** Compute matrix eigenvalues, eigenvectors, and diagonalizations to solve coupled systems of differential equations and structural vibration problems.

4. **Vector Calculus & Field Theorems:** Apply vector differential operators (gradient, divergence, curl) and integral theorems (Green's, Stokes', and Divergence theorems) to fluid and structural field models.

5. **Boundary Value Problems & Series Solutions:** Master Power Series and Frobenius methods for solving linear differential equations with variable coefficients.

Module Learning Outcomes

1. Expand periodic and non-periodic boundary functions into trigonometric Fourier series and half-range Fourier sine/cosine series.

2. Solve initial-boundary value problems for partial differential equations using the method of separation of variables.

3. Utilize Laplace transforms and convolution integrals to solve higher-order ordinary differential equations with impulse and step inputs.

4. Evaluate eigenvalues and eigenvectors to solve coupled systems of differential equations representing engineering dynamic response.

5. Compute line, surface, and volume integrals using Gauss' Divergence Theorem and Stokes' Theorem.

6. Apply Frobenius series methods to derive Bessel functions and Legendre polynomials in engineering field boundary problems.

Indicative Contents

- **Fourier Series & Integral Transforms:** Periodic functions, Dirichlet conditions, Fourier series calculation, half-range sine and cosine series, Parseval's identity, Fourier Integral, and Continuous Fourier Transform (12 hours theory, 6 hours tutorial).

- **Laplace Transform Applications:** Properties, unit step (Heaviside) and Dirac delta functions, transfer functions, convolution theorem, application to initial-value ODE systems (10 hours theory, 5 hours tutorial).

- **Partial Differential Equations (PDEs):** Classification of 2nd-order PDEs (elliptic, parabolic, hyperbolic), separation of variables method, 1D Wave equation (vibrating strings/beams), 1D Heat conduction equation, 2D Laplace equation in Cartesian and polar coordinates (16 hours theory, 8 hours tutorial).

- **Advanced Linear Algebra & Matrix Analysis:** Vector spaces, linear independence, matrix diagonalization, quadratic forms, eigenvalues and eigenvectors applied to dynamic system state-space modeling (10 hours theory, 5 hours tutorial).

- **Vector Calculus & Boundary Series Methods:** Gradient, divergence, curl, line and surface integrals, Green's theorem, Divergence theorem of Gauss, Stokes' theorem; Series solutions of differential equations around ordinary and singular points, Bessel functions (12 hours theory, 6 hours tutorial).

Learning and Teaching Strategies

1. **Analytical Mathematical Lectures:** Rigorous theoretical derivations of differential equations, field theorems, and transform properties.

2. **Weekly Interactive Tutorials:** Step-by-step problem-solving workshops focusing on partial differential equations and transform methods.

3. **Applied Mathematical Homework:** Computational assignment sets reinforcing transform algorithms and dynamic linear matrix solutions.

Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Assignments	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs

Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

- **Delivery Plan (Weekly Syllabus)**

- **Week 1:** Periodic functions, orthogonality of trigonometric functions, definition and derivation of Fourier series coefficients.

- **Week 2:** Even and odd functions, half-range expansion (sine and cosine series), harmonic analysis.

- **Week 3:** Fourier Integral representation, introduction to continuous Fourier Transforms and inverse transforms.

- **Week 4:** Laplace Transform properties review, Heaviside step functions, unit impulse (Dirac delta) function, convolution theorem.

- **Week 5:** Application of Laplace Transforms to linear boundary value problems and coupled differential equation systems.

- **Week 6:** Introduction to Partial Differential Equations (PDEs): Physical modeling, classification (elliptic, parabolic, hyperbolic).

- **Week 7:** Midterm Examination.

- **Week 8:** Solving the 1D Wave equation $u_{tt} = c^2 u_{xx}$ using separation of variables and Fourier series boundary matching.

- **Week 9:** Solving the 1D Heat conduction equation $u_t = k u_{xx}$ with homogeneous and non-homogeneous boundary conditions.

- **Week 10:** Solving 2D Laplace equation $\nabla^2 u = 0$ in rectangular and circular boundary domains.

- **Week 11:** Advanced Linear Algebra: Eigenvalues, eigenvectors, diagonalizing matrices, matrix exponential e^{At}.

- **Week 12:** Vector differential calculus: Vector fields, scalar fields, directional derivatives, gradient, divergence, and curl.

- **Week 13:** Line and surface integrals in 3D space, Green's Theorem in the plane.

- **Week 14:** Gauss' Divergence Theorem and Stokes' Theorem: Formulation and engineering transport applications.

- **Week 15:** Power series solutions of ordinary differential equations, Frobenius method, introduction to Bessel functions.

- **Week 16:** Final Examination.

Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical module with weekly structured tutorials).

Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Erwin Kreyszig – *Advanced Engineering Mathematics* (10th Edition), Wiley. Peter V. O'Neil – *Advanced Engineering Mathematics* (8th Edition), Cengage Learning.	Yes
Recommended Texts	Dennis G. Zill – *Advanced Engineering Mathematics* (7th Edition), Jones & Bartlett Learning.	Yes
Websites	MIT OpenCourseWare (Differential Equations & Advanced Calculus) & NPTEL Advanced Engineering Mathematics.	-

Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Theory of Structures
Module Type	Core Engineering (C)
Module Code	RE.312
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 5
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Dr.Abeer Saeed Zebalah
Module Leader's e-mail	abeer.alkraway@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.223 (Strength of Materials II) | Semester: 4
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Structural Determinacy & Stability:** Classify 2D trusses, beams, and rigid frames according to static determinacy, kinematic determinacy, and geometric stability.

2. **Energy Methods for Deflection:** Apply the Virtual Work Method (Unit Load Method) and Castigliano's Second Theorem to calculate deflections and rotations in trusses, beams, and frames.

3. **Influence Lines for Moving Loads:** Construct Influence Lines (IL) for reactions, shear force, and bending moment in determinate beams and trusses subjected to moving traffic loads.

4. **Classical Indeterminate Analysis (Classical Methods):** Master the Force Method (Consistent Deformations) for analyzing statically indeterminate beams, frames, and trusses.

5. **Displacement Analysis (Slope-Deflection & Moment Distribution):** Apply the Slope-Deflection Method and Moment Distribution Method (Hardy Cross) to compute internal end moments in continuous beams and rigid frames.

Module Learning Outcomes

1. Evaluate static and kinematic determinacy and geometric stability of structural systems.

2. Compute displacements and rotations in determinate trusses, beams, and frames using the Virtual Work method.

3. Construct influence lines for beams and bridge trusses and identify critical live-load positioning for maximum internal actions.

4. Solve degree of static indeterminacy (n) and compute redundant forces using the Method of Consistent Deformations.

5. Analyze continuous beams and non-sway/sidesway rigid frames using the Slope-Deflection equations.

6. Apply Hardy Cross Moment Distribution Method to evaluate bending moment distributions in continuous highway bridge girders and building frames.

Indicative Contents

- **Structural Classification & Stability:** Degrees of static indeterminacy ($3r + m - 3j$), kinematic determinacy, unstable configurations, external vs. internal stability (6 hours theory, 3 hours tutorial).

- **Deflections using Energy Principles:** Principle of Virtual Work for trusses ($\sum u\,\Delta = \sum N\,nL/AE$), Virtual Work for flexural members ($\int M\,m\,dx/EI$), temperature changes and fabrication tolerance effects (12 hours theory, 6 hours tutorial).

- **Influence Lines for Moving Wheel Loads:** Concept of influence lines, Müller-Breslau principle, IL for reactions, shear, and bending moments in simple and cantilever beams; IL for truss member forces; absolute maximum live bending moment under truck wheel trains (12 hours theory, 6 hours tutorial).

- **Force Method (Consistent Deformations):** Concept of redundant forces, compatibility equations, flexibility coefficients, application to indeterminate beams, portal frames, and indeterminate trusses (10 hours theory, 5 hours tutorial).

- **Displacement Methods (Slope-Deflection & Moment Distribution):** Slope-Deflection equations, fixed-end moments, continuous beams, frame analysis with and without sidesway; Moment Distribution method, stiffness factors, distribution factors, carry-over factors, iterative solution for continuous bridge beams and rigid frames (20 hours theory, 10 hours tutorial).

4. Learning and Teaching Strategies

1. **Theoretical & Analytical Lectures:** Deriving equilibrium and compatibility relations, energy integrals, and moment distribution algorithms.

2. **Weekly Problem-Solving Tutorials:** Comprehensive worked examples on influence line positioning, virtual work integration, and iterative moment distribution.

3. **Structural Design Homework Assignments:** Numerical problem sets requiring graphical drawing of Influence Lines and internal force diagrams.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation					
Assessment Component	**Time / Number**	**Weight (Marks)**	**Weighting**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	15%	Weeks 3, 5, 10, 12	LO #1–#5

Homework / Assignments	4	10% (10 marks)	10%	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	25%	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	50%	Week 16	All LOs
Total Assessment		**100% (100 Marks)**	**100%**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Concepts of structural analysis: Types of loads, structural forms, static determinacy and stability formulas for trusses, beams, and frames.
- **Week 2:** Virtual Work Method (Unit Load Method) for computing displacements in 2D pin-jointed trusses.
- **Week 3:** Virtual Work Method for beam and rigid frame deflections and rotations, integration tables for flexural work.
- **Week 4:** Virtual work application to thermal gradient strains and fabrication tolerances in trusses and frames.
- **Week 5:** Influence Lines (IL) for determinate beams: Concepts, drawing IL for support reactions, shear forces, and bending moments.
- **Week 6:** Application of Influence Lines: Uniformly distributed live loads, concentrated moving wheel load series, absolute maximum moment.
- **Week 7:** Midterm Examination.
- **Week 8:** Influence Lines for bridge floor girder systems and planar bridge trusses (Pratt, Howe, Warren trusses).
- **Week 9:** Force Method of Analysis (Method of Consistent Deformations): Degree of indeterminacy, choice of redundants, flexibility matrix principles.
- **Week 10:** Force Method applied to indeterminate beams, propped cantilevers, and 1-degree indeterminate trusses.
- **Week 11:** Introduction to Displacement Methods: Slope-Deflection equations formulation, sign conventions, fixed-end moments (FEM).

- **Week 12:** Slope-Deflection Method applied to continuous beams with fixed and pinned supports.

- **Week 13:** Slope-Deflection Method applied to rigid portal frames: Non-sway frames vs. sidesway frame equilibrium conditions.

- **Week 14:** Moment Distribution Method (Hardy Cross Method): Member stiffness factor (K), joint stiffness, distribution factor (DF), carry-over factor (COF).

- **Week 15:** Moment Distribution Method applied to multi-span continuous bridge girders and single-story portal frames with sidesway.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical structural module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	R. C. Hibbeler – *Structural Analysis* (10th Edition), Pearson. Aslam Kassimali – *Structural Analysis* (6th Edition), Cengage Learning.	Yes
Recommended Texts	Kenneth M. Leet, Chia-Ming Uang, Joel T. Lanning – *Fundamentals of Structural Analysis* (5th Edition), McGraw-Hill.	Yes
Websites	MIT OpenCourseWare (Structural Analysis) & NPTEL Structural Engineering Portals.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Soil Mechanics I
Module Type	Core Engineering (C)
Module Code	RE.313
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 5
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	lecturer. Dr. Amer Gheni Jihad
Module Leader's e-mail	amer.ghani@qu.edu.iq
Module Leader's Acad. Title	lecturer
Module Leader's Qualification	Ph.D.
Module Tutor	

Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.124 (Construction Materials) | Semester: 2
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Soil Volumetric & Phase Relationships:** Master physical phase relationships (three-phase soil diagram), void ratio (e), porosity (n), moisture content (w), degree of saturation (S_r), and unit weights ($\gamma_d, \gamma_b, \gamma_{sat}$).

2. **Soil Classification Systems:** Classify soils using Atterberg limits, sieve analysis, and hydrometer results according to USCS (ASTM D2487) and AASHTO M145 highway systems.

3. **Soil Compaction Mechanics:** Analyze compaction mechanics, moisture-density curves, Optimum Moisture Content (OMC), Maximum Dry Density (MDD), and field compaction specifications.

4. **Soil Permeability & Seepage Analysis:** Evaluate soil permeability (k), Darcy's Law, Constant/Falling Head permeability tests, and draw flow nets to compute seepage discharge and uplift pressure.

5. **Effective Stress & 1D Consolidation:** Understand total stress (σ), pore water pressure (u), effective stress (σ'), capillary rise, and one-dimensional primary consolidation settlement (S_c) using Terzaghi's theory.

Module Learning Outcomes

1. Solve phase relations for saturated, unsaturated, and dry soil masses using three-phase phase diagrams.

2. Classify soil samples into AASHTO and USCS soil groups using grain size distribution curves and Atterberg limits (LL, PL, PI).

3. Interpret standard and modified Proctor compaction curves to determine OMC and MDD for subgrade soil construction.

4. Measure soil hydraulic conductivity (k) in laboratory tests and compute 2D seepage flow rates beneath hydraulic structures using flow nets.

5. Calculate vertical total stress, pore water pressure, and effective stress profiles under geostatic loading and capillary action.

6. Determine consolidation parameters (compression index C_c, recompression index C_r, coefficient of consolidation C_v, pre-consolidation pressure σ'_p) and predict primary consolidation settlement.

Indicative Contents

- **Phase Relationships & Physical Properties:** Three-phase soil model, definitions and derivations for $e, n, w, S_r, G_s, \gamma_b, \gamma_d, \gamma_{sat}, \gamma_{sub}$ (8 hours theory, 4 hours lab).

- **Index Properties & Soil Classification:** Particle size distribution (sieve analysis and hydrometer analysis), Atterberg limits (Liquid Limit LL, Plastic Limit PL, Plasticity Index PI, Liquidity Index LI), USCS and AASHTO classification systems (10 hours theory, 6 hours lab).

- **Soil Compaction:** Theory of compaction, Standard and Modified Proctor compaction tests, compaction energy, zero-air-voids curve, field compaction equipment, and field density control (8 hours theory, 6 hours lab).

- **Hydraulic Properties & Seepage:** Soil permeability, Darcy's Law, Constant Head and Falling Head tests, factors affecting k, empirical relationships, 2D Laplace equation for seepage, Flow Net construction, seepage flow rate ($Q = kH \cdot N_f/N_d$), piping failure, and exit gradient (12 hours theory, 6 hours lab).

- **Effective Stress & Stresses in Soil:** Concept of effective stress ($\sigma' = \sigma - u$), effective stress in partially saturated soils, capillary tension, vertical stress distribution in soil mass (Boussinesq and Westergaard point load, line load, and circular load equations) (10 hours theory, 4 hours lab).

- **One-Dimensional Consolidation:** Terzaghi's 1D consolidation theory, oedometer test, void ratio vs. effective stress ($\log \sigma'$) curve, pre-consolidation pressure (σ'_p), Overconsolidation Ratio (OCR), primary consolidation settlement computation, coefficient of consolidation (C_v), and time rate of settlement (T_v) (12 hours theory, 8 hours lab).

4. Learning and Teaching Strategies

1. **Theoretical & Analytical Lectures:** Physics of soil mechanics, stress distribution formulas, and consolidation differential equations.

2. **Supervised Soil Laboratory Practicals:** Hands-on testing of soil index properties, compaction, permeability, and oedometer consolidation testing.

3. **Engineering Problem Sets:** Numerical calculations of phase relations, effective stress diagrams, flow net seepage, and consolidation settlement predictions.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Laboratory Reports	8 reports	15% (15 marks)	Weekly	LO #1–#4, #6
Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1–#3
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #2, #3, #4, #6
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to Geotechnical Engineering; origin of soils, soil formation, soil structure, and mineralogy.

- **Week 2:** Phase relationships: Three-phase diagram, definitions of mass, volume, void ratio, porosity, water content, degree of saturation.

- **Week 3:** Derivation of interrelationships between physical properties $(e, n, w, S_r, G_s, \gamma_d, \gamma_b, \gamma_{sat})$.

- **Week 4:** Grain size distribution: Mechanical sieve analysis and hydrometer analysis; D_{10}, D_{30}, D_{60}, Uniformity Coefficient (C_u), Coefficient of Curvature (C_c).

- **Week 5:** Consistency limits (Atterberg limits): Liquid limit, plastic limit, shrinkage limit, plasticity index, A-line chart interpretation.

- **Week 6:** Soil classification systems: Unified Soil Classification System (USCS) and AASHTO Soil Classification for highway engineering.

- **Week 7:** Midterm Examination.

- **Week 8:** Soil compaction theory: Mechanics of compaction, Standard Proctor vs. Modified Proctor energy, zero-air-void curve formulation.

- **Week 9:** Permeability and Darcy's Law: Hydraulic gradient, coefficient of permeability (k), laboratory testing principles.

- **Week 10:** Seepage analysis: 2D Laplace equation, boundary conditions, Flow Net sketching rules, calculating seepage discharge (Q) and uplift pressures.

- **Week 11:** Stresses in soils: Concept of Effective Stress, total stress, pore water pressure, effective stress changes under water table variations and capillarity.

- **Week 12:** Stress distribution in soil mass: Boussinesq equation for vertical point load, line load, strip load, and uniform circular load.

- **Week 13:** One-dimensional consolidation theory: Difference between compaction and consolidation, Terzaghi's spring-cylinder analogy.

- **Week 14:** Laboratory 1D consolidation test (Oedometer): $e - \log \sigma'$ curve, determining pre-consolidation pressure (σ'_p) via Casagrande construction.

- **Week 15:** Calculating primary consolidation settlement (S_c) for normally consolidated and overconsolidated clay layers; time rate of consolidation (T_v, U, C_v).

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Laboratory safety orientation, soil sampling methods, and moisture content determination (ASTM D2216).

- **Week 2:** Experiment 1: Determination of Specific Gravity (G_s) of soil solids using Pycnometer method (ASTM D854).

- **Week 3:** Experiment 2: Particle Size Distribution by Sieve Analysis for coarse-grained soils (ASTM D422).

- **Week 4:** Experiment 3: Particle Size Analysis of fine-grained soils using Hydrometer Method (ASTM D422).

- **Week 5:** Experiment 4: Determination of Liquid Limit (LL) using Casagrande cup and Plastic Limit (PL) testing (ASTM D4318).

- **Week 6:** Application Exercise: Classifying given soil samples using USCS and AASHTO procedures based on lab test data.

- **Week 7:** Practical Midterm Laboratory Evaluation.

- **Week 8:** Experiment 5: Standard Proctor Compaction Test to determine Moisture-Density relationship, MDD, and OMC (ASTM D698).

- **Week 9:** Experiment 6: Field density testing using Sand Cone Method (ASTM D1556) and compaction verification calculations.

- **Week 10:** Experiment 7: Constant Head Permeability Test for granular soil permeability determination (ASTM D2434).

- **Week 11:** Experiment 8: Falling Head Permeability Test for fine-grained cohesive soils.

- **Week 12:** Experiment 9: Drawing Flow Nets manually and solving quicksand/piping safety factors.

- **Week 13:** Experiment 10: One-Dimensional Consolidation Test (Oedometer test setup, loading increments, dial gauge reading) (ASTM D2435).

- **Week 14:** Data Processing: Analyzing oedometer laboratory data, plotting $e - \log \sigma'$ curves, and calculating $C_c, C_r,$ and C_v.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Braja M. Das & Khaled Sobhan – *Principles of Geotechnical Engineering* (9th Edition), Cengage Learning. Karl Terzaghi, Ralph B. Peck, Gholamreza Mesri – *Soil Mechanics in Engineering Practice* (3rd Edition), Wiley.	Yes
Recommended Texts	T. William Lambe & Robert V. Whitman – *Soil Mechanics*, Wiley.	Yes
Websites	ISSMGE (International Society for Soil Mechanics and Geotechnical Engineering) & US Army Corps of Engineers Geotechnical Manuals.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Traffic Engineering I
Module Type	Core Engineering (C)
Module Code	RE.314
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 5
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Dr.Ihsan Ali Obaid
Module Leader's e-mail	ihsan.obaid@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	Assistant Lecturer Manal Ghadban manal.ghadban@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.224 (Engineering Surveying II) | Semester: 4
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Fundamental Traffic Flow Parameters:** Master microscopic and macroscopic traffic stream variables: Volume (q), Speed (u), Density (k), Headway (h), and Spacing (s).

2. **Traffic Flow Relationships & Modeling:** Understand speed-density, speed-flow, and flow-density relationships, Greenshields model, and traffic stream capacity concepts.

3. **Traffic Data Collection & Field Surveys:** Train students to conduct traffic volume counts, spot speed studies, travel time and delay studies, and origin-destination (O-D) surveys.

4. **Highway Capacity Analysis (HCM):** Apply Highway Capacity Manual (HCM) procedures to evaluate Level of Service (LOS) for uninterrupted flow facilities (freeways, multilane highways, two-lane highways).

5. **Traffic Control Fundamentals & Signal Timing:** Introduce traffic control devices, warrants, and timing analysis for isolated signalized intersections using Webster's method.

Module Learning Outcomes

1. Compute traffic volume parameters including Annual Average Daily Traffic (AADT), Average Daily Traffic (ADT), Peak Hour Factor (PHF), and Design Hourly Volume (DHV).

2. Apply Greenshields, Greenberg, and Underwood macroscopic models to fit field traffic data and calculate maximum capacity (q_{max}).

3. Conduct statistical analyses of spot speed data (mean speed, 85th percentile speed, pace, standard deviation).

4. Evaluate Level of Service (LOS) and capacity for two-lane rural highways and multilane highways using HCM procedures.

5. Determine travel time delays, running speeds, and congestion indices from field floating-car delay surveys.

6. Design signal phase plans, green split ratios, and optimum cycle length (C_{opt}) for isolated signalized intersections using Webster's method.

Indicative Contents

- **Traffic Stream Parameters & Relationships:** Macroscopic vs. microscopic traffic flow parameters, Flow rate (q), Density (k), Time-mean speed (u_t), Space-mean speed (u_s), Time headway (h_t), Distance headway (h_d); Greenshields linear speed-density model $u = u_f(1 - k/k_j)$, capacity derivation ($q_{max} = u_f k_j/4$) (10 hours theory, 6 hours practical).

- **Traffic Data Collection & Statistical Speed Analysis:** Volume studies (manual counts, automatic counters, PHF calculation); Spot speed studies (radar gun, pneumatic tubes, 85th percentile speed, 15th percentile speed, speed variance); Travel time and delay studies (Floating car method, license plate method) (12 hours theory, 8 hours practical).

- **Highway Capacity & Level of Service (HCM):** HCM concepts of Base Capacity and Level of Service (LOS A through F), Service Flow Rates (SF), Free-Flow Speed (FFS) adjustment factors, analysis of Basic Freeway Segments, Multilane Highways, and Two-Lane Rural Highways (14 hours theory, 8 hours practical).

- **Intersection Traffic Control & Signalization Basics:** Types of intersections, priority control, roundabouts; Traffic signal warrants (MUTCD), signal phasing, intergreen period (yellow + all red), Webster's minimum delay cycle length formula $C_{opt} = (1.5L + 5)/(1 - Y)$, green interval allocation (14 hours theory, 8 hours practical).

4. Learning and Teaching Strategies

1. **Interactive Lectures & Technical Case Studies:** Detailed instruction on traffic flow theory equations, HCM analysis charts, and signal timing algorithms.

2. **Supervised Field Traffic Surveys:** Hands-on campus/city field data collection using radar guns, tally counters, and floating car delay runs.

3. **Capacity & Signal Design Project:** Group project analyzing an existing urban corridor segment, calculating LOS, and designing signal timing optimization.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Field Survey Reports & Design Project	6 reports	15% (15 marks)	Weekly	All LOs
Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1–#3
Final Practical Field Exam	2 hours	10% (10 marks)	Week 15	LO #2, #3, #5

Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100%** **(100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to Traffic Engineering: Components of road traffic (driver, vehicle, roadway, environment).
- **Week 2:** Traffic flow fundamental parameters: Flow rate (q), density (k), time-mean speed (u_t), and space-mean speed (u_s).
- **Week 3:** Derivation of relationships between q, u, k; Microscopic parameters: Time headway (h_t) and space headway (h_d).
- **Week 4:** Macroscopic traffic flow models: Greenshields linear model, Greenberg logarithmic model, and Underwood exponential model.
- **Week 5:** Traffic volume characteristics: AADT, ADT, DHV, directional distribution (D), and Peak Hour Factor (PHF).
- **Week 6:** Spot speed analysis: Frequency distribution, cumulative speed curves, 85th percentile speed for speed limit setting.
- **Week 7:** Midterm Examination.
- **Week 8:** Travel time and delay studies: Floating-car method equations (Wardrop's method), stopped-time delay vs. travel time delay.
- **Week 9:** Highway Capacity Manual (HCM) methodology: Concept of capacity, Level of Service (LOS A–F), measures of effectiveness (MOE).
- **Week 10:** Capacity and LOS analysis of Basic Freeway Segments: Free-flow speed determination, demand flow rate adjustments.
- **Week 11:** Capacity and LOS analysis of Multilane Highways and Two-Lane Rural Highways (percent time-spent-following, average travel speed).
- **Week 12:** Traffic control devices: Road markings, traffic signs, MUTCD guidelines, and intersection control principles.
- **Week 13:** Signalized intersections: Signal warrants, phase definitions, lost time (start-up lost time and clearance lost time), critical lane groups.

- **Week 14:** Saturation flow rate (s) determination, flow ratios ($y = v/s$), and phase allocation.

- **Week 15:** Webster's optimum signal cycle length formula C_{opt}, green splits calculation, and signal timing diagram construction.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Introduction to traffic survey equipment: Tally counters, radar speed guns, GPS trackers, and video recording tools.

- **Week 2:** Field Exercise 1: Manual traffic volume counts at a major urban intersection during peak hours.

- **Week 3:** Field Exercise 2: Data processing of volume counts: Constructing Traffic Volume Profiles, calculating 15-minute flow rates and PHF.

- **Week 4:** Field Exercise 3: Spot Speed Study using radar gun / stopwatch method on a roadway section.

- **Week 5:** Field Exercise 4: Statistical analysis of spot speed data: Plotting speed histograms, normal distribution check, determining 15th, 50th, and 85th percentiles.

- **Week 6:** Field Exercise 5: Travel Time and Delay Survey using the Floating-Car method along a selected urban arterial corridor.

- **Week 7:** Practical Midterm Field Evaluation.

- **Week 8:** Field Exercise 6: Calculating running speed, travel speed, and intersection delay from floating-car test run logs.

- **Week 9:** Field Exercise 7: Highway Capacity Analysis workshop: Determining LOS for a multilane highway segment using HCM spreadsheets.

- **Week 10:** Field Exercise 8: Two-lane highway LOS evaluation project using HCM alignment data.

- **Week 11:** Field Exercise 9: Intersection turning movement survey (TMC) and vehicle classification count.

- **Week 12:** Field Exercise 10: Measuring saturation flow rate at a signalized intersection approach using stopwatch queue discharge methods.

- **Week 13:** Field Exercise 11: Signal timing design exercise using Webster's method for a 4-leg isolated intersection.

- **Week 14:** Field Exercise 12: Application of traffic simulation software (e.g., Synchro / HCS) for signal optimization and capacity modeling.

- **Week 15:** Final Practical Field Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Roger P. Roess, Elena S. Prassas, William R. McShane – *Traffic Engineering* (5th Edition), Pearson. Transportation Research Board (TRB) – *Highway Capacity Manual (HCM 7th Edition)*, TRB.	Yes
Recommended Texts	C. Jotin Khisty & B. Kent Lall – *Transportation Engineering: An Introduction* (3rd Edition), Pearson.	Yes
Websites	Federal Highway Administration (FHWA) Traffic Operations & TRB Highway Capacity Committee.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Pavement Design I
Module Type	Core Engineering (C)
Module Code	RE.315
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 5
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Dr. Basim Hassan Al-Humeidawi
Module Leader's e-mail	basim.alhumeidawi@qu.edu.iq
Module Leader's Acad. Title	Professor
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.221 (Asphalt Technology II) | Semester: 4
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Pavement Types & Subgrade Characterization:** Master structural components of flexible vs. rigid pavements and evaluate subgrade strength using California Bearing Ratio (CBR), Resilient Modulus (M_r), and Modulus of Subgrade Reaction (k).

2. **Traffic Loading Computations:** Convert mixed traffic volume flows into Equivalent Single Axle Loads (ESALs, 80 kN/$18{,}000$ lbs) using AASHTO Load Equivalency Factors (LEF).

3. **AASHTO Flexible Pavement Structural Design:** Master the 1993 AASHTO empirical design equation, Structural Number (SN), layer coefficients (a_1, a_2, a_3), drainage coefficients (m_2, m_3), and layer thickness determination.

4. **Stresses in Flexible Pavements:** Analyze elastic stress, strain, and deflection fields in homogeneous single-layer and Boussinesq/Burmister multi-layer flexible pavement structures.

5. **Pavement Drainage Design:** Evaluate subsurface moisture effects, design permeable base layers, and calculate drainage coefficients based on time-to-drain criteria.

Module Learning Outcomes

1. Differentiate structural load distribution mechanisms between flexible, rigid, and composite pavements.

2. Calculate design cumulative Equivalent Single Axle Loads ($ESAL_{18}$) over design life based on traffic growth rate, directional distribution, and axle load spectra.

3. Determine subgrade Resilient Modulus (M_r) from soil CBR test correlation formulas ($M_r = 1500 \times CBR$ psi).

4. Determine required total Structural Number (SN) using AASHTO 1993 design charts and equations considering Reliability (R), Standard Deviation (S_o), and Serviceability Loss (ΔPSI).

5. Compute layer thicknesses (D_1, D_2, D_3) for surface, base, and subbase layers satisfying layer thickness minimums and structural integrity.

6. Calculate vertical compressive strains on subgrade and horizontal tensile strains at the bottom of asphalt layer using Burmister 2-layer elastostatic theory.

Indicative Contents

- **Pavement Structural Framework & Subgrade:** Function of pavement layers (wearing course, binder course, base course, subbase, subgrade); Subgrade evaluation: CBR test, Plate Bearing Test, Resilient Modulus (M_r), correlation formulas (10 hours theory, 5 hours tutorial).

- **Traffic Loading & Axle Load Equivalency:** Single, tandem, tridem axles, contact pressure, equivalent axle load factor (EALF), calculation of $18{,}000$ lb $(80$ kN$)$ ESALs over design period (n years) using traffic growth rate (r) (12 hours theory, 6 hours tutorial).

- **Stresses in Flexible Pavements:** Homogeneous mass elastic theory (Boussinesq), Burmister two-layer and three-layer elastic stress distribution theory, critical design strains (fatigue cracking strain ϵ_t, rutting strain ϵ_v) (12 hours theory, 6 hours tutorial).

- **AASHTO 1993 Flexible Pavement Design Method:** Concepts of initial serviceability (p_o), terminal serviceability (p_t), ΔPSI; Reliability (R), overall standard deviation (S_o); Structural Number (SN) equation: $SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$; layer thickness selection rules (18 hours theory, 9 hours tutorial).

- **Subsurface Drainage Design:** Effects of water on pavement layers, drainage quality levels, time-to-drain calculation, determination of drainage coefficients (m_2, m_3) for granular layers (8 hours theory, 4 hours tutorial).

4. Learning and Teaching Strategies

1. **Interactive Technical Lectures:** Analytical derivation of structural equations, AASHTO nomographs, and elastostatic stress formulations.

2. **Weekly Problem-Solving Tutorials:** Step-by-step design calculations, cumulative ESAL estimations, and AASHTO nomograph alignment exercises.

3. **Pavement Structural Design Project:** Student group assignment designing flexible pavement layer thicknesses for an actual Iraqi highway corridor.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Design Project	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3

Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to Pavement Engineering: Flexible pavements vs. Rigid pavements, cross-sectional load distribution principles.
- **Week 2:** Subgrade soil characterization: CBR test procedure, Modulus of Subgrade Reaction (k), and Resilient Modulus (M_r).
- **Week 3:** Environmental and climatic factors: Temperature effects, freeze-thaw cycles, moisture variation in road subgrades.
- **Week 4:** Traffic loading characterization: Wheel loads, tire inflation pressure, contact area geometry, axle configurations.
- **Week 5:** Axle Load Equivalency Factors (LEF): Fourth-power law concept, calculating relative damage caused by heavy trucks.
- **Week 6:** Computation of design $ESAL_{18}$ over highway design life ($10-30$ years): Growth factor equation $GF = [(1+r)^n - 1]/r$, directional and lane distribution factors.
- **Week 7:** Midterm Examination.
- **Week 8:** Elastic stress distribution in flexible pavements: One-layer elastic system (Boussinesq theory for surface deflections and stresses).
- **Week 9:** Burmister two-layer elastic theory: Interfacial stresses and vertical subgrade deflection analysis using Burmister design charts.
- **Week 10:** Multi-layer elastic analysis concepts: Critical tensile strain at asphalt bottom (ϵ_t) and vertical subgrade compressive strain (ϵ_v).
- **Week 11:** Principles of AASHTO Empirical Design: AASHO Road Test history, Present Serviceability Index (PSI), initial (p_o) and terminal (p_t) serviceability.
- **Week 12:** AASHTO 1993 flexible design parameters: Reliability (R), standard normal deviate (Z_R), combined standard error (S_o).
- **Week 13:** Determination of Structural Number (SN) using the AASHTO 1993 design equation and graphical nomograph solution.

- **Week 14:** Selection of layer structural coefficients (a_1, a_2, a_3) for HMA, crushed aggregate base, and subbase materials; drainage coefficients (m_2, m_3).

- **Week 15:** Structural Layer Thickness Determination (D_1, D_2, D_3) matching minimum layer constraints and cost optimization.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical design module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Yang H. Huang – *Pavement Analysis and Design* (2nd Edition), Pearson. AASHTO – *AASHTO Guide for Design of Pavement Structures*, AASHTO.	Yes
Recommended Texts	E.J. Yoder & M.W. Witczak – *Principles of Pavement Design* (2nd Edition), Wiley.	Yes
Websites	Federal Highway Administration (FHWA) Pavement Technology & Asphalt Institute Design Guidelines.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Computer Programming
Module Type	Basic Engineering / Support (B)
Module Code	RE.316
ECTS Credits	3
SWL (hr/sem)	75
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 5
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant Lecturer Shaimaa Haidar Shahid
Module Leader's e-mail	shaimaa.eng.road@qu.edu.iq
Module Leader's Acad. Title	Assistant Lecturer
Module Leader's Qualification	MSC
Module Tutor	Assistant LecturerMohammed Jassim Shukhan mohammed.jassim@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** QU24 (Computer II) | Semester: 4
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **High-Level Programming Fundamentals:** Master high-level structured programming (Python/MATLAB) concepts including variable types, logical expressions, control structures, and modular functions.

2. **Algorithm Development for Civil Engineering:** Train students to design flowcharts and computational algorithms to solve highway, transportation, and structural engineering problems.

3. **Data Analysis & Numerical Processing:** Apply scientific libraries (NumPy, Pandas, SciPy / MATLAB toolboxes) to process highway survey datasets and perform statistical analysis.

4. **Data Visualization & Scientific Plotting:** Generate professional 2D and 3D plots, traffic distribution graphs, and structural strain curves using Matplotlib/Seaborn/MATLAB.

5. **Applied Engineering Problem Solving:** Develop complete executable scripts for pavement structural design calculations, traffic signal timing optimization, and soil consolidation modeling.

Module Learning Outcomes

1. Write clean, modular, and documented code using standard syntax, control flow statements (if-else), and iterative loops (for, while).

2. Construct custom functions and modular code libraries to automate repetitive civil engineering calculations.

3. Import, manipulate, filter, and analyze external CSV/Excel engineering datasets using tabular data structures.

4. Develop numerical algorithmic scripts to solve systems of linear equations, root-finding, and numerical integration in geotechnical and transportation contexts.

5. Generate customized, publication-quality 2D and 3D scientific plots of engineering design data.

6. Execute a complete computational project solving a real-world highway engineering problem.

Indicative Contents

- **Programming Essentials & Control Flow:** Environment setup, data types (integers, floats, strings, lists, arrays, dictionaries), arithmetic and logical operators, conditional branching (if-elif-else), loops (for, while), loop control (break, continue) (10 hours theory, 10 hours lab).

- **Functions, Modules & File I/O:** Defining user-defined functions, arguments, return values, variable scope, reading and writing text/CSV/Excel data files, error handling (try-except) (8 hours theory, 8 hours lab).

- **Numerical Computing & Scientific Libraries:** Numerical arrays (NumPy), matrix transformations, linear algebra routines, polynomial root finding, curve fitting (8 hours theory, 8 hours lab).

- **Data Analysis & Visualization:** Data manipulation (Pandas DataFrames), summary statistics, data grouping, 2D line plotting, scatter plots, bar charts, histograms, custom styling, exporting figures (10 hours theory, 10 hours lab).

- **Engineering Applications Development:** Programming scripts for: AASHTO $ESAL_{18}$ calculations, Webster traffic signal timing optimization, soil phase relationship solvers, and structural frame displacement solutions (9 hours theory, 9 hours lab).

4. Learning and Teaching Strategies

1. **Interactive Coding Lectures:** Live coding demonstrations in the computer laboratory explaining algorithmic logic, debugging, and syntax execution.

2. **Practical Lab Assignments:** Hands-on computational exercises solving specific highway and civil engineering mathematical tasks.

3. **Cap-Stone Programming Mini-Project:** Team project requiring students to develop an automated software tool for pavement layer design or traffic capacity evaluation.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	45	3
Unstructured SWL (h/sem)	30	2
Total SWL (h/sem)	75	5

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	3	10% (10 marks)	Weeks 4, 8, 12	LO #1–#4
Practical Coding Exercises	8 exercises	15% (15 marks)	Weekly	All LOs
Midterm Practical Exam	1.5 hours	15% (15 marks)	Week 7	LO #1–#3

Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	All LOs
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to high-level programming languages (Python / MATLAB) in civil engineering; IDE setup and basic syntax.
- **Week 2:** Variable declaration, numeric data types, strings, lists, tuples, and memory allocation basics.
- **Week 3:** Arithmetic, relational, and logical operators; constructing decision-making statements (if, if-else, if-elif-else).
- **Week 4:** Iterative loops: for loops for sequence iteration, while loops for condition-based repetition, nested loops.
- **Week 5:** Designing algorithms: Flowcharts, pseudocode, breaking down complex engineering tasks into step-by-step logic.
- **Week 6:** Functions: Writing custom functions, parameter passing, return statements, default arguments, and modular code organization.
- **Week 7:** Midterm Examination.
- **Week 8:** File input/output: Reading from and writing to text files, CSV datasets, and Excel spreadsheets automatically.
- **Week 9:** Scientific array computing (NumPy): Multi-dimensional arrays, vectorization vs. loops, fast array math operations.
- **Week 10:** Linear algebra with code: Solving dynamic structural matrix equations ($Ax = b$), computing matrix inverses and eigenvalues.
- **Week 11:** Tabular data processing (Pandas DataFrames): Loading traffic survey datasets, filtering, sorting, and statistical summary routines.
- **Week 12:** Scientific data visualization: Creating line plots, scatter plots, multi-panel figures, custom axis formatting, legend styling.

- **Week 13:** Algorithmic numerical methods: Implementing Newton-Raphson root finders for AASHTO Structural Number (SN) equation.

- **Week 14:** Engineering Application I: Programming an automated script for Webster traffic signal cycle length optimization.

- **Week 15:** Engineering Application II: Developing a soil mechanics compaction curve fitting tool and peak search algorithm.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Practical Lab 1: Setting up Python/Jupyter Notebook or MATLAB environment; executing basic variable assignments and arithmetic.

- **Week 2:** Practical Lab 2: Coding logical selection blocks to classify soil samples based on USCS Atterberg limit inputs.

- **Week 3:** Practical Lab 3: Writing iterative loops to process spot speed survey datasets and compute time-mean and space-mean speeds.

- **Week 4:** Practical Lab 4: Creating custom modular functions to calculate soil phase properties (e, n, w, S_r, γ_d).

- **Week 5:** Practical Lab 5: Reading raw Total Station survey CSV files, filtering coordinates, and exporting geometric outputs.

- **Week 6:** Practical Lab 6: Matrix operations in NumPy/MATLAB to solve truss member forces using direct stiffness matrices.

- **Week 7:** Practical Midterm Laboratory Examination.

- **Week 8:** Practical Lab 7: Importing hourly traffic volume CSV files into Pandas DataFrames and calculating 15-minute peak flow rates and PHF.

- **Week 9:** Practical Lab 8: Plotting Greenshields speed-density linear relationships and computing maximum capacity (q_{max}) from experimental data.

- **Week 10:** Practical Lab 9: Coding the AASHTO 1993 flexible pavement Structural Number (SN) iterative equation solver.

- **Week 11:** Practical Lab 10: Developing an automated program to calculate 1D primary consolidation settlement profiles.

- **Week 12:** Practical Lab 11: Generating publication-quality figures for Marshall stability and flow curves with specification overlay lines.
- **Week 13:** Integrated Project Workshop: Developing a complete user interface / command script for a highway engineering problem.
- **Week 14:** Code review, performance optimization, refactoring, and project presentation.
- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	John V. Guttag – *Introduction to Computation and Programming Using Python* (3rd Edition), MIT Press. Stormy Attaway – *MATLAB: A Practical Introduction to Programming and Problem Solving* (5th Edition), Butterworth-Heinemann.	Yes
Recommended Texts	Wes McKinney – *Python for Data Analysis* (3rd Edition), O'Reilly Media.	Yes
Websites	Python Software Foundation Documentation & MathWorks MATLAB Engineering Documentation.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Airport Engineering
Module Type	Specialist / Core (S)
Module Code	RE.317
ECTS Credits	3
SWL (hr/sem)	75
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 5
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Sahar Basim Jawad
Module Leader's e-mail	sahar.jawad@qu.edu.iq
Module Leader's Acad. Title	Lecturer
Module Leader's Qualification	MSC
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.224 (Engineering Surveying II) | Semester: 4
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Aircraft Characteristics & Airport Planning:** Understand aircraft weight components, landing gear configurations, performance characteristics, and FAA/ICAO airport site selection criteria.

2. **Runway Orientation & Wind Rose Analysis:** Determine optimal runway orientation and wind coverage percentages using the Wind Rose diagram according to FAA and ICAO standards.

3. **Runway Length Determination & Corrections:** Calculate basic runway length and apply standard corrections for airport elevation, reference temperature, and longitudinal runway slope.

4. **Geometric Design of Airside Components:** Design geometric elements of runways, taxiways, exit taxiways, holding aprons, turning radii, and obstacle limitation surfaces (OLS).

5. **Airport Pavements & Structural Evaluation:** Understand flexible and rigid airport pavement design methods and evaluate pavement structural capacity using the ACN-PCN / PCR-ACR system.

Module Learning Outcomes

1. Analyze aircraft dimensions, maximum takeoff weight (MTOW), gear load distribution, and turning radii.

2. Plot local wind data on a Wind Rose diagram to select runway orientation achieving minimum 95% crosswind coverage.

3. Calculate required field runway length by applying ICAO/FAA corrections for elevation, temperature, and effective gradient.

4. Design airside geometric features including taxiway width, separation distances, fillet radii, and high-speed exit taxiways.

5. Identify ICAO Obstacle Limitation Surfaces (Approach surface, Transitional surface, Inner horizontal surface, Conical surface).

6. Evaluate airport pavement structural adequacy using the ICAO Aircraft Classification Number - Pavement Classification Number (ACN-PCN) method.

Indicative Contents

- **Aircraft Characteristics & Airport Master Planning:** History of aviation, ICAO and FAA airport classification codes, aircraft weight components (OEW, MTOW, MLW), landing gear types, aircraft performance parameters, and airport master plan layout (8 hours theory, 4 hours tutorial).

- **Runway Orientation & Wind Rose Diagram:** Wind velocity and direction analysis, maximum allowable crosswind components ($10.5, 13, 20$ knots), constructing 16-compass

direction Wind Rose diagrams, selecting optimum runway centerline azimuth (10 hours theory, 5 hours tutorial).

- **Runway Length Corrections:** Basic runway length determination, standard atmosphere corrections: Elevation correction (7% per 300 m above sea level), Temperature correction (1% per $1°$C rise above standard temperature), Slope correction (20% per 1% effective slope) per ICAO/FAA rules (10 hours theory, 5 hours tutorial).

- **Geometric Design of Airside Elements:** Runway width, shoulders, blast pads, runway clearways and stopways; Taxiway geometric design, separation clearances, high-speed exit taxiways geometry (turnoff speed, radius, location), apron layout and aircraft parking gate configurations (10 hours theory, 5 hours tutorial).

- **Airport Pavements & Structural Evaluation:** Differences between highway and airport pavements, FAA rigid and flexible pavement design charts, introduction to ICAO ACN-PCN and new PCR-ACR pavement rating systems, pavement overload operations (7 hours theory, 4 hours tutorial).

4. Learning and Teaching Strategies

1. **Technical Lectures & Graphical Demonstrations:** Illustrating airport master plans, ICAO obstacle surface geometry, and Wind Rose plotting steps.

2. **Weekly Design Tutorials:** Step-by-step mathematical calculations for runway length corrections, taxiway geometry, and crosswind coverage calculation.

3. **Airport Geometric Design Assignment:** Group project designing airside geometric elements and runway orientation for a regional airport site.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	45	3
Unstructured SWL (h/sem)	30	2
Total SWL (h/sem)	75	5

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**

Quizzes	3	15% (15 marks)	Weeks 4, 8, 12	LO #1–#5
Homework / Design Project	3	10% (10 marks)	Weeks 3, 9, 13	All LOs
Midterm Written Exam	1.5 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to Airport Engineering: Air transportation system, ICAO and FAA regulatory frameworks, airport classification.
- **Week 2:** Aircraft physical and operational characteristics: Dimensions, wingspan, wheel base, aircraft weight definitions (MTOW, MLW).
- **Week 3:** Aircraft landing gear configurations (single, dual, dual-tandem) and equivalent single wheel load (ESWL) concept.
- **Week 4:** Airport site selection criteria: Environmental impacts, topography, airspace availability, wind conditions, ground accessibility.
- **Week 5:** Wind analysis: Wind velocity vector components (headwind, tailwind, crosswind), ICAO allowable crosswind limits.
- **Week 6:** Wind Rose Diagram construction: Template layout, plotting wind frequency data, selecting optimum runway orientation for 95% coverage.
- **Week 7:** Midterm Examination.
- **Week 8:** Runway length requirements: Takeoff run available (TORA), Takeoff distance available (TODA), Accelerate-stop distance available (ASDA), Landing distance available (LDA).
- **Week 9:** Standard atmospheric conditions ($15^{\circ}\text{C}, 1013.25$ hPa); ICAO correction factors for airport elevation ($7\%/300$ m) and temperature.
- **Week 10:** Combined ICAO/FAA temperature-elevation checks and effective longitudinal slope corrections ($20\%/1\%$ slope).

- **Week 11:** Geometric design of runways: Width, longitudinal/transverse slopes, sight distance, blast pads, and clearways/stopways.

- **Week 12:** Geometric design of taxiways: Width, edge safety margins, turning radii, fillet design, and parallel taxiway separation distances.

- **Week 13:** High-speed exit taxiways: Design speed, turnoff angle ($30°$), radius of curvature, and location along the runway.

- **Week 14:** ICAO Obstacle Limitation Surfaces (OLS): Approach, departure, transitional, inner horizontal, and conical surfaces.

- **Week 15:** Airport pavement structural evaluation: FAA design method overview, ICAO ACN-PCN rating system, and reporting pavement capacity.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical specialist module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Robert Horonjeff, Francis X. McKelvey, Seth Young, Alexander Wells – *Planning and Design of Airports* (5th Edition), McGraw-Hill. ICAO – *Annex 14: Aerodromes - Volume I: Aerodrome Design and Operations*, ICAO.	Yes
Recommended Texts	Norman J. Ashford, Saleh Mumayiz, Paul H. Wright – *Airport Engineering: Planning, Design, and Development of 21st Century Airports* (4th Edition), Wiley.	Yes
Websites	Federal Aviation Administration (FAA) Airport Design Standards & ICAO Aviation Standards Portals.	-

10. Grading Scheme

Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Statistics and Probability
Module Type	Basic Engineering / Support (B)
Module Code	RE.318
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 5
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Elaf Dheyaa Abdulridha
Module Leader's e-mail	elaf.alzubaidi@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	MSC
Module Tutor	Assistant Lecturer Dhurgham Falih dhurgam.flaih.hatam@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq

Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** ENG.221 (Mathematics IV) | Semester: 4
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Descriptive Statistics & Data Presentation:** Master data collection, frequency distributions, measures of central tendency (mean, median, mode), and measures of dispersion (variance, standard deviation, coefficient of variation).

2. **Probability Theory & Conditional Rules:** Formulate probability axioms, joint and conditional probabilities, Bayes' Theorem, and counting principles (permutations and combinations).

3. **Random Variables & Probability Distributions:** Define discrete and continuous random variables, probability density functions (PDF), cumulative distribution functions (CDF), expected value, and variance.

4. **Statistical Inference & Hypothesis Testing:** Apply sampling distributions, Central Limit Theorem, confidence intervals, Z-test, t-test, Chi-Square (χ^2) goodness-of-fit test, and Analysis of Variance (ANOVA).

5. **Regression & Correlation Analysis:** Master simple and multiple linear regression models, method of least squares, coefficient of determination (R^2), and correlation metrics in highway transportation data.

Module Learning Outcomes

1. Compute descriptive statistics (mean, variance, standard deviation, percentiles) and construct frequency histograms for highway traffic and material test datasets.

2. Calculate event probabilities, conditional probabilities, and apply Bayes' Theorem to engineering risk assessment.

3. Apply discrete probability distributions (Binomial, Poisson) and continuous probability distributions (Normal, Lognormal, Exponential, Weibull) to modeling traffic arrivals and material strengths.

4. Construct confidence intervals for population means and proportions from engineering sample data.

5. Perform hypothesis tests (t -test, Chi-Square test, ANOVA) to evaluate statistical significance in civil engineering experiments.

6. Formulate simple and multiple linear regression equations, evaluate residual errors, and interpret correlation coefficients (r) and R^2.

Indicative Contents

- **Descriptive Statistics & Exploratory Data Analysis:** Data types (qualitative, quantitative, discrete, continuous), stem-and-leaf plots, frequency distributions, histograms, box plots, mean, sample variance, standard deviation, coefficient of variation (CV) (10 hours theory, 5 hours tutorial).

- **Probability Theory Fundamentals:** Sample space, events, set operations, axioms of probability, addition rule, conditional probability, multiplication rule, independent events, total probability law, Bayes' Theorem (10 hours theory, 5 hours tutorial).

- **Random Variables & Probability Distributions:** Discrete vs. continuous random variables, probability mass function (PMF), probability density function (PDF), cumulative distribution function (CDF), expected value $E(X)$, variance $Var(X)$; Binomial distribution, Poisson distribution (traffic flow arrivals), Uniform distribution, Normal (Gaussian) distribution, Standard Normal distribution (Z-score), Lognormal distribution, Exponential distribution, Weibull distribution (16 hours theory, 8 hours tutorial).

- **Sampling Distributions & Hypothesis Testing:** Sampling distributions, Central Limit Theorem, point estimation, confidence intervals for mean and proportion; Null (H_0) and Alternative (H_1) hypotheses, Type I (α) and Type II (β) errors, Z-test, Student's t-test (one-sample and two-sample), Chi-Square (χ^2) test for goodness-of-fit, One-Way ANOVA (14 hours theory, 7 hours tutorial).

- **Regression Modeling & Correlation:** Method of least squares, simple linear regression model $y = \beta_0 + \beta_1 x + \epsilon$, standard error of estimate, Pearson correlation coefficient (r), coefficient of determination (R^2), introduction to multiple linear regression analysis (10 hours theory, 5 hours tutorial).

4. Learning and Teaching Strategies

1. **Mathematical & Statistical Lectures:** Deriving probability theorems, distribution functions, hypothesis testing metrics, and regression equations.

2. **Weekly Analytical Tutorials:** Solving real-world engineering statistical problems using statistical tables (Z, t, χ^2, F distributions).

3. **Data Analysis Assignments:** Practical computational homework analyzing real highway speed, pavement quality control, and accident datasets.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Assignments	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to Statistics and Probability in Civil and Highway Engineering; populations, samples, and data collection.

- **Week 2:** Summarizing data: Frequency tables, histograms, cumulative frequency polygons, mean, median, mode, sample variance, standard deviation.

- **Week 3:** Probability concepts: Sets, sample space, events, tree diagrams, counting rules (permutations and combinations).

- **Week 4:** Axioms of probability, addition rule, mutually exclusive events, conditional probability, independent events.

- **Week 5:** Total probability theorem and Bayes' Theorem: Application to structural reliability and risk assessment.

- **Week 6:** Discrete random variables: PMF, CDF, expected value $E(X)$, variance $Var(X)$; Binomial distribution applications.

- **Week 7:** Midterm Examination.

- **Week 8:** Poisson distribution: Modeling random events in time and space (vehicle arrivals, traffic accidents).

- **Week 9:** Continuous random variables: PDF, CDF, expected value and variance properties; Uniform and Exponential distributions.

- **Week 10:** Normal (Gaussian) distribution: Standard Normal distribution (Z), calculating cumulative probabilities, 85th percentile speed determination.

- **Week 11:** Lognormal and Weibull distributions: Applications in material fatigue life and soil property variability modeling.

- **Week 12:** Sampling distributions, sample mean distribution, Central Limit Theorem (CLT); Point and interval estimation.

- **Week 13:** Confidence intervals for single mean (σ known vs. unknown t-distribution) and population proportions.

- **Week 14:** Hypothesis testing: Step-by-step procedure, significance level (α), P-value, one-tailed and two-tailed Z-tests and t-tests.

- **Week 15:** Goodness-of-fit tests (χ^2 test), simple linear regression, method of least squares, correlation coefficient (r), coefficient of determination (R^2).

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Douglas C. Montgomery & George C. Runger – *Applied Statistics and Probability for Engineers* (7th Edition), Wiley. Ronald E. Walpole, Raymond H. Myers et al. – *Probability & Statistics for Engineers & Scientists* (9th Edition), Pearson.	Yes
Recommended Texts	Alfredo H.S. Ang & Wilson H. Tang – *Probability Concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering* (2nd Edition), Wiley.	Yes
Websites	NIST/SEMATECH e-Handbook of Statistical Methods & MIT OpenCourseWare (Applied Statistics).	-

10. Grading Scheme

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

Third Stage

Semester 6

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Design of Concrete Structures
Module Type	Core Engineering (C)
Module Code	RE.321
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 6
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Dr. Abeer Saeed Zebalah
Module Leader's e-mail	abeer.alkraway@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.312 (Theory of Structures) / RE.222 (Concrete Technology II) | Semester: 5 / 4

- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **ACI Code Design Principles:** Master the fundamentals of Reinforced Concrete (RC) design using Ultimate Strength Design (USD) per ACI 318 specifications.

2. **Flexural Analysis & Design of Beams:** Calculate flexural capacity and design singly/doubly reinforced rectangular and T-beam cross-sections.

3. **Shear & Diagonal Tension Design:** Evaluate diagonal tension shear stress distribution, determine concrete shear resistance (V_c), and design vertical stirrups (V_s).

4. **Development Length & Serviceability:** Analyze bond stresses, anchorage requirements, development lengths (l_d), deflection control, and crack width limits.

5. **One-Way Slab Design:** Design one-way solid slabs and ribbed slab systems for flexure, shear, temperature, and shrinkage reinforcement.

Module Learning Outcomes

1. Apply safety factors, load combinations ($1.2D + 1.6L$), and strength reduction factors (ϕ) per ACI 318 code.

2. Analyze stress-strain state of RC beams under elastic, cracking, and ultimate flexural conditions.

3. Design singly and doubly reinforced rectangular concrete sections satisfying under-reinforced tension-controlled failure criteria ($\epsilon_t \geq 0.005$).

4. Determine effective flange width (b_e) and design reinforced concrete T-beams for positive and negative flexural moments.

5. Calculate shear reinforcement requirements and detail web stirrup spacing (s) along beam spans.

6. Design one-way continuous slabs and detail reinforcement cut-offs, hook anchorages, and lap splices.

Indicative Contents

- **Introduction & ACI Design Principles:** Mechanical properties of concrete and steel reinforcement, ultimate strength design (USD) philosophy, load combinations, strength reduction factors (ϕ), Whitney rectangular stress block (10 hours theory, 5 hours tutorial).

- **Flexural Design of Rectangular Beams:** Balanced, under-reinforced, and over-reinforced modes of failure; analysis and design of singly reinforced rectangular beams; design of doubly reinforced beams (A'_s) (16 hours theory, 8 hours tutorial).

- **Flexural Design of T-Beams & Flanged Sections:** Behavior of flanged sections, effective flange width (b_e), neutral axis inside flange ($a \leq h_f$) vs. neutral axis in web ($a > h_f$), flexural design equations (10 hours theory, 5 hours tutorial).

- **Shear Design & Web Reinforcement:** Diagonal tension failure mechanisms, nominal shear strength ($V_n = V_c + V_s$), web stirrup design, maximum stirrup spacing limits, shear critical section (d from support) (12 hours theory, 6 hours tutorial).

- **Development Length & One-Way Slabs:** Bond mechanics, tension development length (l_d), compression development length, standard hooks ($90°, 180°$); Design of one-way continuous solid and joist slabs, temperature/shrinkage reinforcement ($A_{s,min}$) (12 hours theory, 6 hours tutorial).

4. Learning and Teaching Strategies

1. **Theoretical & Code-Based Lectures:** Explaining ACI 318 design principles, structural safety factors, and stress block derivations.

2. **Weekly Design Tutorials:** Step-by-step structural calculation workshops focusing on beam sizing, slab thickness, and reinforcement detailing.

3. **Structural Detailing Homework:** Assignments requiring manual drawing and reinforcement detailing of RC structural members.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	**Hours per Semester**	**Hours per Week**
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	**Time / Number**	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Design Assignments	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		**100% (100 Marks)**		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to reinforced concrete design, ACI 318 code evolution, load combinations, and ultimate limit state philosophy.
- **Week 2:** Mechanics of flexure: Uncracked elastic stage, cracked elastic stage, and ultimate flexural strength stage.
- **Week 3:** Equivalent rectangular stress block (Whitney block), stress block parameters (α_1, β_1), and reinforcement ratio (ρ).
- **Week 4:** Analysis and design of singly reinforced rectangular beams for tension-controlled section behavior ($\phi = 0.90$).
- **Week 5:** Practical flexural design of singly reinforced rectangular beams: Selecting dimensions (b, d, h) and bar arrangements.
- **Week 6:** Analysis and design of doubly reinforced rectangular beams (A'_s): Yielding condition of compression reinforcement.
- **Week 7:** Midterm Examination.
- **Week 8:** Behavior and effective flange width (b_e) of T-beams and L-beams according to ACI specifications.
- **Week 9:** Design procedure for T-beams when neutral axis falls in the web ($a > h_f$).
- **Week 10:** Shear and diagonal tension in reinforced concrete beams: Inclined cracking, shear transfer mechanisms.
- **Week 11:** Design of shear web reinforcement: Concrete shear strength ($V_c = 0.17\lambda\sqrt{f'_c}b_w d$), designing vertical U-stirrups (V_s).
- **Week 12:** ACI limits for maximum and minimum shear reinforcement, stirrup spacing (s) detailing along beam spans.
- **Week 13:** Bond stress, development length of deformed bars in tension (l_d), modification factors, and compression development length.
- **Week 14:** Standard hooks ($90°$ and $180°$) design, mechanical anchorages, bar cut-offs, and lap splice length requirements.
- **Week 15:** Design of one-way solid slabs: Minimum thickness criteria (h_{min}), flexural design, shear check, and temperature/shrinkage steel.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical design module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	**Details**	**Available in Library?**
Required Texts	Jack C. McCormac & Russell H. Brown – *Design of Reinforced Concrete* (10th Edition), Wiley. American Concrete Institute – *Building Code Requirements for Structural Concrete (ACI 318-19)*, ACI.	Yes
Recommended Texts	James K. Wight – *Reinforced Concrete: Mechanics and Design* (7th Edition), Pearson.	Yes
Websites	American Concrete Institute (ACI) Structural Design Resources & PCA Engineering Guides.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	**Details**
Module Title	Traffic Engineering II
Module Type	Core Engineering (C)
Module Code	RE.322
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 6
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof. Asst. Dr.Ihsan Ali Obaid
Module Leader's e-mail	ihsan.obaid@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	Ph.D.
Module Tutor	Assistant Lecturer Shaimaa Haidar Shahid shaimaa.eng.road@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.314 (Traffic Engineering I) | Semester: 5
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Signalized Intersection Capacity (HCM):** Master Highway Capacity Manual (HCM) methodology for signalized intersection capacity, control delay, and Level of Service (LOS).

2. **Coordinated Signal Systems & Arterials:** Analyze arterial progress, signal coordination, bandwidth time-space diagrams, and actuated signal control logic.

3. **Unsignalized Intersections & Roundabouts:** Evaluate capacity and Level of Service for Two-Way Stop-Controlled (TWSC), All-Way Stop-Controlled (AWSC), and modern roundabouts.

4. **Parking Facility Design & Operations:** Study parking characteristics, demand forecasting, parking survey analysis, and geometric layout of off-street/on-street parking facilities.

5. **Traffic Safety & Crash Analysis:** Apply statistical techniques to analyze traffic crash data, identify hazardous collision locations (blackspots), and design countermeasures.

Module Learning Outcomes

1. Compute adjusted saturation flow rates (S), lane group capacity (C), volume-to-capacity ratio (v/c), and control delay per vehicle at signalized intersections per HCM.

2. Construct time-space progression diagrams and compute bandwidth efficiency for coordinated arterial signal systems.

3. Calculate critical headways, follow-up times, and entry capacity for unsignalized intersections and modern roundabouts.

4. Design parking lot layouts (stall dimensions, aisle widths, circulation paths) based on parking accumulation and turnover data.

5. Evaluate traffic crash rates (per million entering vehicles / per hundred million vehicle-miles) and perform collision diagram analyses.

6. Propose engineering countermeasures and safety treatments for high-accident highway corridors.

Indicative Contents

- **Signalized Intersection Capacity (HCM Method):** Lane group identification, adjusted saturation flow rate equation $S = S_o f_w f_{HV} f_g f_p f_a f_{LU} f_{LT} f_{RT} f_{LPB} f_{RPB}$, capacity $c_i = S_i(g_i/C)$, control delay formulation ($d_1 + d_2 + d_3$), determining LOS A–F (14 hours theory, 8 hours practical).

- **Signal Coordination & Actuated Control:** Progression quality (PF), time-space diagrams, offset design, green wave bandwidth optimization, semi-actuated and fully-actuated signal controllers, detector placement (10 hours theory, 6 hours practical).

- **Unsignalized Intersections & Roundabouts:** TWSC capacity methodology, potential capacity (c_p), movement capacity (c_m), queue service rate; Roundabout capacity equations, entry capacity (c_e), circulating flow rate (v_c), geometry design (12 hours theory, 6 hours practical).

- **Parking Facilities Design:** Parking metrics (accumulation, duration, turnover, efficiency), parking inventory and duration surveys, geometric design parameters ($90°, 60°, 45°, 30°$ stalls, aisle widths), parking garage circulation (10 hours theory, 6 hours practical).

- **Traffic Safety & Crash Analysis:** Crash statistics, crash rate metrics (Million Entering Vehicles MEV, Rate Per Hundred Million Vehicle Miles HMVM), collision diagrams, identification of high-collision locations (blackspots), safety audit protocols, countermeasure selection (14 hours theory, 8 hours practical).

4. Learning and Teaching Strategies

1. **Lectures & Case Study Analysis:** Detailed instruction on HCM capacity formulas, signal coordination mathematics, and crash rate statistics.

2. **Supervised Field & Computer Practicals:** Practical work utilizing traffic capacity software (HCS, Synchro) and conducting field parking/safety surveys.

3. **Comprehensive Traffic Design Project:** Team project conducting a full capacity and safety analysis for a local urban arterial corridor.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	Hours per Semester	Hours per Week
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	Time / Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Field Reports & Design Project	6 reports	15% (15 marks)	Weekly	All LOs

Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1–#3
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #1, #2, #4
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		100% (100 Marks)		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Review of signal timing basics; introduction to HCM signalized intersection capacity methodology.
- **Week 2:** Determination of base saturation flow rate (S_o) and adjustment factors for lane width, heavy vehicles, grade, and parking.
- **Week 3:** Adjustment factors for turn movements (left-turns, right-turns, pedestrian/bicycle conflicts), lane group capacity calculation.
- **Week 4:** Control delay modeling: Uniform delay (d_1), incremental delay (d_2), initial queue delay (d_3), and LOS determination.
- **Week 5:** Coordinated signal systems: Principles of progress, bandwidth, efficiency, and constructing time-space progression diagrams.
- **Week 6:** Actuated signal control: Semi-actuated vs. fully-actuated logic, passage time, minimum/maximum green, detector placement geometry.
- **Week 7:** Midterm Examination.
- **Week 8:** Unsignalized intersections: Two-Way Stop-Controlled (TWSC) operational principles, gap acceptance, critical headway ($\backslash t_c$), follow-up time (t_f).
- **Week 9:** Computing potential capacity (c_p) and movement capacity (c_m) for TWSC intersections, impedance factors, and LOS evaluation.
- **Week 10:** Modern Roundabouts: Key geometric elements (entry width, circulating width, central island radius), entry capacity equations.
- **Week 11:** Parking characteristics: Definitions of accumulation, duration, turnover rate, supply-demand relationships, and parking surveys.
- **Week 12:** Geometric design of parking facilities: On-street vs. off-street layouts, stall dimensions ($90°, 60°, 45°$), aisle widths, and ramp geometry.

- **Week 13:** Traffic safety engineering: Crash reporting systems, collision types, crash severity index, and driver-vehicle-roadway factors.

- **Week 14:** Statistical crash rate formulations: Intersection crash rate (MEV) and section crash rate (HMVM), critical crash rate method.

- **Week 15:** Collision diagram construction, high-accident location identification (blackspot analysis), and safety countermeasure implementation.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Introduction to traffic analysis software (Highway Capacity Software HCS / Synchro) interface and setup.

- **Week 2:** Field Exercise 1: Collecting peak hour traffic, geometry, and signal timing data for a multi-phase urban intersection.

- **Week 3:** Practical Workshop 1: Inputting field data into HCS/Synchro, running signalized capacity analysis, and evaluating output LOS.

- **Week 4:** Practical Workshop 2: Performing sensitivity analysis on lane geometry and signal phasing variations in software.

- **Week 5:** Field Exercise 2: Mapping a signalized arterial corridor and logging signal offsets and travel speeds.

- **Week 6:** Practical Workshop 3: Constructing time-space diagrams and optimizing arterial signal progression bandwidth in Synchro.

- **Week 7:** Practical Midterm Laboratory Evaluation.

- **Week 8:** Field Exercise 3: Turning movement and delay count at a Two-Way Stop-Controlled (TWSC) intersection.

- **Week 9:** Practical Workshop 4: Evaluating TWSC intersection capacity and LOS using HCM templates.

- **Week 10:** Practical Workshop 5: Roundabout capacity modeling and geometry evaluation using SIDRA / HCS software.

- **Week 11:** Field Exercise 4: Parking duration and turnover survey at an off-street parking facility (license plate matching technique).

- **Week 12:** Practical Workshop 6: Processing parking survey data, plotting accumulation profiles, and drafting optimal parking lot CAD layouts.

- **Week 13:** Field Exercise 5: Collecting crash history data, site geometry, and traffic volumes for a high-collision urban intersection.

- **Week 14:** Practical Workshop 7: Constructing collision diagrams, calculating site crash rates, and selecting corrective safety countermeasures.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	Details	Available in Library?
Required Texts	Roger P. Roess, Elena S. Prassas, William R. McShane – *Traffic Engineering* (5th Edition), Pearson. Transportation Research Board (TRB) – *Highway Capacity Manual (HCM 7th Edition)*, TRB.	Yes
Recommended Texts	Nicholas J. Garber & Lester A. Hoel – *Traffic and Highway Engineering* (5th Edition), Cengage Learning.	Yes
Websites	Federal Highway Administration (FHWA) Safety & Signalized Intersection Design Guidelines.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	Details
Module Title	Pavement Design II
Module Type	Core Engineering (C)
Module Code	RE.323
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 6
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Prof.. Dr.Basim Hassan Al-Humeidawi |
Module Leader's e-mail	basim.alhumeidawi@qu.edu.iq
Module Leader's Acad. Title	Professor
Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.315 (Pavement Design I) | Semester: 5
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Rigid Pavement Structural Design:** Master structural design of concrete pavements (JPCP, JRCP, CRCP) using AASHTO 1993 and Portland Cement Association (PCA) methods.

2. **Concrete Pavement Stresses & Joints:** Analyze Westergaard thermal curling stresses, wheel load stresses, joint types (contraction, expansion, construction), and dowel/tie bar design.

3. **Pavement Distress Evaluation:** Evaluate functional and structural pavement distresses (rutting, fatigue cracking, faulting, spalling) and determine Pavement Condition Index (PCI).

4. **Pavement Overlay Structural Design:** Master design of structural asphalt and concrete overlays over existing flexible and rigid pavements per AASHTO 1993 guidelines.

5. **Pavement Management Systems (PMS):** Understand pavement life-cycle cost analysis (LCCA), maintenance and rehabilitation (M&R) strategies, and non-destructive testing (FWD).

Module Learning Outcomes

1. Formulate Westergaard stress equations for interior, edge, and corner load placements on rigid pavement slabs.

2. Design concrete slab thickness (D) for jointed plain concrete pavement (JPCP) using AASHTO 1993 empirical design equations and nomographs.

3. Design transverse contraction joint spacing, dowel bar diameter/length/spacing, and longitudinal tie bar steel area.

4. Conduct visual distress field surveys and calculate Pavement Condition Index (PCI) per ASTM D6433 procedures.

5. Calculate required asphalt overlay thickness (D_{ol}) using effective Structural Number (SN_{eff}) and falling weight deflectometer (FWD) deflection bowl data.

6. Perform Life-Cycle Cost Analysis (LCCA) comparing structural maintenance strategies over a 30-year design horizon.

Indicative Contents

- **Rigid Pavement Types & Westergaard Stresses:** JPCP, JRCP, CRCP structural behavior; Westergaard elastic thin plate theory for edge, corner, and interior stress formulations; Thermal curling stresses and moisture warping (12 hours theory, 6 hours tutorial).

- **AASHTO 1993 & PCA Rigid Design Methods:** Modulus of subgrade reaction (k), effective k-value adjustment, concrete modulus of rupture (S'_c), load transfer coefficient (J), drainage coefficient (C_d), AASHTO slab thickness equation; PCA fatigue and erosion criteria (16 hours theory, 8 hours tutorial).

- **Rigid Pavement Joint Design:** Transverse contraction, expansion, and construction joints; Dowel bar shear/bearing stress design, tie bar sizing and embedment length for longitudinal joints (8 hours theory, 4 hours tutorial).

- **Pavement Evaluation & PCI Rating:** Distress classification (cracking, deformation, surface defects, joint deficiencies), severity levels, deduct values, computing Pavement Condition Index (PCI) per ASTM D6433, Non-Destructive Testing (FWD backcalculation) (12 hours theory, 6 hours tutorial).

- **Pavement Overlay Design & PMS:** Asphalt overlay over flexible pavement ($SN_{ol} = SN_y - SN_{eff}$), asphalt overlay over rigid pavement, concrete overlays (bonded, unbonded); Pavement Management System (PMS) principles, Life-Cycle Cost Analysis (LCCA) (12 hours theory, 6 hours tutorial).

4. Learning and Teaching Strategies

1. **Interactive Design Lectures:** Detailed theoretical derivation of Westergaard stress equations, AASHTO rigid nomographs, and overlay design procedures.

2. **Weekly Problem-Solving Tutorials:** Guided design workshops solving dowel bar sizing, slab thickness determination, and PCI deduct calculations.

3. **Pavement Overlay & Maintenance Project:** Team assignment evaluating a damaged pavement section, computing PCI, and designing an asphalt overlay.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	Hours per Semester	Hours per Week
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	Time / Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5

Homework / Design Project	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		100% (100 Marks)		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to Rigid Pavements: Types (JPCP, JRCP, CRCP), load transfer mechanism, base/subbase requirements.
- **Week 2:** Modulus of subgrade reaction (k), plate bearing test determination, and adjusting k for loss of support (LS) and rigid base layers.
- **Week 3:** Stresses in rigid pavements: Westergaard's stress equations for corner, edge, and interior wheel loadings.
- **Week 4:** Temperature stresses: Thermal expansion/contraction, temperature differential curling stresses (Bradbury's equations), combined load-curling stress.
- **Week 5:** AASHTO 1993 Rigid Pavement Design method: Design variables ($R, S_o, \Delta PSI, S'_c, E_c, J, C_d, k$).
- **Week 6:** Solving the AASHTO rigid pavement design equation for concrete slab thickness (D) using nomographs and numerical solvers.
- **Week 7:** Midterm Examination.
- **Week 8:** Portland Cement Association (PCA) design method: Fatigue analysis and erosion analysis principles for heavy truck traffic.
- **Week 9:** Joint design in concrete pavements: Types of joints, joint spacing rules ($L \leq 21D$), joint reservoir shaping, and sealant selection.
- **Week 10:** Dowel bar design for transverse joints: Diameter, length, spacing, bearing stress on concrete, and load transfer efficiency (LTE).
- **Week 11:** Tie bar design for longitudinal joints: Steel area calculation (A_s), bar diameter, length, and bond pull-out strength checks.

- **Week 12:** Pavement condition evaluation: Functional vs. structural evaluation, surface distress survey methods (ASTM D6433).

- **Week 13:** Calculating Pavement Condition Index (PCI): Identifying distress types, severity levels, calculating deduct values and corrected deduct values (CDV).

- **Week 14:** Non-Destructive Testing (NDT) with Falling Weight Deflectometer (FWD): Deflection bowl parameters, backcalculation of layer moduli (E_1, E_2, M_r).

- **Week 15:** Structural Overlay Design: AASHTO 1993 method for asphalt overlay on flexible pavement ($D_{ol} = SN_{ol}/a_{ol}$); Introduction to PMS and LCCA.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical design module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	Details	Available in Library?
Required Texts	Yang H. Huang – *Pavement Analysis and Design* (2nd Edition), Pearson. AASHTO – *AASHTO Guide for Design of Pavement Structures*, AASHTO.	Yes
Recommended Texts	Norbert Delatte – *Concrete Pavement Design, Construction, and Performance* (2nd Edition), CRC Press.	Yes
Websites	American Concrete Pavement Association (ACPA) & Federal Highway Administration (FHWA) Pavement Office.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	Details
Module Title	Soil Mechanics II
Module Type	Core Engineering (C)
Module Code	RE.324
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 6
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	lecturer. Dr. Amer Gheni Jihad
Module Leader's e-mail	amer.ghani@qu.edu.iq
Module Leader's Acad. Title	lecturer

Module Leader's Qualification	Ph.D.
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.313 (Soil Mechanics I) | Semester: 5
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Soil Shear Strength Mechanics:** Master Mohr-Coulomb failure criteria, shear strength parameters (cohesion c, friction angle ϕ), direct shear, and triaxial compression testing (UU, CU, CD).

2. **Lateral Earth Pressure Theories:** Analyze Rankine and Coulomb lateral active (K_a) and passive (K_p) earth pressure theories on retaining structures.

3. **Retaining Wall Stability Design:** Evaluate structural stability (overturning, sliding, bearing capacity failure) of gravity, cantilever, and braced retaining walls.

4. **Slope Stability Analysis:** Analyze stability of infinite slopes and finite slopes (Swedish Circle method, Ordinary Method of Slices, Bishop's Simplified method).

5. **Bearing Capacity of Shallow Foundations:** Determine ultimate (q_{ult}) and allowable (q_{all}) bearing capacity of shallow footings using Terzaghi and Meyerhof bearing capacity equations.

Module Learning Outcomes

1. Evaluate effective stress Mohr circles and determine shear strength parameters (c', ϕ') from triaxial testing data.

2. Calculate active (P_a) and passive (P_p) lateral earth pressure distributions behind retaining walls with surface surcharges and sloping backfill.

3. Perform factor of safety (FS) calculations against overturning, sliding, and bearing failure for cantilever retaining walls.

4. Compute factor of safety for infinite slopes in cohesionless and cohesive soils with seepage flow.

5. Evaluate finite slope safety factors using the Method of Slices and friction circle methods.

6. Compute ultimate bearing capacity (q_{ult}) of strip, square, and circular shallow footings on single and multi-layered soils.

Indicative Contents

- **Shear Strength of Soil:** Mohr-Coulomb failure criterion, principal stresses at failure, direct shear test, Unconsolidated-Undrained (UU), Consolidated-Undrained (CU with pore pressure measurement), and Consolidated-Drained (CD) triaxial tests, stress paths ($p - q$ diagrams) (14 hours theory, 8 hours lab).

- **Lateral Earth Pressure:** Rest pressure (K_o), Rankine active ($K_a = \tan^2(45 - \phi/2)$) and passive ($K_p = \tan^2(45 + \phi/2)$) earth pressures, tension cracks in cohesive soils, Coulomb wedge theory, effect of wall friction (δ) and backfill slope (β) (12 hours theory, 6 hours lab).

- **Stability of Retaining Structures:** Types of retaining walls (gravity, cantilever, counterfort), lateral force resultant location, stability checks against overturning ($FS_{overturning} \geq 2.0$), sliding ($FS_{sliding} \geq 1.5$), and bearing capacity failure (10 hours theory, 4 hours lab).

- **Slope Stability Analysis:** Causes of slope failures, infinite slopes in sand and clay, finite slopes, planar failure surface, Swedish slip circle method ($\phi = 0$), Ordinary Method of Slices (Fellenius), Bishop's Simplified Method (12 hours theory, 6 hours lab).

- **Bearing Capacity of Shallow Foundations:** Modes of shear failure (general, local, punching shear), Terzaghi bearing capacity equation ($q_{ult} = cN_c + qN_q + 0.5\gamma BN_\gamma$), shape and depth factors, Meyerhof general bearing capacity equation, groundwater table correction factors (12 hours theory, 6 hours lab).

4. Learning and Teaching Strategies

1. **Theoretical & Analytical Lectures:** Deriving Mohr-Coulomb strength equations, earth pressure wedge statics, and slope limit equilibrium formulas.

2. **Supervised Geotechnical Laboratory Practicals:** Conducting direct shear tests, unconfined compression tests, and triaxial compression testing on soil samples.

3. **Geotechnical Calculation Homework:** Problem sets calculating retaining wall safety factors, slope failure circles, and footing bearing capacities.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	Hours per Semester	Hours per Week
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	Time / Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Quizzes	4	10% (10 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Laboratory Reports	6 reports	15% (15 marks)	Weekly	LO #1, #2, #4
Midterm Written Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	LO #1, #2
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		100% (100 Marks)		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Introduction to soil shear strength: Shear failure mechanism, Mohr-Coulomb failure criteria equation ($\tau_f = c' + \sigma' \tan \phi'$).

- **Week 2:** Direct shear test mechanics: Equipment setup, stress distribution, advantages and limitations, drained shear parameters.

- **Week 3:** Triaxial shear testing: Equipment setup, cell pressure (σ_3), principal stress difference ($\Delta\sigma_d$), pore pressure measurement (u).

- **Week 4:** Unconsolidated-Undrained (UU) test, Consolidated-Undrained (CU) test, and Consolidated-Drained (CD) test stress paths.

- **Week 5:** Lateral earth pressure: Earth pressure at rest ($K_o = 1 - \sin \phi'$), Rankine's theory for active and passive states in cohesionless soils.

- **Week 6:** Rankine earth pressure in cohesive soils: Active earth pressure, tension crack depth ($z_c = 2c'/\gamma\sqrt{K_a}$), passive earth pressure.

- **Week 7:** Midterm Examination.

- **Week 8:** Coulomb's active and passive earth pressure theory: Trial wedge method, influence of wall friction (δ) and backfill slope (β).

- **Week 9:** Retaining wall design: Types of retaining walls, proportions, lateral pressure resultant calculations with water table and surcharges.

- **Week 10:** Stability analysis of cantilever retaining walls: Safety factors against overturning, sliding, and bearing capacity failure.

- **Week 11:** Introduction to slope stability: Mass movement, failure modes, safety factor definition ($FS = \tau_f/\tau_{developed}$).

- **Week 12:** Stability of infinite slopes in dry and submerged cohesionless soils, infinite slopes in cohesive soils with parallel seepage.

- **Week 13:** Stability of finite slopes: Mass procedure, planar failure, Swedish Circle method ($\phi = 0$ analysis) for cohesive soils.

- **Week 14:** Method of Slices for $c - \phi$ soils: Ordinary Method of Slices (Fellenius method) and introduction to Bishop's Simplified method.

- **Week 15:** Shallow foundation bearing capacity: Terzaghi's bearing capacity equation, failure modes, shape factors, water table location corrections.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Geotechnical lab safety orientation and sample extrusion/preparation procedures.

- **Week 2:** Experiment 1: Direct Shear Test on sand samples at various normal stress levels (ASTM D3080).

- **Week 3:** Experiment 2: Unconfined Compression Test (UC) on cohesive soil samples (ASTM D2166).

- **Week 4:** Experiment 3: Triaxial Compression Test - Unconsolidated Undrained (UU) test setup and testing (ASTM D2850).

- **Week 5:** Experiment 4: Triaxial Compression Test - Consolidated Undrained (CU) test with pore pressure measurement (ASTM D4767).

- **Week 6:** Laboratory Data Analysis: Plotting Mohr circles at failure, failure envelopes, and deriving c, ϕ, c', ϕ' parameters.

- **Week 7:** Practical Midterm Laboratory Evaluation.

- **Week 8:** Experiment 5: Retaining Wall Lateral Pressure Demonstration Apparatus testing.

- **Week 9:** Application Workshop 1: Manual calculation of active earth pressure profiles behind a 6-meter retaining wall with surcharge.

- **Week 10:** Application Workshop 2: Stability verification project for a cantilever retaining wall.

- **Week 11:** Experiment 6: Slope Stability Analysis Demonstration using geotechnical software (GeoStudio SLOPE/W / Slide).

- **Week 12:** Application Workshop 3: Solving a finite slope stability problem using Ordinary Method of Slices in spreadsheets.

- **Week 13:** Application Workshop 4: Computing allowable bearing capacity for shallow footings on highway bridge abutment sites.

- **Week 14:** Comprehensive geotechnical review and test data reconciliation.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	Details	Available in Library?
Required Texts	Braja M. Das & Khaled Sobhan – *Principles of Geotechnical Engineering* (9th Edition), Cengage Learning. Braja M. Das – *Principles of Foundation Engineering* (9th Edition), Cengage Learning.	Yes

Recommended Texts	Robert D. Holtz, William D. Kovacs, Thomas C. Sheahan – *An Introduction to Geotechnical Engineering* (2nd Edition), Pearson.	Yes
Websites	ISSMGE Technical Committees & US Federal Highway Administration (FHWA) Geotechnical Publications.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	Details
Module Title	Computer Applications
Module Type	Basic Engineering / Support (B)
Module Code	RE.325
ECTS Credits	3
SWL (hr/sem)	75
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☑ Lab ☑ Practical ☐ Tutorial
Semester of Delivery	Semester 6
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering

Module Leader	Assistant Lecturer Rand Mohammed Jassim
Module Leader's e-mail	rand.mohammed.eng@qu.edu.iq
Module Leader's Acad. Title	Assistant Lecturer
Module Leader's Qualification	MSC
Module Tutor	Assistant Lecturer Hussein Jassim hussein.jasim@qu.edu.iq
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.316 (Computer Programming) | Semester: 5
- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Civil 3D Roadway Corridor Design:** Master advanced Autodesk Civil 3D tools for corridor creation, cross-section assemblies, earthwork volume calculation, and plan production.

2. **Structural Analysis Software (SAP2000 / STAAD Pro):** Model 2D/3D civil structural frames, bridge girders, apply highway traffic loadings, and extract internal force diagrams.

3. **Traffic Capacity & Simulation Software (HCS / Synchro / VISSIM):** Analyze signalized intersections, optimize traffic signal timing, and simulate traffic progression along urban corridors.

4. **Pavement Structural Analysis Software (KENPAVE / AASHTOWare):** Perform multi-layer elastic stress-strain computations and structural thickness design for flexible and rigid pavements.

Module Learning Outcomes

1. Construct 3D highway corridor models in Civil 3D, create cross-sectional sample lines, and compute mass haul earthwork volumes.

2. Model 2D/3D framed bridge structures in SAP2000, apply dead/live loads, and extract bending moment diagrams.

3. Perform intersection capacity and Level of Service (LOS) calculations using HCS and Synchro software.

4. Optimize traffic signal progression bandwidth along multi-intersection arterials using Synchro.

5. Compute critical elastic strains (ϵ_t, ϵ_v) in multi-layer flexible pavements using KENPAVE software.

6. Generate complete engineering drawings, software analysis reports, and design documentation.

Indicative Contents

- **Autodesk Civil 3D Advanced Corridor Design:** Surface creation, horizontal alignment, vertical profile design, subassembly composer, assemblies, corridor generation, sample lines, section views, cut/fill earthwork volume calculation, plan & profile sheet generation (12 hours theory, 12 hours lab).

- **Structural Frame Analysis (SAP2000):** Interface overview, grid setup, defining material properties (concrete, steel), section properties, 2D frame and 3D space truss modeling, applying moving vehicle load patterns, finite element frame analysis, extracting shear and bending diagrams (11 hours theory, 11 hours lab).

- **Traffic Simulation & Signal Optimization (HCS & Synchro):** Entering intersection geometry, traffic volumes, signal timing; HCS capacity analysis; Synchro arterial optimization, time-space progression, queue analysis, 3D traffic simulation (11 hours theory, 11 hours lab).

- **Pavement Structural Software (KENPAVE / AASHTOWare):** Layered elastic analysis theory, inputting layer moduli (E_i), Poisson's ratio (ν_i), dual-wheel axle configurations, running KENLAYER for flexible pavement damage analysis, running KENSLABS for rigid pavement stress evaluation (11 hours theory, 11 hours lab).

4. Learning and Teaching Strategies

1. **Lectures & Live Software Demonstrations:** Interactive classroom sessions demonstrating software workflows, modeling logic, and output verification.

2. **Hands-On Computer Laboratory Workshops:** Practical exercises where students independently build civil models, run software solvers, and interpret results.

3. **Applied Multi-Disciplinary Software Project:** Individual project requiring students to design a complete highway corridor section incorporating Civil 3D alignment, SAP2000 bridge modeling, and Synchro traffic signal timing.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	Hours per Semester	Hours per Week
Structured SWL (h/sem)	45	3
Unstructured SWL (h/sem)	30	2
Total SWL (h/sem)	75	5

6. Module Evaluation

Module Evaluation				
Assessment Component	Time / Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Quizzes	3	10% (10 marks)	Weeks 4, 8, 12	LO #1–#5
Practical Lab Assignments	8 exercises	15% (15 marks)	Weekly	All LOs
Midterm Practical Exam	1.5 hours	15% (15 marks)	Week 7	LO #1, #2
Final Practical Lab Exam	2 hours	10% (10 marks)	Week 15	All LOs
Final Theoretical Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		100% (100 Marks)		

7. Delivery Plan (Weekly Syllabus - Theory)

- **Week 1:** Orientation: Overview of professional software packages in highway, structural, and traffic engineering.
- **Week 2:** Autodesk Civil 3D: Importing land survey data, creating digital terrain models (TIN), surface contour editing.
- **Week 3:** Civil 3D Alignment & Profile Design: Laying out horizontal centerlines, design speeds, vertical profiles, and parabolic curves.
- **Week 4:** Civil 3D Assembly & Corridor Modeling: Subassemblies (lanes, shoulders, daylighting slopes), building 3D roadway corridors.
- **Week 5:** Civil 3D Earthwork Analysis: Sample lines creation, material volume computation (Average End Area method), generating Mass Haul diagrams.

- **Week 6:** Introduction to SAP2000: Finite element modeling concepts, coordinate systems, node/element definitions.

- **Week 7:** Midterm Examination.

- **Week 8:** Structural frame analysis in SAP2000: Defining beam/column sections, applying point/distributed loads, support conditions.

- **Week 9:** Highway bridge loading in SAP2000: Moving load cases (HL-93 truck loading), influence line generation, moment envelope diagrams.

- **Week 10:** Traffic software (HCS & Synchro): Data input structure, signalized intersection capacity per HCM guidelines.

- **Week 11:** Arterial signal coordination in Synchro: Offset optimization, green wave bandwidth calculation, queue length modeling.

- **Week 12:** Introduction to KENPAVE software suite: Flexible pavement (KENLAYER) vs. Rigid pavement (KENSLABS) structural mechanics.

- **Week 13:** KENLAYER inputs: Multi-layer elastic theory, material non-linearity, load repititions, computing tensile (ϵ_t) and compressive (ϵ_v) strains.

- **Week 14:** KENSLABS inputs: Finite element analysis of concrete slabs, joint load transfer efficiency, corner stress calculations.

- **Week 15:** Software integration and data exchange between Civil 3D, CAD, and structural/traffic analysis software packages.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- **Week 1:** Computer Lab 1: Surface generation and contour map creation from field point datasets in Civil 3D.

- **Week 2:** Computer Lab 2: Designing a 2 km highway horizontal alignment with spiral transition curves in Civil 3D.

- **Week 3:** Computer Lab 3: Generating ground and design vertical profiles with summit and sag vertical curves.

- **Week 4:** Computer Lab 4: Building a complete 3D road corridor assembly and generating cross-sectional views at 20 m intervals.

- **Week 5:** Computer Lab 5: Computing earthwork cut/fill quantities and plotting Mass Haul Diagrams in Civil 3D.

- **Week 6:** Computer Lab 6: Modeling a continuous 3-span reinforced concrete highway bridge girder in SAP2000.

- **Week 7:** Practical Midterm Laboratory Examination.

- **Week 8:** Computer Lab 7: Applying AASHTO moving truck load combinations on a SAP2000 bridge deck model and extracting max shear/moment.

- **Week 9:** Computer Lab 8: Modeling an isolated 4-leg signalized intersection in HCS and determining lane group capacity and LOS.

- **Week 10:** Computer Lab 9: Modeling a 4-intersection urban arterial corridor in Synchro and optimizing signal offsets.

- **Week 11:** Computer Lab 10: Running 3D microscopic traffic simulation in Synchro/VISSIM and exporting queue delay reports.

- **Week 12:** Computer Lab 11: Performing multi-layer elastic flexible pavement analysis in KENLAYER for 3-layer pavement system.

- **Week 13:** Computer Lab 12: Evaluating concrete slab stresses under corner loading in KENSLABS software.

- **Week 14:** Integrated Project Workshop: Assembling all project software deliverables into a unified engineering submission.

- **Week 15:** Final Practical Laboratory Examination.

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	Details	Available in Library?
Required Texts	Autodesk – *Autodesk Civil 3D Official Training Guide*, Autodesk Press. Computers and Structures Inc. – *SAP2000 Integrated Software for Structural Analysis and Design User Manual*, CSI.	Yes

Recommended Texts	Yang H. Huang – *KENPAVE Software Manual & Pavement Analysis and Design* (2nd Edition), Pearson. Trafficware – *Synchro & SimTraffic User Guide*, Trafficware LLC.	Yes
Websites	Autodesk Knowledge Network, CSI Technical Knowledge Base & TRB Software Portals.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	Details
Module Title	Railways Engineering
Module Type	Core Engineering (C)
Module Code	RE.326
ECTS Credits	4
SWL (hr/sem)	100
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 6
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering
Module Leader	Assistant Lecturer Mohammed Jassim Shukhan

Module Leader's e-mail	mohammed.jassim@qu.edu.iq
Module Leader's Acad. Title	Assistant Lecturer
Module Leader's Qualification	MSC
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.224 (Engineering Surveying II) / RE.314 (Traffic Engineering I) | Semester: 4 / 5

- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Permanent Way Track Components:** Understand functions, specifications, and mechanics of railway track components (rails, sleepers/ties, ballast, subballast, subgrade, fastings).
2. **Wheel-Rail Contact Mechanics:** Analyze train resistance, tractive effort, axle loads, wheel-rail contact stresses (Hertzian stress), and track load distribution.

3. **Geometric Design of Railway Track:** Design track gauge, superelevation (cant), cant deficiency, transition curves, gradients, and vertical alignment curves.

4. **Turnouts, Switches & Crossings:** Master geometric design of railway turnouts, switch rails, frog angles, lead distances, and crossover layouts.

5. **Railway Signaling & Operations:** Understand train control systems, fixed block signaling, interlocking principles, continuous welded rail (CWR), and track maintenance.

Module Learning Outcomes

1. Identify functions, material selection, and failure modes of steel rails, concrete sleepers, and aggregate ballast.

2. Calculate train resistance components (rolling, grade, curve, acceleration resistance) and required locomotive tractive effort.

3. Compute equilibrium cant (e), maximum allowable speed (V_{max}), and cant deficiency (D_c) for curved railway tracks.

4. Design length of transition spiral curves based on rate of change of cant and acceleration constraints.

5. Compute geometric dimensions (lead distance, turnout length, switch angle, frog number N) for railway turnouts.

6. Describe Continuous Welded Rail (CWR) thermal stress management, block signaling systems, and mechanized track maintenance.

Indicative Contents

- **Permanent Way Structure & Track Components:** Permanent way cross-section, track gauges (standard gauge 1435 mm, broad gauge, narrow gauge); Steel rails (flat-bottom, bull-head, rail stresses, rail wear, joints); Sleepers (timber, prestressed concrete, steel); Ballast and subballast functions, sizing, and depth calculation (12 hours theory, 6 hours tutorial).

- **Train Dynamics & Track Stresses:** Locomotive traction mechanics, train resistance formulas (rolling resistance, aerodynamic drag, grade resistance, curvature resistance), axle loads, elastic beam on equiponderant foundation (BOEF) theory, Zimmermann and Talbot stress analysis formulas (12 hours theory, 6 hours tutorial).

- **Geometric Design of Railway Track:** Track alignment principles, cant/superelevation formula $e = 11.8V^2/R$, equilibrium speed, maximum permissible speed, cant deficiency (E_d), rate of cant ramp, length of transition curve (L_t), vertical curves (14 hours theory, 7 hours tutorial).

- **Turnouts, Switches & Crossings:** Turnout components (points/switch, stock rails, lead rails, frog/crossing, check rails), frog number (N), angle of crossing (α), lead distance (L), curve radius (R), crossover and turnout design calculations (12 hours theory, 6 hours tutorial).

- **Continuous Welded Rail (CWR), Signaling & Maintenance:** Continuous Welded Rail (CWR) thermal expansion stresses, breathing length, neutral temperature; Railway signaling systems (absolute block, automatic block, ETCS); Mechanized track maintenance (tamping, stone blowing, rail grinding) (10 hours theory, 5 hours tutorial).

4. Learning and Teaching Strategies

1. **Theoretical & Analytical Lectures:** Physics of wheel-rail interaction, geometric design calculations, and signaling logic.

2. **Weekly Design Tutorials:** Step-by-step calculations for track cant, turnout lead distances, train resistance, and CWR thermal expansion.

3. **Railway Track Design Project:** Student group assignment designing track geometry, superelevation, and turnout layout for a passenger railway line.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	Hours per Semester	Hours per Week
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	40	2.7
Total SWL (h/sem)	100	6.7

6. Module Evaluation

Module Evaluation				
Assessment Component	Time / Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Design Project	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		100% (100 Marks)		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to Railway Engineering: History, advantages over highway transport, track gauges, and permanent way components.
- **Week 2:** Steel Rails: Rail profiles (flat-bottom Vignole rails), rail section designation (kg/m), steel metallurgy, and rail defects.
- **Week 3:** Sleepers (Ties): Functions, requirements, concrete sleepers (mono-block vs. bi-block), timber sleepers, and sleeper density.
- **Week 4:** Ballast and Subballast: Functions, material specifications, ballast bed depth calculations, and subgrade preparation.
- **Week 5:** Fastening systems: Elastic rail clips (Pandrol, e-clip), rail pads, baseplates, and insulated rail joints.

- **Week 6:** Train resistance: Mechanics of movement, train resistance components (Davis equation: $R = A + Bv + Cv^2$), grade and curve resistance.

- **Week 7:** Midterm Examination.

- **Week 8:** Tractive effort and hauling capacity: Locomotive power, adhesion coefficient, maximum tonnage capacity up gradients.

- **Week 9:** Stresses in track: Beam on Elastic Foundation (BOEF) theory, vertical pressure distribution through ballast and subgrade.

- **Week 10:** Geometric design of track: Superelevation (cant e), equilibrium cant formula derivation, speed limits on curves.

- **Week 11:** Cant deficiency (E_d) and cant excess (E_x): Maximum allowable values, speed calculations for mixed freight/passenger lines.

- **Week 12:** Length of transition curves (L_t): Rate of change of cant, rate of change of lateral acceleration, cubic parabola equations.

- **Week 13:** Turnouts and Crossings I: Component functions, switch rails, stock rails, lead distance, frog number (N), crossing angle (α).

- **Week 14:** Turnouts and Crossings II: Geometric design formulas for turnout lead distance (L), curve radius (R), and turnout crossovers.

- **Week 15:** Continuous Welded Rail (CWR): Thermal stress formulation ($\sigma = E\alpha\Delta T$), breathing zones, and signaling/block control principles.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical core engineering module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	Details	Available in Library?
Required Texts	Clifford F. Bonnett – *Practical Railway Engineering* (2nd Edition), Imperial College Press.	Yes

	Satish Chandra & M.M. Agarwal – *Railway Engineering* (2nd Edition), Oxford University Press.	
Recommended Texts	J.S. Mundrey – *Railway Track Engineering* (4th Edition), McGraw-Hill.	Yes
Websites	AREMA (American Railway Engineering and Maintenance-of-Way Association) & UIC (International Union of Railways).	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	Details
Module Title	Engineering Management and Economy
Module Type	Basic Engineering / Support (B)
Module Code	RE.327
ECTS Credits	2
SWL (hr/sem)	50
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 6
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering

Module Leader	Prof. Asst. Elaf Dheyaa Abdulridha
Module Leader's e-mail	elaf.alzubaidi@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	MSC
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

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

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Time Value of Money:** Master interest formulas, cash flow diagrams, present worth, future worth, annual worth, and gradient cash flow series.

2. **Economic Evaluation Methods:** Apply Present Worth (PW), Annual Worth (AW), Internal Rate of Return (IRR), and Benefit-Cost Ratio (B/C) methods to evaluate civil engineering project alternatives.

3. **Project Planning & Network Scheduling:** Master Critical Path Method (CPM), Precedence Diagramming Method (PDM), Program Evaluation and Review Technique (PERT), and Gantt charts.

4. **Contract Management & Procurement:** Understand engineering contract types (lump-sum, unit-price, cost-plus), bidding documentation, FIDIC conditions of contract, and risk management.

5. **Cost Control & Depreciation:** Calculate asset depreciation (straight-line, declining balance), cost estimating techniques, and project cash flow control.

Module Learning Outcomes

1. Construct cash flow diagrams and convert cash flows using compound interest factors ($P/F, F/P, P/A, A/P, P/G, A/G$).

2. Evaluate mutually exclusive engineering project alternatives using Present Worth, Annual Worth, and Benefit-Cost (B/C) ratio methods.

3. Determine Internal Rate of Return (IRR) for infrastructure investments and conduct sensitivity analyses.

4. Construct CPM project network diagrams, calculate forward/backward passes, early/late times, total float, and identify the critical path.

5. Compute expected project completion probability using PERT three-time estimate technique (a, m, b).

6. Distinguish between civil engineering contract forms (Unit Price vs. Lump Sum) and apply FIDIC contract principles.

Indicative Contents

- **Engineering Economy & Time Value of Money:** Interest rates (simple vs. compound), cash flow diagrams, discrete compounding equivalence factors $(F/P, P/F, F/A, A/F, P/A, A/P)$, uniform series, linear gradient series $(P/G, A/G)$ (8 hours theory, 4 hours tutorial).

- **Project Evaluation Methods:** Present Worth (PW) method, Future Worth (FW) method, Annual Worth (AW) method, Internal Rate of Return (IRR) trial-and-error calculation, Benefit-Cost (B/C) ratio for public transportation projects, payback period (8 hours theory, 4 hours tutorial).

- **Project Management & Network Scheduling:** Project lifecycle, Work Breakdown Structure (WBS), Activity-on-Node (AON) network diagrams, Critical Path Method (CPM), early start/finish (ES, EF), late start/finish (LS, LF), total float (TF), free float (FF); PERT probabilistic scheduling (8 hours theory, 4 hours tutorial).

- **Contracts, Bidding & Depreciation:** Contract types (unit price, lump sum, cost-plus, BOT), bidding and tendering procedures, FIDIC contract conditions, asset depreciation methods (straight-line, declining balance, sum-of-years-digits) (6 hours theory, 2 hours tutorial).

4. Learning and Teaching Strategies

1. **Theoretical & Analytical Lectures:** Instruction on economic equivalence mathematics, project network algorithms, and contract legal structures.

2. **Weekly Problem-Solving Tutorials:** Guided workshops on cash flow equivalence computations, CPM network calculations, and IRR determinations.

3. **Project Scheduling Assignment:** Individual project creating a CPM network schedule and cost analysis for a road construction contract.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	Hours per Semester	Hours per Week
Structured SWL (h/sem)	30	2
Unstructured SWL (h/sem)	20	1.3
Total SWL (h/sem)	50	3.3

6. Module Evaluation

Module Evaluation				
Assessment Component	Time / Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Quizzes	3	15% (15 marks)	Weeks 4, 8, 12	LO #1–#5
Assignments / CPM Project	3 assignments	15% (15 marks)	Weeks 3, 9, 13	LO #1, #2, #4, #5
Midterm Written Exam	1 hour	20% (20 marks)	Week 7	LO #1, #2
Final Exam	2 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		100% (100 Marks)		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Introduction to Engineering Economy: Time value of money, cash flow concepts, simple vs. compound interest.
- **Week 2:** Compound interest factors: Single payment factors ($F/P, P/F$), uniform series factors ($P/A, A/P, F/A, A/F$).
- **Week 3:** Arithmetic gradient series ($P/G, A/G$) and geometric gradient cash flows in engineering projects.
- **Week 4:** Present Worth (PW) and Capitalized Cost analysis for comparing mutually exclusive project alternatives.
- **Week 5:** Annual Worth (AW) method, Future Worth (FW) method, and payback period calculations.
- **Week 6:** Internal Rate of Return (IRR) calculation method, incremental rate of return analysis for alternative selection.
- **Week 7:** Midterm Examination.

- **Week 8:** Benefit-Cost (B/C) Ratio method for public sector transportation and infrastructure investments.

- **Week 9:** Asset depreciation methods: Straight-line, declining balance, double-declining balance, and sum-of-the-years-digits.

- **Week 10:** Introduction to Project Management: Project lifecycle, planning, organizational structures, Work Breakdown Structure (WBS).

- **Week 11:** Network scheduling techniques: Activity-on-Node (AON) network logic, precedence relationships.

- **Week 12:** Critical Path Method (CPM): Forward pass (ES, EF), backward pass (LS, LF), calculating total float (TF) and free float (FF).

- **Week 13:** Program Evaluation and Review Technique (PERT): Three-time estimates (optimistic a, most likely m, pessimistic b), mean, variance, completion probability.

- **Week 14:** Resource leveling, project crashing (cost-time trade-off analysis), and Gantt chart construction.

- **Week 15:** Engineering contracts: Types of construction contracts (Unit Price, Lump Sum, Cost Plus), FIDIC conditions, tendering process.

- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical support module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	Details	Available in Library?
Required Texts	Leland Blank & Anthony Tarquin – *Engineering Economy* (8th Edition), McGraw-Hill. S. Keoki Sears, Glenn A. Sears et al. – *Construction Project Management* (6th Edition), Wiley.	Yes
Recommended Texts	James L. Riggs, David D. Bedworth, Sabah U. Randhawa – *Engineering Economics* (4th Edition), McGraw-Hill.	Yes

Websites	Project Management Institute (PMI) Standards & FIDIC Contract Publications.	-

10. Grading Scheme

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

MODULE DESCRIPTION FORM

1. Module Information

Module Information	
Field	Details
Module Title	Advanced Mathematics and Numerical Analysis
Module Type	Basic Engineering / Support (B)
Module Code	RE.328
ECTS Credits	5
SWL (hr/sem)	125
Module Level	Level 3
Module Delivery	☑ Theory ☑ Lecture ☐ Lab ☐ Practical ☑ Tutorial
Semester of Delivery	Semester 6
Administering Department	Department of Highway and Transportation Engineering
College	College of Engineering

Module Leader	Prof. Asst. Shuruq Abd Al-ameer Jawaad
Module Leader's e-mail	shuruq.khafaji@qu.edu.iq
Module Leader's Acad. Title	Assistant Professor
Module Leader's Qualification	MSC
Module Tutor	
Peer Reviewer Name	Professor Jalal Taqi Shaker Al-Obaedi jalal.alobaedi@qu.edu.iq
Scientific Committee Approval Date	01/06/2023
Version Number	1.0

2. Relation with Other Modules

- **Prerequisite module:** RE.311 (Advanced Mathematics and Engineering Analysis) | Semester: 5

- **Co-requisites module:** None | Semester: -

3. Module Aims, Learning Outcomes and Indicative Contents

Module Aims

1. **Numerical Boundary-Value Methods:** Master Finite Difference Methods (FDM) for solving 1D and 2D boundary-value problems in structural and geotechnical engineering.

2. **Numerical Solution of Partial Differential Equations:** Formulate numerical schemes (explicit, implicit, Crank-Nicolson) for parabolic heat/consolidation equations and elliptic Laplace/Poisson equations.

3. **Finite Element Method (FEM) Fundamentals:** Introduce 1D element formulation, shape functions, stiffness matrices ($[K]$), load vectors ($\{F\}$), and assembly for structural and seepage problems.

4. **Numerical Optimization Techniques:** Apply unconstrained and constrained numerical optimization methods (Golden Section search, Gradient Descent, Newton's method) to engineering design.

5. **Advanced Curve Fitting & Spline Interpolation:** Master cubic spline interpolation, multi-variable least squares regression, and Fourier series curve fitting for discrete highway engineering data.

Module Learning Outcomes

1. Formulate Finite Difference equations for 1D beam bending and column deflection boundary-value problems.

2. Develop explicit and Crank-Nicolson finite difference schemes for solving time-dependent 1D consolidation/heat equations.

3. Solve 2D Laplace and Poisson partial differential equations using iterative Liebmanc/Gauss-Seidel finite difference grids.

4. Construct 1D bar and beam finite element stiffness matrices ($[k]$), assemble global matrices ($[K]$), and apply boundary conditions.

5. Solve single-variable and multi-variable numerical optimization problems for structural and transport cost minimization.

6. Interpolate engineering datasets using natural and clamped cubic splines and evaluate residual error bounds.

Indicative Contents

- **Finite Difference Methods (FDM) for ODEs:** Finite difference approximations for 1st, 2nd, and 4th derivatives (forward, backward, central differences), applying FDM to 1D beam flexure ($EId^4y/dx^4 = w(x)$) and column buckling (12 hours theory, 6 hours tutorial).

- **Numerical Solution of Elliptic & Parabolic PDEs:** FDM grids for 2D Laplace ($\nabla^2 u = 0$) and Poisson ($\nabla^2 u = f(x, y)$) equations, Five-point stencil operator, Gauss-Seidel iteration; Parabolic PDEs (1D consolidation/heat equation), Explicit finite difference method, Courant stability criterion ($r \leq 0.5$), Implicit method, Crank-Nicolson scheme (18 hours theory, 9 hours tutorial).

- **Fundamentals of Finite Element Method (FEM):** Introduction to FEM, 1D spring/bar elements, shape functions (linear, quadratic), strain-displacement matrix ($[B]$), element stiffness matrix formulation ($[k] = \int [B]^T [D][B]dV$), global assembly, applying essential boundary conditions (14 hours theory, 7 hours tutorial).

- **Numerical Optimization:** Unconstrained 1D optimization (Golden Section Search, Parabolic Interpolation), Multi-variable optimization (Gradient Descent / Steepest Descent method, Newton's method); Constrained optimization concepts and Lagrange multipliers (10 hours theory, 5 hours tutorial).

- **Advanced Interpolation & Curve Fitting:** Polynomial interpolation error, Natural and Clamped Cubic Spline interpolation algorithms, linear and non-linear multi-variable least-squares regression modeling (6 hours theory, 3 hours tutorial).

4. Learning and Teaching Strategies

1. **Analytical & Numerical Lectures:** Derivation of finite difference stencils, FEM shape functions, and optimization algorithms.

2. **Weekly Problem-Solving Tutorials:** Computational workshops focusing on grid discretization, matrix assembly, and iterative PDE calculations.

3. **Computational Homework Assignments:** Numerical problem sets requiring manual step-by-step matrix assembly and finite difference table iterations.

5. Student Workload (SWL)

Student Workload (SWL)		
SWL Category	Hours per Semester	Hours per Week
Structured SWL (h/sem)	60	4
Unstructured SWL (h/sem)	65	4.3
Total SWL (h/sem)	125	8.3

6. Module Evaluation

Module Evaluation				
Assessment Component	Time / Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Quizzes	4	15% (15 marks)	Weeks 3, 5, 10, 12	LO #1–#5
Homework / Assignments	4	10% (10 marks)	Weeks 2, 6, 9, 13	All LOs
Midterm Written Exam	2 hours	25% (25 marks)	Week 7	LO #1–#3
Final Exam	3 hours	50% (50 marks)	Week 16	All LOs
Total Assessment		100% (100 Marks)		

7. Delivery Plan (Weekly Syllabus)

- **Week 1:** Review of differential calculus; finite difference approximations for 1st, 2nd, 3rd, and 4th derivatives using Taylor series expansions.

- **Week 2:** Applying central finite differences to 1D boundary value problems: Beam deflection and elastic foundation differential equations.

- **Week 3:** Finite difference solutions for 4th-order ODEs: Beam-column buckling loads and deflections.

- **Week 4:** Introduction to Partial Differential Equations numerical solutions: Elliptic PDEs (2D Laplace equation $\nabla^2 u = 0$).
- **Week 5:** Five-point finite difference operator stencil, Liebmann's iterative method, boundary condition implementation (Dirichlet and Neumann).
- **Week 6:** 2D Poisson equation ($\nabla^2 u = f(x, y)$) grid setup and application to torsional and seepage problems.
- **Week 7:** Midterm Examination.
- **Week 8:** Parabolic PDEs (1D unsteady heat/consolidation equation $u_t = k u_{xx}$): Explicit finite difference method formulation.
- **Week 9:** Stability criteria (Courant number $r = k\Delta t/\Delta x^2 \leq 0.5$) for explicit schemes; Implicit finite difference method.
- **Week 10:** Crank-Nicolson method for parabolic PDEs: Tridiagonal matrix system formulation and Thomas algorithm solution.
- **Week 11:** Introduction to the Finite Element Method (FEM): Discretization, nodes, elements, degrees of freedom, 1D direct stiffness matrix.
- **Week 12:** 1D Bar and Truss finite elements: Interpolation shape functions (N_1, N_2), strain-displacement matrix ($[B]$), stiffness matrix ($[k]$).
- **Week 13:** Global stiffness matrix assembly ($[K]\{U\} = \{F\}$), applying boundary support constraints and solving element nodal displacements/forces.
- **Week 14:** Numerical Optimization I: Single-variable unconstrained search algorithms (Golden Section search, Newton's method).
- **Week 15:** Numerical Optimization II: Multi-variable optimization (Gradient descent method) and Advanced Cubic Spline interpolation algorithms.
- **Week 16:** Final Examination.

8. Delivery Plan (Weekly Lab. Syllabus)

- N/A (Theoretical module with weekly structured tutorials).

9. Learning and Teaching Resources

Learning and Teaching Resources		
Resource Type	Details	Available in Library?
Required Texts	Steven C. Chapra & Raymond P. Canale – *Numerical Methods for Engineers* (8th Edition), McGraw-Hill. D. L. Logan – *A First Course in the Finite Element Method* (6th Edition), Cengage Learning.	Yes
Recommended Texts	Richard L. Burden & J. Douglas Faires – *Numerical Analysis* (10th Edition), Cengage Learning.	Yes
Websites	MIT OpenCourseWare (Numerical Methods & Finite Element Analysis) & NPTEL Advanced Numerical Methods.	-

10. Grading Scheme

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

Republic of Iraq - Ministry of Higher Education and Scientific Research

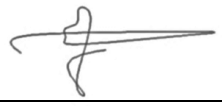
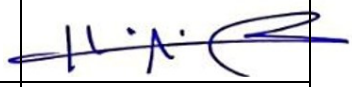
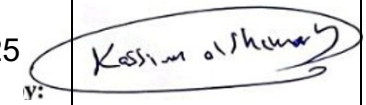
Scientific Supervision and Evaluation Apparatus - Quality Assurance and Academic Accreditation Directorate

University of Al-Qadisiyah - College of Engineering - Department of Roads and Transport Engineering

Complete Academic Program Specification and Module Description Handbook

Fourth Stage (Academic Year 2025–2026)

Academic Program Description Form	
University Name:	University of Al-Qadisiyah
College / Institute:	College of Engineering
Scientific Department:	Department of Roads and Transport Engineering
Academic Program Title:	Bachelor of Science (B.Sc.) in Roads and Transport Engineering
Final Qualification Title:	B.Sc. Degree in Roads and Transport Engineering
Academic Study System:	Semester / Annual System (Fourth Stage - Academic Year 2025/2026)
Date of File Preparation:	12-10-2025
File Date Filled:	12-10-2025

Administrative Role	Full Name	Date	Signature / Endorsement
Head of Scientific Department	Assoc. Prof. Salam Maytham Jaber	20/1/2025	
Scientific Associate Dean	Prof. Dr. Haitham Ali Badi	20/1/2025	
Quality Assurance Director	Assoc. Prof. Qasim Kazem Humaid	22/1/2025	
Dean of College of Engineering	Prof. Dr. Ali Abdulhussein Al-Khalidi	22/1/2025	

University of Qadisiyah

College of Engineering - Roads and Transportation Department



Introduction

The educational program is a well-planned set of courses that include procedures and experiences arranged in the form of an academic syllabus. Its main goal is to improve and build graduates' skills so they are ready for the job market. The program is reviewed and evaluated every year through internal or external audit procedures and programs like the External Examiner Program.

The academic program description is a short summary of the main features of the program and its courses. It shows what skills students are working to develop based on the program's goals. This description is very important because it is the main part of getting the program accredited, and it is written by the teaching staff together under the supervision of scientific committees in the scientific departments.

This guide includes a description of the academic program after updating the subjects and paragraphs of the previous guide in light of the developments of the educational system in Iraq, adhering to the traditional annual/quarterly academic program description and national standards of the Iraqi Council for Accreditation of Engineering Education (ICAEE).

Key Concepts and Terminology:

Terminology	Definition and Academic Significance
Academic Program Description	Provides a brief summary of its vision, mission, and objectives, including an accurate description of the targeted learning outcomes according to specific learning strategies.
Course Description	Provides a brief summary of the most important characteristics of the course and the learning outcomes expected of the students to achieve, proving whether they have made the most of available learning opportunities.
Program Vision	An ambitious picture for the future of the academic program to be sophisticated, inspiring, stimulating, realistic, and applicable.
Program Mission	Briefly outlines the objectives and activities necessary to achieve them and defines the program's development paths and directions.
Program Objectives	Statements that describe what the academic program intends to achieve within a specific period of time and are measurable and observable.
Curriculum Structure	All courses/subjects included in the academic program according to the approved learning system with the number of credit hours and units.
Learning Outcomes	A compatible set of knowledge, skills, and values acquired by students after successful completion of the academic program.
Teaching and Learning Strategies	Strategies used by faculty members to develop students' learning through classroom and extracurricular activities.

Academic Program Description Form (Stage 4)

Item / Concept	Official Academic Statement
University Name	University of Al-Qadisiyah
Faculty / Institute	College of Engineering
Scientific Department	Department of Roads and Transportation Engineering
Academic Program Name	Bachelor of Science in Roads and Transportation Engineering
Final Certificate Name	B.Sc. in Roads and Transportation Engineering
Academic System	Semester / Annual System (Fourth Stage - Academic Year 2025/2026)
Description Preparation Date	October 2026
Auditing & Accreditation Authority	Quality Assurance and Academic Accreditation Division - College of Engineering

1. Program Vision

The Department of Roads and Transportation Engineering at the University of Al-Qadisiyah seeks excellence, innovation, and leadership in the field of civil, highway, and transportation engineering education and scientific research in Iraq and the region, aligning with the national infrastructure development needs and modern technological advancements.

2. Program Mission

Contribute to societal prosperity and economic growth through the preparation of qualified professional civil and highway engineers equipped with distinguished scientific knowledge and technological creativity in highway geometric design, bridge engineering, traffic management, geotechnical engineering, and transport planning. The department is committed to quality assurance and academic accreditation in accordance with national and global engineering standards while upholding professional ethics.

3. Program Objectives

1. Provide students with comprehensive scientific and engineering knowledge in highway design, bridge engineering, pavement structural design, and foundation engineering.

2. Develop students' computational and technical skills using modern software packages (e.g., Civil 3D, STAAD Pro, HCS) to solve complex transportation and structural engineering problems.

3. Equip students with professional capabilities in quantity surveying, preparation of technical specifications, contract administration, and project management.

4. Foster critical thinking, effective communication, teamwork, environmental protection, traffic safety awareness, and lifelong learning.

4. Program Accreditation

The program adheres to the national accreditation requirements of the Iraqi Council for Accreditation of Engineering Education (ICAEE) and aligns with ABET accreditation guidelines.

5. Other External Influences

The program is sponsored and supported by the Ministry of Higher Education and Scientific Research, the Ministry of Construction and Housing, Municipalities and Public Works, and the State Commission for Roads and Bridges.

6. Program Structure (Fourth Stage Focus)

Program Component	Number of Courses	Credit Units	Percentage	Notes*
University Requirements	2	4	11%	Core (English IV & Engineering Ethics)
College Requirements	-	-	-	-
Department Requirements	12	32	89%	Core (Specialized Engineering Subjects)
Total Fourth Stage	**14**	**36**	**100%**	Core Requirements

7. Program Description (Fourth Stage Subjects)

Year / Level	Course Code	Course Title	Credit Hours Theory	Credit Hours Practical / Lab	Credit Hours Tutorial	Credit Units
Fourth Stage (1st Sem.)	R.E 400	Foundation Engineering (1)	2	0	1	3
Fourth Stage (1st Sem.)	R.E 405	Design of Concrete Structures (2)	2	0	1	3

Fourth Stage (1st Sem.)	R.E 410	Design of Steel Bridges (1)	2	0	1	3
Fourth Stage (1st Sem.)	R.E 415	Highways Design 1	2	0	1	3
Fourth Stage (1st Sem.)	R.E 431	Roads Maintenance and Safety	2	0	0	2
Fourth Stage (1st Sem.)	R.E 426	Quantity Surveying and Specifications	2	0	0	2
Fourth Stage (1st Sem.)	R.E 435	Computer Applications (3)	1	2	0	2
Fourth Stage (1st Sem.)	R.E 440	English Language (4)	2	0	0	2
Fourth Stage (1st Sem.)	R.E 445	Graduation Project of 1st Semester	1	2	0	2
Fourth Stage (2nd Sem.)	R.E 401	Foundation Engineering (2)	2	0	1	3
Fourth Stage (2nd Sem.)	R.E 406	Design of Concrete Bridges	2	0	1	3
Fourth Stage (2nd Sem.)	R.E 411	Design of Steel Bridges (2)	2	0	1	3
Fourth Stage (2nd Sem.)	R.E 416	Highways Design 2	2	0	1	3
Fourth Stage (2nd Sem.)	R.E 425	Transports Planning	2	0	0	2
Fourth Stage (2nd Sem.)	R.E 420	Hydrology	2	0	0	2
Fourth Stage (2nd Sem.)	R.E 436	Computer Applications (4)	1	2	0	2

Fourth Stage (2nd Sem.)	R.E 446	Engineering Ethics	2	0	0	2
Fourth Stage (2nd Sem.)	R.E 445	Graduation Project of 2nd Semester	1	2	0	2

8. Program Expected Learning Outcomes

Outcome Code	Expected Learning Outcomes of the Program
GO.1	An ability to distinguish, identify, define, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
GO.2	An ability to produce engineering designs that meet desired needs within specified constraints by applying both analysis and synthesis in the design process.
GO.3	An ability to create and carry out proper measurement and tests with quality assurance, analyze, and interpret results, and utilize engineering judgment to make inferences.
GO.4	An ability to skillfully communicate orally with a gathering of people and in writing with various managerial levels.
GO.5	An ability to perceive ethical and professional responsibilities in engineering cases and make brilliant judgments taking into account consequences in worldwide financial, ecological, and societal considerations.
GO.6	An ability to perceive the continual necessity for professional knowledge growth and how to find, assess, assemble, and apply it properly.
GO.7	An ability to work adequately on teams and to set up objectives, plan activities, meet due dates, and manage risk and uncertainty.

Knowledge

- **GO.1:** An ability to distinguish, identify, define, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.

- **GO.6:** An ability to perceive the continual necessity for professional knowledge growth and how to find, assess, assemble, and apply it properly.

Skills

- **GO.2:** An ability to produce engineering designs that meet desired needs within certain constraints by applying both analysis and synthesis in the design process.

- **GO.3:** An ability to create and carry out proper measurement and tests with quality assurance, analyze, and interpret results, and utilize engineering judgment to make inferences.

Ethics

- **GO.4:** An ability to skillfully communicate orally with a gathering of people and in writing with various managerial levels.

- **GO.5:** An ability to perceive ethical and professional responsibilities in engineering cases and make brilliant judgments taking into account consequences in worldwide financial, ecological, and societal considerations.

- **GO.7:** An ability to work adequately on teams and to set up objectives, plan activities, meet due dates, and manage risk and uncertainty.

9. Teaching and Learning Strategies

1. **Theoretical Lectures:** To explain fundamental concepts and theoretical principles.

2. **Tutorials and Problem Solving:** To strengthen students' analytical problem-solving abilities.

3. **Laboratory and Computer Applications:** To provide practical experience in software tools and material testing.

4. **Homework and Assignments:** To encourage independent learning and continuous practice.

5. **Seminars and Design Projects:** To build teamwork skills, technical report writing, and presentation abilities.

10. Evaluation Methods

1. Daily, monthly, and mid-term written examinations.

2. Homework assignments, design sheets, and practical reports.

3. Classroom engagement, oral discussions, and quizzes.

4. Software modeling assessments and laboratory tests.

5. Project defense and poster presentations before scientific committees.

6. Final comprehensive written examinations.

11. Faculty (Fourth Stage Teaching Staff)

Faculty Member Name	Academic Rank	General Specialization	Special Requirements / Skills
Dr.Jalal Taqi Shaker Al-Obaedi	Professor	Civil Engineering	Roads and Airports Engineering
Dr.Saif Alzabeebee	Assist. Professor	Civil Engineering	Geotechnics
Dr.Hamsa Abbas Nayyef Zubaidi	Assist. Professor	Highway and Transportation Engineering	Highway and Transportation Engineering
Dr.Abeer Saeed Zebalah	Assist. Professor	Civil Engineering	Geotechnics
Dr. Salam Al-Obaidi	Assist. Professor	Civil Engineering	Structural Analysis and Design
Dr.Thulfiqar Salim	Lecturer	Civil Engineering	Building and Construction Engineering
Dr. Muhammed Abaaas Musa	Lecturer	Civil Engineering	Structural Engineering
Dr. Zaid Ali kadhim	Lecturer	Civil Engineering	Structural Engineering
Saba Mohammed Shaheed	Lecturer	Civil Engineering	Soil Mechanics
Rania Ihsan ALI	Assist. Lecturer	Roads and Transport Engineering	Roads and Transport Engineering
Rand Muhammed Jasim	Assist. Lecturer	Civil Engineering	Civil Engineering
Muhamed Jasim Shukan	Assist. Lecturer	Roads and Transport Engineering	Roads and Transport Engineering

12. Acceptance Criterion

Admission to the Bachelor's program in Roads and Transportation Engineering is governed by the Central Admission Rules of the Iraqi Ministry of Higher Education and Scientific Research based on High School GPA (Scientific / Applied tracks) and department capacity plans.

13. The Most Important Sources of Information About the Program

A. College of Engineering Official Website.

B. Handbook of the Roads and Transportation Engineering Department.

C. National Standards of the Iraqi Council for Accreditation of Engineering Education (ICAEE).

D. International Specifications (AASHTO, AISC, ACI, ASTM).

14. Program Development Plan

Continuous curriculum updating to keep pace with international universities, integration of Building Information Modeling (BIM) in road infrastructure, upgrading computing software licenses (Civil 3D, STAAD Pro, HCS), expanding field visits to highway construction sites, and aligning graduation projects with practical industry challenges.

Program Skills Map (Fourth Stage)

Course Code	Course Title	Core / Elective	GO.1	GO.2	GO.3	GO.4	GO.5	GO.6	GO.7
R.E 400	Foundation Engineering (1)	Core	✓	✓	✓				
R.E 401	Foundation Engineering (2)	Core	✓	✓	✓				
R.E 405	Design of Concrete Structures (2)	Core	✓	✓					
R.E 406	Design of Concrete Bridges	Core	✓	✓		✓			
R.E 410	Design of Steel Bridges (1)	Core	✓	✓					
R.E 411	Design of Steel Bridges (2)	Core	✓	✓		✓			

R.E 415	Highways Design 1	Core	✓	✓	✓				
R.E 416	Highways Design 2	Core	✓	✓	✓		✓		
R.E 431	Roads Maintenance and Safety	Core	✓	✓			✓	✓	
R.E 426	Quantity Surveying and Specifications	Core		✓		✓	✓		✓
R.E 425	Transports Planning	Core	✓	✓		✓	✓	✓	
R.E 420	Hydrology	Core	✓	✓	✓				
R.E 435	Computer Applications (3)	Core	✓	✓	✓			✓	
R.E 436	Computer Applications (4)	Core	✓	✓	✓			✓	
R.E 440	English Language (4)	Core				✓		✓	
R.E 446	Engineering Ethics	Core				✓	✓	✓	
R.E 445	Graduation Project	Core	✓	✓	✓	✓	✓	✓	✓

Fourth Stage

Course 1: Foundation Engineering (I)

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Foundation Engineering (I) / R.E 400
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	1st Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (2 Theory + 1 Tutorial)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To develop an understanding of subsurface exploration, soil boring logs, and soil shear strength parameter determination. 2. To present shallow foundation ultimate bearing capacity theories (Terzaghi, Meyerhof, Hansen) under vertical, inclined, and eccentric loads. 3. To calculate elastic immediate settlement and primary consolidation settlement beneath shallow footings. 4. To build capacity in the structural and geotechnical design of combined footings, strap footings, and mat/raft foundations.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Interpret subsurface site exploration data, SPT/CPT soil boring logs, and determine geotechnical design parameters.

b) Calculate ultimate and allowable bearing capacity of shallow foundations using Terzaghi, Meyerhof, and Hansen equations.

c) Evaluate bearing capacity reduction factors for footings subjected to eccentric and inclined loadings.

d) Predict elastic (immediate) settlement and primary consolidation settlement in saturated cohesive soils.

e) Perform geotechnical and structural design of rectangular and trapezoidal combined footings.

f) Design strap footings, continuous strip footings, and rigid mat/raft foundations.

g) Analyze flexible mat foundations using Winkler subgrade reaction spring models.

h) Apply geotechnical mechanics and mathematical formulations to shallow foundation design problems.

i) Produce foundation design solutions satisfying soil capacity, settlement limits, and structural code constraints.

j) Interpret geotechnical laboratory and field test data to draw engineering design parameters.

k) Work collaboratively in design teams to complete shallow foundation calculation sheets.

l) Communicate shallow foundation designs via technical calculation reports and reinforcement drawings.

m) Utilize specialized geotechnical software (PLAXIS/GeoStudio) for foundation stress and settlement analysis.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and application
7. Seminars
8. In- and Out-Class oral conversations
9. Reports, presentations, and posters

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Extracurricular activities and homework.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (2 theo., 1 tut.)	a, h, j, l	Subsurface Site Exploration: Soil borings, sampling techniques, and planning	1	3
2	3 (2 theo., 1 tut.)	a, j, k, l	In-situ Field Testing: Standard Penetration Test (SPT), CPT, and soil boring logs	1-6	1-3
3	3 (2 theo., 1 tut.)	b, h, i, l	Bearing Capacity of Shallow Foundations: Terzaghi Bearing Capacity Theory	1-9	1-3
4	3 (2 theo., 1 tut.)	b, h, i, l	General Bearing Capacity Equation (Meyerhof, Hansen, Vesic shape/depth factors)	1-9	1-3
5	3 (2 theo., 1 tut.)	c, h, i, l	Design of Shallow Footings under Eccentric and Inclined Loads	1-9	1-3
6	3 (2 theo., 1 tut.)	d, h, i, j	Settlement of Shallow Foundations: Elastic (Immediate) Settlement calculations	1-9	1-3
7	3 (2 theo., 1 tut.)	d, h, i, j	Primary Consolidation Settlement calculation in saturated cohesive soils	1-9	1-3
8	3 (2 theo., 1 tut.)	e, h, i, k	Geotechnical and Structural Design of Rectangular Combined Footings	1-9	1-3

9	3 (2 theo., 1 tut.)	e, h, i, k	Geotechnical and Structural Design of Trapezoidal Combined Footings	1-9	1-3
10	3 (2 theo., 1 tut.)	f, h, i, l	Structural Design of Strap Footings and Continuous Strip Footings	1-9	1-3
11	3 (2 theo., 1 tut.)	f, h, i, l	Mat / Raft Foundations: Types, structural behavior, and Conventional Rigid Method	1-9	1-3
12	3 (2 theo., 1 tut.)	g, h, i, m	Flexible Method for Mat Foundations using Winkler Subgrade Spring Model	1-9	1-3
13	3 (2 theo., 1 tut.)	a-g, h-m	Design of Shallow Foundations under High Groundwater Table conditions	1-9	1-3
14	3 (2 theo., 1 tut.)	a-g, h-m	Structural Concrete Reinforcement Detailing for footings and mat slabs	1-9	1-3
15	3 (2 theo., 1 tut.)	a-m	Comprehensive Shallow Foundation Design Review and Term Exam	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Principles of Foundation Engineering*, Braja M. Das, 9th Edition, Cengage Learning, 2019. 2. *Foundation Analysis and Design*, Joseph E. Bowles, 5th Edition, McGraw-Hill, 1996. **References:**

	1. *Soil Mechanics in Engineering Practice*, K. Terzaghi, R. B. Peck, G. Mesri, 3rd Edition, Wiley, 1996. **Others:** 1. Class notebook and solved shallow foundation problem sheets.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Soil Mechanics Laboratory equipment. 2. Excel spreadsheets / PLAXIS 2D for footing settlement and mat analysis.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Field visits to site investigation boring rigs and shallow foundation construction sites.

15. Admissions	**Details**
Pre-requisites	R.E 301, R.E 302
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	**Instructor Academic Profile**
Primary Instructor	Assist. Prof. Dr. Saif Alzabeebee Ph.D. Civil Engineering – Geotechnics saif.alzabeebee@qu.edu.iq
Co-Instructor	N/A

Course 2: Design of Concrete Structures (II)

No. & Field Header	**Specification Details**
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Design of Concrete Structures (II) / R.E 405
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program

5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	1st Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (2 Theory + 1 Tutorial)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To present analysis and design methods for two-way edge-supported slab systems per ACI 318 code. 2. To design flat plates and flat slabs considering one-way and two-way punching shear. 3. To apply Yield Line Theory to determine ultimate flexural strength of concrete slabs. 4. To design slender concrete columns and beam sections under combined flexure, shear, and torsion.

10. Learning Outcomes, Teaching, Learning and Assessment Method

By the end of this course, the student should be able to :

a) Determine minimum thickness and calculate total static moment M_0 for two-way slabs per ACI 318.

b) Apply the ACI Direct Design Method (DDM) and Equivalent Frame Method (EFM) to two-way slab systems.

c) Evaluate punching shear strength and design shear stud rails/drop panels in flat plate floor systems.

d) Apply Yield Line Theory and virtual work method to determine plastic collapse mechanisms of slabs.

e) Evaluate column slenderness ratio (KL/r) and design slender columns using the Moment Magnification Method.

f) Design reinforced concrete beam sections under combined flexure, shear, and torsional moment (T_u).

g) Detail longitudinal and transverse reinforcement for two-way slabs, slender columns, and torsional members.

h) Apply structural concrete mechanics and ACI 318 code equations to building frame problems.

i) Produce concrete element designs satisfying ultimate strength, serviceability, and safety criteria.

j) Work collaboratively in structural design teams to prepare complete floor slab calculation packages.

k) Communicate structural concrete designs through standard structural engineering drawings.

l) Utilize structural software (ETABS/SAFE) and design spreadsheets for slab and column analysis.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and design assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and code specifications
7. Seminars
8. Structural drawing sheets
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Structural design sheets and homework.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)

1	3 (2 theo., 1 tut.)	a, h, i, k	Two-Way Edge-Supported Slabs: Behavior, classification, minimum thickness	1	3
2	3 (2 theo., 1 tut.)	a, b, h, i, k	ACI Direct Design Method (DDM): Limitations, total static moment M_0	1-6	1-3
3	3 (2 theo., 1 tut.)	b, h, i, k	Distribution of bending moments into Column Strips and Middle Strips	1-9	1-3
4	3 (2 theo., 1 tut.)	b, h, i, l	Equivalent Frame Method (EFM): Frame idealization and structural analysis	1-9	1-3
5	3 (2 theo., 1 tut.)	c, h, i, k	Flat Plates and Flat Slabs: One-way vs two-way punching shear strength	1-9	1-3
6	3 (2 theo., 1 tut.)	c, h, i, k	Punching shear reinforcement design: Shear studs, stirrups, drop panels	1-9	1-3
7	3 (2 theo., 1 tut.)	d, h, i, k	Yield Line Theory: Virtual work principle and yield mechanisms in slabs	1-9	1-3
8	3 (2 theo., 1 tut.)	d, h, i, k	Yield line analysis for rectangular, triangular, and circular concrete slabs	1-9	1-3
9	3 (2 theo., 1 tut.)	e, h, i, k	Slender Columns: Slenderness ratio, sway vs non-sway frame classification	1-9	1-3
10	3 (2 theo., 1 tut.)	e, h, i, k	Moment Magnification Method for non-sway slender column design	1-9	1-3
11	3 (2 theo., 1 tut.)	e, h, i, k	Moment Magnification Method for sway slender frame column design	1-9	1-3

12	3 (2 theo., 1 tut.)	f, h, i, k	Torsion in Concrete Beams: Thin-walled tube analogy and cracking torque	1-9	1-3
13	3 (2 theo., 1 tut.)	f, h, i, k	Combined Shear, Flexure, and Torsional Moment Design per ACI 318	1-9	1-3
14	3 (2 theo., 1 tut.)	g, h, i, k	Reinforcement Detailing for Torsion: Closed stirrups and longitudinal bars	1-9	1-3
15	3 (2 theo., 1 tut.)	a-l	Comprehensive Concrete Structures Design Review and Term Exam	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Design of Reinforced Concrete*, Jack C. McCormac, Russell H. Brown, 10th Edition, Wiley, 2015. **References:** 1. *Reinforced Concrete Mechanics and Design*, James K. Wight, 7th Edition, Pearson, 2016. **Others:** 1. ACI 318M Structural Concrete Building Code. 2. Collection of solved design sheets and exam archives.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Structural Engineering Software (ETABS, SAFE). 2. Excel spreadsheets for moment distribution and column interaction diagrams.

Community-based facilities (include for example, guest Lectures, internship, field studies)	Site visits to ongoing multi-story concrete building construction sites.

15. Admissions	**Details**
Pre-requisites	R.E 305, R.E 306
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	**Instructor Academic Profile**
Primary Instructor	Assist. Prof. Dr. Salam Al-Obaidi Ph.D. Civil Engineering – Structural Analysis and Design salam.methem@qu.edu.iq
Co-Instructor	Lecturer Dr. Thulfiqar Salim Hussein Ph.D. Civil Engineering – Building and Construction Engineering Thulfiqar.Hussein@qu.edu.iq

Course 3: Design of Steel Structures (I)

No. & Field Header	**Specification Details**
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Design of Steel Structures (I) / R.E 410
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	1st Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (2 Theory + 1 Tutorial)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:**

	1. To present structural steel material properties, AISC LRFD specifications, and safety factor principles. 2. To design steel tension members, considering gross yielding, net fracture, and block shear rupture. 3. To design steel compression columns considering flexural and local buckling. 4. To design high-strength bolted connections and welded joints under shear, tension, and eccentricity.

10. Learning Outcomes, Teaching, Learning and Assessment Method

By the end of this course, the student should be able to :

a) Understand mechanical properties of structural steel grades and LRFD load combination philosophy.

b) Calculate design tensile strength for tension members considering gross yielding, net fracture, and shear lag (U).

c) Evaluate block shear rupture capacity in bolted tension connections and splice plates.

d) Determine effective slenderness ratio (KL/r) and design steel compression columns per AISC specifications.

e) Check local buckling limits for compact and non-compact steel compression elements.

f) Design high-strength bolted connections (A325, A490) for bearing, shear, slip-critical, and eccentric loading.

g) Design fillet and groove welded connections subjected to axial and eccentric forces.

h) Apply structural steel mechanics and AISC LRFD specifications to steel framing problems.

i) Produce structural steel element designs satisfying strength and serviceability requirements.

j) Work collaboratively in teams to prepare structural steel connection calculation sheets.

k) Communicate structural steel designs using standardized steel detailing drawings.

l) Utilize steel design spreadsheets and software for automated section selection.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and design assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and AISC code
7. Seminars
8. Structural steel drawing sheets
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Steel design sheets and homework.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (2 theo., 1 tut.)	a, h, k	Structural Steel Properties: Grades, AISC LRFD design philosophy, safety factors	1	3
2	3 (2 theo., 1 tut.)	a, h, i, k	LRFD Load Factors, Load Combinations, and Resistance Factors (ϕ)	1-6	1-3
3	3 (2 theo., 1 tut.)	b, h, i, k	Design of Steel Tension Members: Gross section yielding vs net fracture	1-9	1-3

4	3 (2 theo., 1 tut.)	b, h, i, k	Net Section Area Calculations: Staggered bolt holes and shear lag factor (U)	1-9	1-3
5	3 (2 theo., 1 tut.)	c, h, i, k	Block Shear Rupture Strength and design of steel tension splice connections	1-9	1-3
6	3 (2 theo., 1 tut.)	d, h, i, k	Steel Column Stability: Euler buckling load, effective slenderness ratio (KL/r)	1-9	1-3
7	3 (2 theo., 1 tut.)	d, h, i, k	AISC Column Design Curves for flexural buckling strength determination	1-9	1-3
8	3 (2 theo., 1 tut.)	e, h, i, k	Local Buckling Limits: Compact vs non-compact sections in compression	1-9	1-3
9	3 (2 theo., 1 tut.)	d, e, h, i, j	Design of Built-Up Steel Compression Columns and lacing/batten plates	1-9	1-3
10	3 (2 theo., 1 tut.)	f, h, i, k	High-Strength Bolts (A325, A490): Bolt shear strength and bearing strength	1-9	1-3
11	3 (2 theo., 1 tut.)	f, h, i, k	Slip-Critical Bolted Connections Design and eccentric bolted connections	1-9	1-3
12	3 (2 theo., 1 tut.)	g, h, i, k	Welding Processes: Fillet weld strength design and effective weld size	1-9	1-3
13	3 (2 theo., 1 tut.)	g, h, i, k	Complete Joint Penetration (CJP) and Partial (PJP) groove weld design	1-9	1-3
14	3 (2 theo., 1 tut.)	f, g, h, i, l	Design of Eccentric Welded Connections using elastic and ultimate strength methods	1-9	1-3

15	3 (2 theo., 1 tut.)	a-l	Comprehensive Steel Structures Design Review and Term Exam	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Structural Steel Design*, Jack C. McCormac, Stephen F. Csernak, 6th Edition, Pearson, 2018. **References:** 1. *Steel Structures: Design and Behavior*, C. G. Salmon, J. E. Johnson, Pearson. **Others:** 1. AISC Steel Construction Manual (15th Edition). 2. Collection of steel connection design sheets.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. AISC Interactive Steel Design Tables. 2. Excel spreadsheets for tension, column, and connection design.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Field visits to steel fabrication workshops and industrial steel portal frame sites.

15. Admissions	**Details**
Pre-requisites	R.E 310, R.E 311
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	**Instructor Academic Profile**
Primary Instructor	Lecturer Dr.Muhammed Abaaas Musa Ph.D. Civil Engineering – Structural Engineering Mohammed.mousa@qu.edu.iq
Co-Instructor	N/A

Course 4: Highways Design (I)

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Highways Design (I) / R.E 415
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	1st Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (2 Theory + 1 Tutorial)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To present highway functional classification, design controls, design vehicles, and traffic parameters per AASHTO Green Book. 2. To calculate Stopping Sight Distance (SSD), Passing Sight Distance (PSD), and Decision Sight Distance (DSD). 3. To perform geometric design of simple circular, compound, and spiral transition horizontal alignment curves. 4. To design crest and sag vertical curves, earthwork volumes, and Mass-Haul Diagrams.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Classify rural and urban highway networks, design speed controls, and design vehicles. b) Compute Stopping Sight Distance (SSD), Passing Sight Distance (PSD), and Decision Sight Distance (DSD) on grades.

c) Perform geometric design of circular horizontal curves, spiral transition curves, and check sight distance obstructions.

d) Calculate superelevation runoff lengths, superelevation rates (e), and pavement widening on horizontal curves.
e) Design crest and sag parabolic vertical curves satisfying sight distance, driver comfort, and drainage requirements.
f) Compute highway cross-sectional areas, earthwork cut/fill volumes, and construct Mass-Haul Diagrams.
g) Apply highway geometric principles and AASHTO guidelines to highway corridor problems.
h) Produce highway geometric designs meeting terrain, safety, and operational constraints.
i) Work collaboratively in design teams to complete full corridor geometric plan and profile sets.
j) Communicate highway engineering designs through standard plan, profile, and cross-section sheets.
k) Utilize highway CAD software (Autodesk Civil 3D) for 3D alignment and earthwork calculations.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and drawing assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and AASHTO Green Book
7. Seminars
8. Highway design drawing sheets
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Highway geometric drawing sheets and homework.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (2 theo., 1 tut.)	a, g, j	Highway Engineering Introduction: Functional	1	3

			classification, rural vs urban roads		
2	3 (2 theo., 1 tut.)	a, g, h, j	Design Controls: Design vehicle, design speed, traffic volumes (ADT, DHV, K-factor)	1-6	1-3
3	3 (2 theo., 1 tut.)	b, g, h, j	Stopping Sight Distance (SSD) formulation on level terrain and steep grades	1-9	1-3
4	3 (2 theo., 1 tut.)	b, g, h, j	Passing Sight Distance (PSD) and Decision Sight Distance (DSD) calculations	1-9	1-3
5	3 (2 theo., 1 tut.)	c, d, g, h, j	Horizontal Alignment Mechanics: Side friction factor (f), superelevation (e)	1-9	1-3
6	3 (2 theo., 1 tut.)	c, d, g, h, j	Design of Simple Circular Horizontal Curves and sight distance obstructions	1-9	1-3
7	3 (2 theo., 1 tut.)	d, g, h, j	Superelevation Development Methods: Axis of rotation, runoff & tangent runout	1-9	1-3
8	3 (2 theo., 1 tut.)	c, d, g, h, j	Spiral Transition Curves Mechanics and pavement widening on horizontal curves	1-9	1-3
9	3 (2 theo., 1 tut.)	e, g, h, j	Vertical Alignment: Maximum grades, critical length of grade, climbing lanes	1-9	1-3
10	3 (2 theo., 1 tut.)	e, g, h, j	Parabolic Vertical Curve Equations (Crest and Sag vertical curve geometry)	1-9	1-3
11	3 (2 theo., 1 tut.)	e, g, h, j	Geometric Design of Crest Vertical Curves for SSD and PSD requirements	1-9	1-3
12	3 (2 theo., 1 tut.)	e, g, h, j	Geometric Design of Sag Vertical Curves for	1-9	1-3

			headlight, comfort, and drainage		
13	3 (2 theo., 1 tut.)	f, g, h, j	Highway Cross-Sectional Elements: Lanes, shoulders, medians, side slopes	1-9	1-3
14	3 (2 theo., 1 tut.)	f, g, h, k	Earthwork Volume Calculations: Average End Area Method & Mass-Haul Diagram	1-9	1-3
15	3 (2 theo., 1 tut.)	a-k	Comprehensive Highway Geometric Design Review and Term Exam	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *A Policy on Geometric Design of Highways and Streets* (AASHTO Green Book), 7th Edition, AASHTO, 2018. **References:** 1. *Highway Engineering*, Paul H. Wright, Karen Dixon, 7th Edition, Wiley, 2004. **Others:** 1. Iraqi Highway Design Manual (IHDM). 2. Collection of highway plan and profile drawing sheets.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Highway Design CAD Software (Autodesk Civil 3D). 2. Excel spreadsheets for horizontal/vertical curve design and earthwork mass-haul.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Field visits to highway earthwork and grading construction sites.

15. Admissions	**Details**

Pre-requisites	R.E 315
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	**Instructor Academic Profile**
Primary Instructor	Prof. Dr. Jalal Taqi Shaker Al-Obaedi Ph.D. Civil Engineering – Roads and Airports Engineering jalal.alobaedi@qu.edu.iq
Co-Instructor	Assistant Lecturer Rania Ihsan Ali M.Sc. Civil Engineering – Roads and Transport Engineering rainaali.eng.road@qu.edu.iq

Course 5: Roads Maintenance and Safety

No. & Field Header	**Specification Details**
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Roads Maintenance and Safety / R.E 431
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	1st Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	30 hrs. / 2 hrs. per week (2 Theory)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To develop an understanding of Pavement Management Systems (PMS) and pavement condition evaluation. 2. To present flexible and rigid pavement distress identification techniques and Pavement Condition Index (PCI) calculations. 3. To build capacity in selecting appropriate preventive, corrective, and structural road maintenance treatments.

	4. To develop knowledge in traffic safety management, crash data analysis, black-spot identification, and road safety audits.

10. Learning Outcomes, Teaching, Learning and Assessment Method

By the end of this course, the student should be able to :

a) Explain the core components and operational framework of Pavement Management Systems (PMS).

b) Identify and measure flexible pavement distresses (fatigue cracking, rutting, raveling, bleeding, edge cracking).

c) Conduct field pavement condition surveys and compute Pavement Condition Index (PCI) per ASTM D6433.

d) Select appropriate preventive maintenance treatments (crack sealing, fog seal, slurry seal, chip seal).

e) Evaluate structural pavement distresses and select rehabilitation strategies (patching, milling, HMA overlays).

f) Identify rigid pavement distresses (spalling, faulting, corner breaks) and select joint/slab repair techniques.

g) Analyze traffic collision data, calculate accident rates, and construct collision diagrams.

h) Identify high-accident locations (Black Spots) using statistical methods and safety performance functions.

i) Conduct Road Safety Audits (RSA) across planning, design, and operational stages using standard checklists.

j) Evaluate highway safety hardware including guardrails, median barriers, and crash cushions.

k) Formulate work zone traffic management plans and safety measures during highway maintenance operations.

l) Apply pavement maintenance guidelines and AASHTO Highway Safety Manual (HSM) procedures.

m) Develop pavement rehabilitation and traffic safety solutions considering economic and safety impacts.

n) Analyze field pavement distress and crash data using engineering judgment.

o) Function effectively on multidisciplinary road safety auditing and pavement inspection teams.

p) Communicate maintenance decisions and safety audit findings through technical reports.

q) Utilize pavement management software (MicroPAVER) and statistical crash analysis tools.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and field reports
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and field distress photos/videos
7. Seminars
8. Case study analysis
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Field distress reports and safety audit assignments.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	2 theo.	a, l, p	Introduction to Pavement Management Systems (PMS) and road maintenance objectives	1	3
2	2 theo.	b, n, p	Flexible Pavement Distresses: Cracking	1-6	1-3

			types (Fatigue, Longitudinal, Transverse)		
3	2 theo.	b, n, p	Flexible Pavement Distresses: Deformation (Rutting, Shoving), Surface defects	1-9	1-3
4	2 theo.	c, n, p	Pavement Condition Index (PCI) Survey Methodology per ASTM D6433	1-9	1-3
5	2 theo.	c, n, q	PCI Calculation Procedure: Distress density, deduct values, corrected deduct value	1-9	1-3
6	2 theo.	d, m, p	Preventive Maintenance Techniques: Crack sealing, fog seal, slurry seal, micro-surfacing	1-9	1-3
7	2 theo.	e, m, p	Corrective Maintenance & Rehabilitation: Patching, HMA overlays, asphalt recycling	1-9	1-3
8	2 theo.	f, m, p	Rigid Pavement Distresses (faulting, spalling, corner breaks) and repair methods	1-9	1-3
9	2 theo.	g, l, m, p	Fundamentals of Traffic Safety: Human, vehicle, and roadway environment factors	1-9	1-3
10	2 theo.	g, h, n, p	Traffic Collision Data Collection, crash report analysis, accident rate calculations	1-9	1-3
11	2 theo.	h, n, q	Identification of High-Accident Locations (Black Spots): Statistical methods	1-9	1-3
12	2 theo.	h, n, p	Traffic Conflict Technique (TCT) and accident reconstruction principles	1-9	1-3

13	2 theo.	i, m, o, p	Road Safety Audit (RSA) stages, procedures, and safety checklists	1-9	1-3
14	2 theo.	j, m, p	Highway Safety Hardware: Longitudinal barriers, guardrails, crash cushions	1-9	1-3
15	2 theo.	k, m, p	Work Zone Traffic Control and Safety Measures during road maintenance operations	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Highway Safety Manual* (HSM), 1st Edition, AASHTO, 2010. 2. *Pavement Maintenance Management*, AASHTO Maintenance Guide. **References:** 1. *ASTM D6433 Standard Practice for Roads Pavement Condition Index Surveys*. 2. *Roadside Design Guide*, 4th Edition, AASHTO, 2011. **Others:** 1. MicroPAVER Pavement Management Software User Manual. 2. Collection of field pavement distress photos and traffic collision reports.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Pavement Distress Inspection Equipment. 2. Excel spreadsheets for PCI calculations and accident rate analysis.

Community-based facilities (include for example, guest Lectures, internship, field studies)	Field studies on urban arterial road distresses and safety audits.

15. Admissions	**Details**
Pre-requisites	R.E 315
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	**Instructor Academic Profile**
Primary Instructor	Assist. Prof. Dr.Hamsa Abbas Zubaidi Ph.D. Highway and Transportation Engineering hamsa.alzubaidi@qu.edu.iq
Co-Instructor	Assist. Lecturer Muhamed Jasim Shukan M.Sc/ Road Eng. mohammed.jassim@qu.edu.iq

Course 6: Quantity Surveying and Specifications

No. & Field Header	**Specification Details**
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Quantity Surveying and Specifications / R.E 426
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	1st Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	30 hrs. / 2 hrs. per week (2 Theory)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To develop an understanding of quantity takeoff principles for highway, bridge, and earthwork engineering projects.

	2. To present procedures for preparing standard Bill of Quantities (BOQ), unit rate analysis, and total project cost estimation. 3. To build capacity in interpreting Iraqi General Standard Specifications for Roads and Bridges (SORB). 4. To develop knowledge in engineering contracts, bidding procedures, and FIDIC conditions of contract.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Interpret engineering contract documents, tender drawings, technical specifications, and legal contract structures. b) Perform detailed quantity takeoff for earthwork operations, including cut, fill, compaction factors, and borrow pits. c) Perform quantity takeoff for pavement structural layers (subbase, aggregate base, prime/tack coats, HMA). d) Compute concrete volumes, formwork areas, and prepare Bar Bending Schedules (BBS) for culverts and bridge structures. e) Conduct unit rate analysis incorporating raw material costs, equipment hourly rates, labor wages, overheads, and profit. f) Prepare priced Bills of Quantities (BOQ) structured according to standard Iraqi Ministry specifications. g) Process interim and final payment certificates, evaluate variation orders, and analyze engineering contract claims. h) Apply clauses of the Iraqi General Standard Specifications for Roads and Bridges (SORB). i) Apply terms and conditions of the FIDIC Conditions of Contract for Construction (Red Book). j) Apply mathematical mensuration formulas and engineering economics to cost estimation problems.

k) Formulate construction cost estimates and contract documents meeting financial and legal constraints.

l) Recognize ethical responsibilities and legal standards in bidding and contract administration.

m) Work collaboratively in estimation teams to compile comprehensive project tender documents.

n) Communicate cost estimates and contract terms through professional BOQ spreadsheets.

o) Utilize spreadsheet software (MS Excel) for automated estimation and BBS generation.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and BOQ assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and actual engineering drawings
7. Seminars
8. Spreadsheet exercises
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Quantity takeoff sheets and BOQ assignments.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	2 theo.	a, l, n	Introduction to Quantity Surveying, contract documents, and bidding procedures	1	3

2	2 theo.	a, i, l, n	Structure of Engineering Contracts, role of resident engineer and quantity surveyor	1-6	1-3
3	2 theo.	j, n, o	Quantity Takeoff Principles: Units of measurement and mensuration formulas	1-9	1-3
4	2 theo.	b, j, n	Highway Earthwork Quantity Calculation: Cut and fill from cross-section sheets	1-9	1-3
5	2 theo.	b, j, n	Earthwork Compaction Factors, shrinkage, swell, and mass-haul quantities	1-9	1-3
6	2 theo.	c, j, n	Quantity Takeoff for Pavement Layers: Subbase, aggregate base, prime/tack coat	1-9	1-3
7	2 theo.	c, j, n	Quantity Takeoff for Asphalt Binder and Wearing Courses (tons / m^2)	1-9	1-3
8	2 theo.	d, j, n	Quantity Takeoff for Box and Pipe Culverts: Excavation, bedding, concrete volume	1-9	1-3
9	2 theo.	d, j, n, o	Preparation of Bar Bending Schedules (BBS) for reinforced concrete culverts	1-9	1-3
10	2 theo.	d, j, n	Concrete and Steel Reinforcement Takeoff for bridge piers and deck slabs	1-9	1-3
11	2 theo.	e, j, k, n	Unit Rate Analysis: Material costs, equipment hourly rates, labor wages, overheads	1-9	1-3
12	2 theo.	f, k, m, n, o	Preparation of Standard Bill of Quantities (BOQ) per Iraqi Ministry formats	1-9	1-3

13	2 theo.	g, l, n	Payment Certificates (Interim and Final), variation orders, and claims	1-9	1-3
14	2 theo.	h, l, n	Iraqi Standard Specifications for Roads and Bridges (SORB) overview	1-9	1-3
15	2 theo.	i, l, n	Conditions of Contract for Construction (FIDIC Red Book) overview	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Standard Specifications for Roads and Bridges* (SORB - Iraq), State Commission for Roads and Bridges. 2. *Estimating in Building Construction*, Frank R. Dagostino, 8th Edition, Pearson, 2014. **References:** 1. *FIDIC Conditions of Contract for Construction* (Red Book), 1st Edition, FIDIC, 1999. **Others:** 1. Sample BOQ forms from the Ministry of Construction and Housing. 2. Collection of highway contract drawing sets for takeoff practice.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. MS Excel for BOQ spreadsheets and rate analysis. 2. Available websites related to FIDIC and Ministry specifications.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Guest lectures by senior resident engineers and contract administrators.

15. Admissions	Details
Pre-requisites	R.E 326
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	Instructor Academic Profile
Primary Instructor	Lecturer Dr Zaid Ali kadhim Ph.D. Civil Engineering – Structural Engineering zaidalzaidi20142016@gmail.com
Co-Instructor	N/A

Course 7: Computer Applications in Roads Engineering (III)

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Computer Applications in Roads Engineering (III) / R.E 435
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	1st Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (1 Theory + 2 Practical Lab)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To develop practical skills in Autodesk Civil 3D for 3D terrain modeling, contour analysis, and point group management. 2. To design 3D horizontal alignments, spiral transition curves, and superelevation in Civil 3D. 3. To design vertical profiles, vertical curves, custom assemblies, and 3D highway corridors.

	4. To generate cross-sections, sample lines, earthwork volume reports, and Mass-Haul diagrams in Civil 3D.

10. Learning Outcomes, Teaching, Learning and Assessment Method

By the end of this course, the student should be able to :

a) Import survey point data, create 3D Digital Terrain Models (TIN surfaces), and perform contour editing in Civil 3D.

b) Design horizontal highway alignments, spiral transition curves, and superelevation in Autodesk Civil 3D.

c) Extract ground profiles, design vertical alignment layout profiles, and vertical curves in Civil 3D.

d) Create custom assemblies/subassemblies and construct 3D highway corridors with target surfaces.

e) Generate sample lines, section views, and compute earthwork cut/fill volumes and Mass-Haul diagrams in Civil 3D.

f) Apply CAD software algorithms to solve complex highway geometric design problems.

g) Produce integrated 3D highway corridor solutions meeting AASHTO geometric design constraints.

h) Work collaboratively in computer laboratory teams to deliver full Civil 3D highway project files.

i) Recognize professional responsibilities and verify accuracy of computer-generated CAD outputs.

j) Communicate engineering designs effectively through computer-generated plan, profile, and section sheets.

k) Master Civil 3D software tools for professional highway design practice.

11. Teaching and Learning Methods

1. Theoretical lectures explaining software algorithms
2. Computer laboratory sessions
3. Homework and software project assignments

4. Tests and Practical Exams
5. In-Class questions and software troubleshooting
6. Connection between theory and software operations
7. Seminars
8. Hands-on computer exercises
9. Software project reports and presentations

12. Assessment methods

1. Practical Examinations, Software Tests, and Quizzes.
2. Weekly software design files and project submissions.
3. Student engagement during laboratory sessions.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (1 th., 2 lab)	a, f, j, k	Autodesk Civil 3D Interface, point styles, importing survey point files	1	3
2	3 (1 th., 2 lab)	a, f, j, k	Creating Point Groups, 3D surface generation (TIN surfaces), boundary definitions	1-6	1-3
3	3 (1 th., 2 lab)	a, f, j, k	Surface Analysis: Slope vectors, contour style editing, elevation analysis	1-9	1-3
4	3 (1 th., 2 lab)	b, f, g, j, k	Horizontal Alignment Design: Creating alignments from polylines, design criteria	1-9	1-3
5	3 (1 th., 2 lab)	b, f, g, j, k	Editing curve radius, adding spiral transition curves, design speed tables	1-9	1-3
6	3 (1 th., 2 lab)	b, f, g, j, k	Superelevation Wizard: Specifying lane widths, crown slope, runoff length	1-9	1-3

7	3 (1 th., 2 lab)	b, f, g, j, k	Superelevation View Creation and manual superelevation station editing	1-9	1-3
8	3 (1 th., 2 lab)	c, f, g, j, k	Existing Ground Surface Profile extraction along horizontal alignment	1-9	1-3
9	3 (1 th., 2 lab)	c, f, g, j, k	Design Vertical Profile Creation: Layout tools, grade lines, vertical curves	1-9	1-3
10	3 (1 th., 2 lab)	d, f, g, j, k	Assembly Creation: Subassemblies (lanes, shoulders, curbs, side slopes)	1-9	1-3
11	3 (1 th., 2 lab)	d, f, g, j, k	Corridor Modeling: Target surface assignment, frequency, corridor rebuilding	1-9	1-3
12	3 (1 th., 2 lab)	e, f, g, j, k	Sample Line Creation along corridor at specified station increments	1-9	1-3
13	3 (1 th., 2 lab)	e, f, g, j, k	Cross-Section View Creation, material list definition (Cut, Fill, Pavement)	1-9	1-3
14	3 (1 th., 2 lab)	e, f, g, j, k	Earthwork Volume Reports, Mass-Haul Diagram generation in Civil 3D	1-9	1-3
15	3 (1 th., 2 lab)	a-k	Comprehensive Civil 3D Highway Design Project Completion and Exam	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Autodesk Civil 3D Essentials User Guide*, Autodesk Press. **References:**

	1. *Mastering Autodesk Civil 3D*, Cyndy Davenport, Ishka Voiculescu, Sybex. **Others:** 1. Computer lab exercise sheets and sample CAD survey files.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. CAD Computer Laboratory equipped with Civil 3D software licenses. 2. Available websites related to Autodesk Knowledge Network.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Hands-on workshops led by certified Autodesk Civil 3D specialists.

15. Admissions	**Details**
Pre-requisites	R.E 335
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	**Instructor Academic Profile**
Primary Instructor	Assist. Prof. Dr..Abeer Saeed Zebalah Ph.D. Civil Engineering – Geotechnics abeer.alkraway@qu.edu.iq
Co-Instructor	Assistant Lecturer Rand Muhammed Jasim M.Sc. Civil Engineering rand.mohammed.eng@qu.edu.iq

Course 8: English Language (IV)

No. & Field Header	**Specification Details**
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah

2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	English Language (IV) / R.E 440
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	1st Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	30 hrs. / 2 hrs. per week (2 Theory)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To develop technical writing skills required for engineering reports, executive summaries, and research proposals. 2. To present specialized technical terminology related to highways, bridge structures, traffic, and soil engineering. 3. To build capacity in reading, interpreting, and describing engineering drawings, data tables, and charts in English. 4. To develop oral communication, public speaking, and presentation skills for academic project defenses.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Distinguish between general English writing and professional engineering technical writing styles. b) Structure formal technical reports, executive summaries, methodology sections, and conclusions. c) Master specialized vocabulary in highway geometric design, pavement engineering, bridges, and soil mechanics.

d) Draft formal business correspondence, method statements, technical emails, and project cover letters.
e) Write technical project proposals and bidding letters following standard international formats.
f) Describe engineering processes, experimental setups, flowcharts, and technical drawings in accurate English.
g) Interpret data tables, graphs, and charts, and write clear data commentary on engineering trends.
h) Structure academic oral presentations and design clean, visually effective PowerPoint slides.
i) Demonstrate effective public speaking techniques, signposting language, and professional body language.
j) Manage question and answer (Q&A) sessions effectively during technical presentations and thesis defenses.
k) Apply advanced English language skills to technical communication in professional engineering contexts.
l) Work collaboratively in teams to prepare joint presentation slide decks.
m) Recognize ethical requirements regarding proper citation, avoiding plagiarism, and academic integrity.
n) Formulate and refine technical writing outputs to meet formal academic and industrial standards.
o) Communicate engineering concepts clearly and persuasively to both technical and non-technical audiences.

11. Teaching and Learning Methods

1. Lectures
2. Interactive exercises
3. Homework and writing assignments
4. Tests and Exams
5. In-Class oral presentations
6. Technical reading comprehension
7. Seminars
8. Individual presentation practice
9. Reports and slide portfolios

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Technical writing assignments and vocabulary quizzes.
3. Oral technical presentations and student engagement.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	2 theo.	a, b, k, n, o	Principles of Technical Writing vs General Writing; Report structure and formatting	1	3
2	2 theo.	b, k, n, o	Writing Effective Abstract and Executive Summary sections for engineering reports	1-6	1-3
3	2 theo.	c, k, o	Technical Vocabulary: Highway geometric design and pavement engineering terms	1-9	1-3
4	2 theo.	c, k, o	Technical Vocabulary: Bridge structures, concrete, steel, and foundation terms	1-9	1-3
5	2 theo.	d, k, o	Drafting Formal Business Letters, method statements, and professional emails	1-9	1-3
6	2 theo.	e, k, o	Writing Technical Proposals and bidding cover letters in clear English	1-9	1-3
7	2 theo.	f, k, o	Describing Process Flow, experimental procedures, and laboratory test setups	1-9	1-3
8	2 theo.	g, k, o	Data Commentary: Describing trends in graphs, charts, and statistical tables	1-9	1-3
9	2 theo.	f, g, k, m, o	Interpreting Technical Specifications and contract clause language in English	1-9	1-3
10	2 theo.	h, k, o	Structure of an Academic Oral Presentation;	1-9	1-3

			Designing effective visual slides		
11	2 theo.	i, k, o	Public Speaking Techniques, body language, and signposting language during talks	1-9	1-3
12	2 theo.	j, k, o	Handling Question and Answer (Q&A) sessions during academic thesis defenses	1-9	1-3
13	2 theo.	h, i, j, k, l, o	Student Technical Presentations on graduation project topics (Session 1)	1-9	1-3
14	2 theo.	h, i, j, k, l, o	Student Technical Presentations on graduation project topics (Session 2)	1-9	1-3
15	2 theo.	a-o	Course Review, final technical essay writing, and presentation feedback	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Technical English for Engineers*, Cambridge University Press. **References:** 1. *Oxford English for Careers: Engineering*, Lewis Lansford, Peter Astley, Oxford. **Others:** 1. Technical writing style guides and grammar handouts.

Special requirements (include for example workshops, periodicals, IT software, websites)	1. Multimedia classroom equipped with audio/video projection. 2. Presentation software (MS PowerPoint).
Community-based facilities (include for example, guest Lectures, internship, field studies)	Public speaking workshops and presentation practice sessions.

15. Admissions	**Details**
Pre-requisites	R.E 340
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	**Instructor Academic Profile**
Primary Instructor	Lecturer Saba Mohammed Shaheed M.Sc. Civil Engineering – Soil Mechanics saba.shheed@qu.edu.iq
Co-Instructor	N/A

Course 9: Graduation Project (I)

No. & Field Header	**Specification Details**
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Graduation Project (I) / R.E 445-A
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	1st Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (1 Advising + 2 Practical/Lab)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:**

	1. To select and formulate a research problem statement in roads, bridges, traffic, or geotechnical engineering. 2. To perform a comprehensive literature review of peer-reviewed journals, specifications, and design manuals. 3. To establish a research methodology, Gantt chart timeline, and initiate field traffic/survey data collection. 4. To present a mid-year progress seminar and submit Semester 1 project progress report.

10. Learning Outcomes, Teaching, Learning and Assessment Method

By the end of this course, the student should be able to :

a) Formulate a clear engineering research problem statement, project scope, and specific objectives.

b) Conduct a detailed literature review summarizing previous academic studies and design specifications.

c) Develop a project work breakdown structure (WBS) and Gantt chart timeline.

d) Plan and execute preliminary field data collection (traffic counts, topographic GPS surveys) and laboratory testing.

e) Prepare and deliver a progress presentation before a scientific examining committee.

f) Apply engineering principles to define complex roads infrastructure problems.

g) Identify public health, safety, environmental, and economic factors relevant to project scope.

h) Communicate research proposal and preliminary data through written reports and oral presentations.

i) Function effectively on a student project team, establishing goals and meeting project milestones.

j) Acquire new knowledge independently using peer-reviewed journals and design standards.

11. Teaching and Learning Methods

1. Weekly faculty advisor supervision sessions
2. Independent field surveys and laboratory experiments
3. Literature review research
4. Mid-year progress seminar
5. In-Class questions and discussions
6. Connection between theory and actual engineering projects
7. Seminars and draft proposal reviews
8. Oral rehearsal presentations
9. Progress report and poster defense

12. Assessment methods

1. Advisor progress evaluation.
2. Mid-year progress seminar defense before examining committee.
3. Written progress report submission.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (1 adv., 2 lab)	a, f, h, i	Project Allocation, assigning faculty advisors, team formation, and initial briefing	1	3
2	3 (1 adv., 2 lab)	a, f, g, h	Problem Statement Definition, scope definition, establishing project methodology	1-6	1-3
3	3 (1 adv., 2 lab)	c, h, i	Project Scheduling, Work Breakdown Structure (WBS), Gantt chart preparation	1-9	1-3
4	3 (1 adv., 2 lab)	b, h, j	Literature Review: Finding peer-reviewed journals, codes, and design manuals	1-9	1-3
5	3 (1 adv., 2 lab)	b, h, j	Summarizing Previous Studies and identifying the engineering research gap	1-9	1-3
6	3 (1 adv., 2 lab)	d, f, h, i	Planning Field Data Collection: Traffic	1-9	1-3

			volume counting, O-D surveys		
7	3 (1 adv., 2 lab)	d, f, h, i	Field Data Collection Execution (traffic surveys, topographic GPS points)	1-9	1-3
8	3 (1 adv., 2 lab)	d, f, h, i	Laboratory Testing Execution (soil CBR, asphalt mix testing, aggregate)	1-9	1-3
9	3 (1 adv., 2 lab)	d, f, h, i	Statistical Processing and validation of field and laboratory datasets	1-9	1-3
10	3 (1 adv., 2 lab)	a-d, f, g, h	Methodology Formulation and initial analytical calculations	1-9	1-3
11	3 (1 adv., 2 lab)	a-d, f, g, h	Preliminary Software Model Setup (Civil 3D alignment or STAAD frame)	1-9	1-3
12	3 (1 adv., 2 lab)	e, h, i	Preparing Mid-Year Progress Presentation slides and abstract	1-9	1-3
13	3 (1 adv., 2 lab)	e, h, i, j	Mid-Year Progress Presentation Defense before department committee	1-9	1-3
14	3 (1 adv., 2 lab)	e, h, i	Advisor Feedback Implementation and refining project plan for semester 2	1-9	1-3
15	3 (1 adv., 2 lab)	a-j	Semester 1 Progress Report Submission and literature review approval	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS	**Text Books:** 1. *College of Engineering Graduation Project Writing & Formatting Guidebook*. 2. AASHTO, ACI, AISC, ASTM, and FHWA Official Design Standards and Manuals.

• OTHER	**References:** 1. Peer-reviewed journal papers (ASCE Journal of Transportation Engineering).
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Soil/Highway Testing Laboratories. 2. CAD/FEA Computer Lab (Civil 3D, STAAD Pro, HCS, MS Excel).
Community-based facilities (include for example, guest Lectures, internship, field studies)	Field traffic surveys and site soil sampling.

15. Admissions	**Details**
Pre-requisites	Successful completion of Stage 1, 2, and 3 subjects
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	**Instructor Academic Profile**
Primary Instructor	VARIBLES
Co-Instructor	N/A

SECOND SEMESTER COURSES

Course 10: Foundation Engineering (II)

No. & Field Header	**Specification Details**
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Foundation Engineering (II) / R.E 401
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	2nd Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (2 Theory + 1 Tutorial)

8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To compute Rankine and Coulomb lateral earth pressures under surcharge loads and water table conditions. 2. To perform stability analysis (overturning, sliding, bearing) and reinforcement design for cantilever retaining walls. 3. To design cantilever and anchored sheet pile walls using free and fixed earth support methods. 4. To evaluate axial load capacity, group efficiency, consolidation settlement, and downdrag on deep pile foundations.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Calculate Rankine and Coulomb active, passive, and at-rest lateral earth pressures with surcharge and water table. b) Perform stability analysis against overturning, sliding, bearing failure, and base eccentricity for retaining walls. c) Detail structural concrete reinforcement for retaining wall stem, toe, and heel slabs. d) Design cantilever sheet pile walls in granular and cohesive soils. e) Design anchored sheet pile walls using Free Earth Support and Fixed Earth Support methods. f) Estimate static axial compressive capacity of single driven and bored piles in sand and clay (α, β, λ methods). g) Evaluate dynamic pile driving formulas, wave equation analysis, and pile group load distribution. h) Predict consolidation settlement of pile groups and analyze negative skin friction (downdrag) on piles.

i) Apply geotechnical engineering principles and equations to earth retaining and deep foundation problems.

j) Produce retaining structure and pile foundation designs satisfying safety codes and soil constraints.

k) Work collaboratively in teams to complete deep foundation and retaining wall design sheets.

l) Communicate earth retaining and pile designs via technical reports and reinforcement drawings.

m) Utilize geotechnical software for pile capacity and retaining wall stability analysis.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and application
7. Seminars
8. In- and Out-Class oral conversations
9. Reports, presentations, and posters

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Extracurricular activities and homework.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (2 theo., 1 tut.)	a, i, l	Lateral Earth Pressure: At-rest (K_0), active (K_a), and passive (K_p) states	1	3
2	3 (2 theo., 1 tut.)	a, i, l	Rankine Earth Pressure Theory for	1-6	1-3

			cohesionless and cohesive backfills		
3	3 (2 theo., 1 tut.)	a, i, l	Coulomb Earth Pressure Theory considering wall friction and backfill slope	1-9	1-3
4	3 (2 theo., 1 tut.)	a, i, l	Earth Pressure under Surcharge Loading and Water Table conditions	1-9	1-3
5	3 (2 theo., 1 tut.)	b, i, j, l	Cantilever Retaining Walls: Proportions, components, and lateral forces	1-9	1-3
6	3 (2 theo., 1 tut.)	b, i, j, k	Stability Analysis of Retaining Walls against Overturning and Sliding	1-9	1-3
7	3 (2 theo., 1 tut.)	b, c, i, j	Soil Bearing Capacity failure check beneath wall base and Eccentricity check	1-9	1-3
8	3 (2 theo., 1 tut.)	c, i, j, l	Structural Concrete Reinforcement Design for Retaining Wall Stem and Base	1-9	1-3
9	3 (2 theo., 1 tut.)	d, i, j, l	Cantilever Sheet Pile Walls: Analysis and design in granular soils	1-9	1-3
10	3 (2 theo., 1 tut.)	e, i, j, l	Anchored Sheet Pile Walls Design: Free Earth Support Method	1-9	1-3
11	3 (2 theo., 1 tut.)	e, i, j, l	Anchored Sheet Pile Walls Design: Fixed Earth Support Method	1-9	1-3
12	3 (2 theo., 1 tut.)	f, i, j, l	Deep Foundations: Types of piles, driven vs bored piles, and installation	1-9	1-3
13	3 (2 theo., 1 tut.)	f, g, i, j	Static Axial Capacity of Single Piles in Sand (α, β, λ) and Clay soils	1-9	1-3
14	3 (2 theo., 1 tut.)	g, h, i, j	Pile Groups: Group efficiency, settlement, negative skin friction, laterally loaded piles	1-9	1-3

15	3 (2 theo., 1 tut.)	a-m	Comprehensive Deep Foundations & Retaining Walls Design Review and Exam	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Principles of Foundation Engineering*, Braja M. Das, 9th Edition, Cengage Learning, 2019. 2. *Foundation Analysis and Design*, Joseph E. Bowles, 5th Edition, McGraw-Hill, 1996. **References:** 1. *Soil Mechanics in Engineering Practice*, K. Terzaghi, R. B. Peck, G. Mesri, 3rd Edition, Wiley. **Others:** 1. Solved retaining wall and pile design calculation sheets.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Geotechnical Software (PLAXIS 2D / GeoStudio). 2. Excel spreadsheets for retaining wall stability and pile group settlement.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Field visits to bridge pile driving operations and deep excavation sheet piling sites.

15. Admissions	**Details**
Pre-requisites	R.E 400
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	Instructor Academic Profile
Primary Instructor	Assist. Prof. Dr. Saif Alzabeebee Ph.D. Civil Engineering – Geotechnics saif.alzabeebee@qu.edu.iq
Co-Instructor	N/A

Course 11: Concrete Bridges Design

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Concrete Bridges Design / R.E 406
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	2nd Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (2 Theory + 1 Tutorial)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To present AASHTO LRFD bridge live load systems (HL-93 truck, tandem, lane load, dynamic load allowance). 2. To calculate live load distribution factors for longitudinal bridge girders. 3. To perform structural design of reinforced concrete highway bridge deck slabs, longitudinal T-girders, and diaphragms. 4. To design concrete bridge piers, abutments, elastomeric bearings, and prestressed concrete bridge girders.

10. Learning Outcomes, Teaching, Learning and Assessment Method

By the end of this course, the student should be able to :

a) Apply AASHTO LRFD highway bridge live load models (HL-93 truck, tandem, lane load, impact factor).

b) Calculate live load distribution factors for interior and exterior longitudinal concrete bridge girders.

c) Perform structural design and reinforcement detailing for reinforced concrete bridge deck slabs using Strip Method.

d) Design longitudinal T-beam girders and transverse diaphragms for flexure, shear, and fatigue limit states.

e) Analyze and design bridge substructure components including wall piers, abutments, and elastomeric bearings.

f) Understand prestressed concrete bridge concepts, pre-stress loss calculations, and allowable stress limits.

g) Apply structural mechanics and AASHTO LRFD specifications to solve concrete bridge design problems.

h) Produce concrete bridge structures satisfying serviceability, safety, durability, and LRFD code criteria.

i) Work effectively in structural design teams to prepare complete bridge calculation packages.

j) Recognize professional and public safety responsibilities in highway bridge structural engineering.

k) Communicate structural concrete bridge designs through standard engineering drawings.

l) Utilize structural FEA software (STAAD Pro/ETABS) and design spreadsheets for bridge structural analysis.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials

3. Homework and design assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and code specifications
7. Seminars
8. Structural drawing sheets
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Structural design sheets and homework.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (2 theo., 1 tut.)	a, g, j, k	Introduction to Bridge Engineering: AASHTO LRFD limit states & load factors	1	3
2	3 (2 theo., 1 tut.)	a, b, g, k	AASHTO LRFD Highway Live Loads: HL-93 Truck, Tandem, Lane Load, Impact	1-6	1-3
3	3 (2 theo., 1 tut.)	c, g, h, k	Structural Design of RC Highway Bridge Deck Slabs: Strip Method	1-9	1-3
4	3 (2 theo., 1 tut.)	c, g, h, k	Reinforcement Detailing of Bridge Deck Slabs for flexure and shrinkage	1-9	1-3
5	3 (2 theo., 1 tut.)	b, d, g, h	AASHTO Live Load Distribution Factors for longitudinal T-beam girders	1-9	1-3
6	3 (2 theo., 1 tut.)	d, g, h, l	Bending Moment and Shear Envelopes for multi-span T-beam bridge girders	1-9	1-3

7	3 (2 theo., 1 tut.)	d, g, h, k	Flexural and Shear Structural Design of Longitudinal Concrete T-Girders	1-9	1-3
8	3 (2 theo., 1 tut.)	d, g, h, k	Design of Transverse Diaphragms and End Cross Beams in concrete bridges	1-9	1-3
9	3 (2 theo., 1 tut.)	d, g, h, j	Serviceability Limit States: Deflection limits and fatigue stress checks	1-9	1-3
10	3 (2 theo., 1 tut.)	e, g, h, k	Bridge Substructures: Loads on abutments, wing walls, and wall piers	1-9	1-3
11	3 (2 theo., 1 tut.)	e, g, h, k	Structural Reinforcement Design for RC Bridge Piers and Pier Caps	1-9	1-3
12	3 (2 theo., 1 tut.)	e, g, h, k	Design of Elastomeric Bridge Bearings and Expansion Joints	1-9	1-3
13	3 (2 theo., 1 tut.)	f, g, h, j	Prestressed Concrete Bridges: Pre-tensioning vs Post-tensioning concepts	1-9	1-3
14	3 (2 theo., 1 tut.)	f, g, h, k	Pre-stress Loss Calculations and Allowable Flexural Stress Limits in girders	1-9	1-3
15	3 (2 theo., 1 tut.)	a-l	Comprehensive Structural Design Project Review of Multi-Span Concrete Bridge	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS	**Text Books:** 1. *AASHTO LRFD Bridge Design Specifications*, 9th Edition, AASHTO, 2020.

• OTHER	2. *Design of Highway Bridges: An LRFD Approach*, R. M. Barker, J. A. Puckett, Wiley, 2013. **References:** 1. *Reinforced Concrete Mechanics and Design*, James K. Wight, 7th Edition, Pearson. **Others:** 1. AASHTO LRFD bridge design example packages and solved calculation sheets.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Structural Engineering Software (STAAD Pro, ETABS). 2. Excel spreadsheets for moment envelopes and bridge girder design.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Site visits to ongoing concrete highway bridge construction sites.

15. Admissions	**Details**
Pre-requisites	R.E 405
Minimum number of students	/
Maximum number of students	70

14. Course Instructor	**Instructor Academic Profile**
Primary Instructor	Assist. Prof. Dr. Salam Al-Obaidi Ph.D. Civil Engineering – Structural Analysis and Design salam.methem@qu.edu.iq
Co-Instructor	Lecturer Dr. Thulfiqar Salim Hussein Ph.D. Civil Engineering – Building and Construction Engineering Thulfiqar.Hussein@qu.edu.iq

Course 12: Design of Steel Bridges (II)

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Design of Steel Bridges (II) / R.E 411
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	2nd Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (2 Theory + 1 Tutorial)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To design flexural steel beams, plastic moment M_p, and Lateral Torsional Buckling (LTB) per AASHTO LRFD. 2. To proportion built-up steel plate girders, web intermediate stiffeners, and bearing stiffeners. 3. To design composite steel-concrete bridge girders and headed stud shear connectors. 4. To analyze and design steel truss highway bridges, floor beam stringer systems, and lateral bracing.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Evaluate plastic moment capacity (M_p), yield moment (M_y), and Lateral Torsional Buckling (LTB) in steel beams.

b) Design rolled steel beams and built-up plate girders for flexure, shear, web crippling, and web bend-buckling.

c) Proportion intermediate transverse web stiffeners and bearing stiffeners for steel plate girders per AASHTO LRFD.

d) Perform structural design of composite steel-concrete bridge girders, including plastic moment and modular ratio.

e) Design shear stud connectors (headed studs) for full and partial composite action in highway bridge decks.

f) Analyze and design steel truss highway bridges (Pratt, Howe, Warren) and floor beam-stringer framing systems.

g) Design lateral bracing systems (top/bottom sway bracing, portal frames) and steel bridge bearings.

h) Apply structural steel mechanics and AASHTO LRFD specifications to steel bridge problems.

i) Produce steel bridge design solutions satisfying strength, fatigue, serviceability, and constructability.

j) Work collaboratively in teams to prepare structural steel bridge member designs.

k) Communicate structural steel bridge designs using standardized steel detailing drawings.

l) Use structural steel design software and spreadsheets for automated plate girder and truss design.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and design assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and AISC/AASHTO codes
7. Seminars
8. Structural steel drawing sheets
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Steel design sheets and homework.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (2 theo., 1 tut.)	a, b, h, k	Flexural Behavior of Steel Beams: Plastic moment M_p and yield moment M_y	1	3
2	3 (2 theo., 1 tut.)	a, b, h, k	Lateral Torsional Buckling (LTB) of steel beams: Unbraced length L_b limits	1-6	1-3
3	3 (2 theo., 1 tut.)	b, h, i, k	Shear Strength of Steel Beam Webs and web stiffener design requirements	1-9	1-3
4	3 (2 theo., 1 tut.)	b, h, i, k	Web Local Yielding, Web Crippling, and Sidesway Web Buckling design	1-9	1-3
5	3 (2 theo., 1 tut.)	c, h, i, k	Built-Up Steel Plate Girders for Bridges: Proportioning flanges and web	1-9	1-3
6	3 (2 theo., 1 tut.)	c, h, i, k	Web Bend-Buckling and flexural resistance of steel plate girders	1-9	1-3
7	3 (2 theo., 1 tut.)	c, h, i, k	Design of Intermediate Transverse Web Stiffeners and Bearing Stiffeners	1-9	1-3
8	3 (2 theo., 1 tut.)	d, h, i, k	Composite Steel-Concrete Bridge Girders: Elastic section stress analysis	1-9	1-3
9	3 (2 theo., 1 tut.)	d, h, i, k	Plastic Moment Capacity of composite	1-9	1-3

			steel girders and modular ratio		
10	3 (2 theo., 1 tut.)	e, h, i, k	Design of Shear Connectors (headed studs) for full composite action	1-9	1-3
11	3 (2 theo., 1 tut.)	h, i, k	Fatigue and Fracture Considerations in welded steel plate bridge girders	1-9	1-3
12	3 (2 theo., 1 tut.)	f, h, i, k	Steel Truss Bridge Configurations: Pratt, Howe, and Warren truss types	1-9	1-3
13	3 (2 theo., 1 tut.)	f, h, i, l	Structural Analysis of Main Truss Members under HL-93 live loads	1-9	1-3
14	3 (2 theo., 1 tut.)	f, g, h, i	Structural Design of Truss Members, Gusset Plates, and Lateral Bracing	1-9	1-3
15	3 (2 theo., 1 tut.)	a-l	Comprehensive Structural Design Review of Steel Plate Girder Highway Bridge	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *AASHTO LRFD Bridge Design Specifications*, 9th Edition, AASHTO, 2020. 2. *Structural Steel Design*, Jack C. McCormac, Stephen F. Csernak, 6th Edition, Pearson, 2018. **References:** 1. *Steel Structures: Design and Behavior*, C. G. Salmon, J. E. Johnson, Pearson. **Others:**

	1. AISC Steel Construction Manual (15th Edition).
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Structural Steel Design Software (STAAD Pro, RAM Structural System). 2. Excel spreadsheets for plate girder and truss member design.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Field visits to steel fabrication workshops and steel bridge erection sites.

15. Admissions	**Details**
Pre-requisites	R.E 410
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	**Instructor Academic Profile**
Primary Instructor	Lecturer Dr.Muhammed Abaaas Musa Ph.D. Civil Engineering – Structural Engineering Mohammed.mousa@qu.edu.iq
Co-Instructor	N/A

Course 13: Highways Design (II)

No. & Field Header	**Specification Details**
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Highways Design (II) / R.E 416
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	2nd Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (2 Theory + 1 Tutorial)

8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To present subgrade soil characterization (CBR, M_r) and traffic load conversion into ESALs. 2. To perform structural design of flexible pavements using AASHTO 1993 Structural Number (SN) method. 3. To perform structural design of rigid concrete pavements (JPCP, JRCP, CRCP) per AASHTO guide. 4. To design rigid pavement contraction/expansion joints, dowel bars, tie bars, and subsurface pavement drainage.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Characterize subgrade soils (CBR, M_r) and evaluate pavement material properties for base and subbase layers. b) Convert mixed traffic streams into Equivalent Single Axle Loads (ESALs) using load equivalency factors. c) Perform structural design of flexible pavements using the AASHTO 1993 Structural Number (SN) method. d) Perform structural design of rigid concrete pavements (JPCP, JRCP, CRCP) per AASHTO LRFD guidelines. e) Design rigid pavement contraction/expansion joints, load transfer dowel bars, and tie bars. f) Design highway surface drainage elements (gutters, inlets) and subsurface permeable drainage bases. g) Apply highway engineering principles and AASHTO design guidelines to pavement structural problems.

h) Produce pavement structural designs meeting traffic loading, reliability, and environmental constraints.

i) Work collaboratively in teams to prepare full pavement structural design packages.

j) Communicate highway pavement designs through standard structural pavement section drawings.

k) Utilize pavement software and design spreadsheets for automated layer thickness selection.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and drawing assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and AASHTO manuals
7. Seminars
8. Highway design drawing sheets
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Highway pavement drawing sheets and homework.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (2 theo., 1 tut.)	a, g, j	Pavement Types: Flexible vs Rigid pavement structural behavior and load distribution	1	3
2	3 (2 theo., 1 tut.)	a, g, h, j	Subgrade Characterization: CBR test, Plate Bearing test, Resilient Modulus (M_r)	1-6	1-3

3	3 (2 theo., 1 tut.)	a, g, h, j	Pavement Material Properties: Subbase, crushed aggregate base, HMA mix	1-9	1-3
4	3 (2 theo., 1 tut.)	b, g, h, j	Equivalent Single Axle Load (ESAL): Axle load equivalency factors (LEF)	1-9	1-3
5	3 (2 theo., 1 tut.)	c, g, h, j	AASHTO 1993 Flexible Pavement Design Equation and design variables	1-9	1-3
6	3 (2 theo., 1 tut.)	c, g, h, j	Reliability (R), overall standard deviation (S_0), and Serviceability (PSI)	1-9	1-3
7	3 (2 theo., 1 tut.)	c, g, h, j	Determination of Required Structural Number (SN) and layer coefficients (a_i, m_i)	1-9	1-3
8	3 (2 theo., 1 tut.)	c, g, h, i	Thickness Determination of HMA wearing, binder, base, and subbase layers	1-9	1-3
9	3 (2 theo., 1 tut.)	d, g, h, j	Rigid Pavement Types: JPCP, JRCP, CRCP, and prestressed concrete pavements	1-9	1-3
10	3 (2 theo., 1 tut.)	d, g, h, j	Westergaard Stress Equations for rigid pavements (Corner, Interior, Edge)	1-9	1-3
11	3 (2 theo., 1 tut.)	d, g, h, j	AASHTO 1993 Rigid Pavement Design Method (Slab thickness D selection)	1-9	1-3
12	3 (2 theo., 1 tut.)	e, g, h, j	Rigid Pavement Joint Design: Contraction, expansion, dowel bars, tie bars	1-9	1-3
13	3 (2 theo., 1 tut.)	f, g, h, j	Highway Surface Drainage Design: Inlets, gutters, and ditch hydraulics	1-9	1-3
14	3 (2 theo., 1 tut.)	f, g, h, k	Subsurface Pavement Drainage Design:	1-9	1-3

			Permeable bases and edge drains		
15	3 (2 theo., 1 tut.)	a-k	Complete Structural Pavement Design Project Review and Term Exam	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Pavement Analysis and Design*, Yang H. Huang, 2nd Edition, Pearson, 2004. 2. *AASHTO Guide for Design of Pavement Structures*, AASHTO, 1993. **References:** 1. *Highway Engineering*, Paul H. Wright, Karen Dixon, Wiley. **Others:** 1. AASHTO pavement design nomographs and calculation sheets.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Pavement Design Software (WinPAS / AASHTOWare Pavement ME). 2. Excel spreadsheets for pavement SN calculation and ESAL estimation.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Field visits to asphalt paving sites and pavement testing laboratories.

15. Admissions	**Details**
Pre-requisites	R.E 415
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	Instructor Academic Profile
Primary Instructor	Prof. Dr. Jalal Taqi Shaker Al-Obaedi Ph.D. Civil Engineering – Roads and Airports Engineering jalal.alobaedi@qu.edu.iq
Co-Instructor	Assistant Lecturer Rania Ihsan Ali M.Sc. Civil Engineering – Roads and Transport Engineering rainaali.eng.road@qu.edu.iq

Course 14: Transports Planning

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Transports Planning / R.E 425
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	2nd Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	30 hrs. / 2 hrs. per week (2 Theory)
Transports Planning **8. Date of production/revision of this specification**	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To develop an understanding of urban transport planning concepts, systems approach, and land-use transport interaction. 2. To present the Traditional Four-Step Travel Demand Forecasting Model (Trip Generation, Trip Distribution, Mode Choice, Traffic Assignment). 3. To build capacity in mathematically modeling travel demand and network traffic flows.

	4. To develop knowledge in economic evaluation of transport planning alternatives using Benefit-Cost ratio (B/C) and NPV methods.

10. Learning Outcomes, Teaching, Learning and Assessment Method

By the end of this course, the student should be able to :

a) Explain urban transportation planning concepts, systems analysis, and land-use transport interaction dynamics.

b) Delineate Traffic Analysis Zones (TAZ) and design Origin-Destination (O-D) travel survey methodologies.

c) Model Trip Generation (productions and attractions) using Multiple Linear Regression and Cross-Classification.

d) Model Trip Distribution using Growth Factor methods (Fratar) and the Gravity Model.

e) Calibrate Gravity Model friction factors (F_{ij}) and socio-economic adjustment factors (K_{ij}).

f) Model Mode Choice (Modal Split) using Multinomial Logit utility models and compute choice probabilities.

g) Calculate direct and cross-elasticities of travel demand with respect to travel time, cost, and transit service quality.

h) Model Traffic Assignment using All-or-Nothing, Capacity Restraint (BPR function), and User Equilibrium (UE) methods.

i) Perform economic evaluation of transport planning alternatives using Benefit-Cost ratio (B/C), NPV, and IRR.

j) Apply transportation modeling theory and mathematical algorithms to urban transport network problems.

k) Develop urban transport network solutions meeting mobility, accessibility, environmental, and financial goals.

l) Analyze travel survey datasets and interpret network traffic model outputs using engineering judgment.

m) Recognize global, societal, economic, and environmental impacts of long-term transport planning decisions.

n) Work effectively in urban planning teams to evaluate multi-modal transport network alternatives.

o) Communicate transport planning models and forecasting results through technical reports.

p) Utilize transport planning software packages (CUBE, TransCAD, or VISUM) for network modeling.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and modeling assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and urban case studies
7. Seminars
8. Mathematical modeling exercises
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Modeling homework assignments and case study reports.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	2 theo.	a, m, o	Introduction to Urban Transport Planning, systems approach, short vs long term planning	1	3

2	2 theo.	b, l, o	Data Collection: Origin-Destination (O-D) surveys and Traffic Analysis Zones (TAZ)	1-6	1-3
3	2 theo.	c, j, o	The Four-Step Travel Demand Model overview; Step 1: Trip Generation principles	1-9	1-3
4	2 theo.	c, j, o	Trip Production and Attraction Modeling using Multiple Linear Regression	1-9	1-3
5	2 theo.	c, j, o	Category Analysis / Cross-Classification method for trip generation modeling	1-9	1-3
6	2 theo.	d, j, o	Step 2: Trip Distribution principles; Growth Factor methods (Fratar Method)	1-9	1-3
7	2 theo.	d, e, j, o	Gravity Model formulation, friction factors (F_{ij}), socio-economic factors (K_{ij})	1-9	1-3
8	2 theo.	d, e, j, o	Gravity Model calibration and doubly-constrained gravity model iterations	1-9	1-3
9	2 theo.	f, g, j, o	Step 3: Mode Choice / Modal Split concepts; Transit vs auto choice factors	1-9	1-3
10	2 theo.	f, g, j, o	Utility Function concept and Multinomial Logit Model formulation	1-9	1-3
11	2 theo.	f, g, j, o	Mode Choice probability calculations and elasticity of travel demand	1-9	1-3
12	2 theo.	h, j, p	Step 4: Traffic Assignment concepts; Network link-node performance functions	1-9	1-3
13	2 theo.	h, j, p	All-or-Nothing assignment and Capacity Restraint	1-9	1-3

			assignment (BPR function)		
14	2 theo.	h, j, p	User Equilibrium (UE) and System Optimal (SO) traffic assignment principles	1-9	1-3
15	2 theo.	i, k, m, n, o	Economic Evaluation of Transport Plans: Benefit-Cost ratio (B/C), NPV, IRR	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Modelling Transport*, Juan de Dios Ortúzar, Luis G. Willumsen, 4th Edition, Wiley, 2011. 2. *Transportation Engineering and Planning*, C.S. Papacostas, P.D. Prevedouros, Pearson. **References:** 1. *Urban Transportation Planning*, Michael D. Meyer, Eric J. Miller, McGraw-Hill. **Others:** 1. Class notes and solved transport planning problem sets.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Transport Planning Software (CUBE, TransCAD, or VISUM). 2. Excel spreadsheets for Gravity Model and Logit Model iterations.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Extra lectures by urban transport planning authority directors.

15. Admissions	Details
Pre-requisites	R.E 325
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	Instructor Academic Profile
Primary Instructor	Assist. Prof. Dr.Hamsa Abbas Zubaidi Ph.D. Highway and Transportation Engineering hamsa.alzubaidi@qu.edu.iq
Co-Instructor	Assist. Lecturer Muhamed Jasim Shukan M.Sc/ Road Eng. mohammed.jassim@qu.edu.iq

Course 15: Hydrology

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Hydrology / R.E 420
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	2nd Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	30 hrs. / 2 hrs. per week (2 Theory)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To develop an understanding of the hydrologic cycle, rainfall intensity analysis, and Intensity-Duration-Frequency (IDF) curves.

	2. To present hydrograph analysis principles and Unit Hydrograph (UH) theory. 3. To build capacity in estimating peak storm runoff and flood discharge (Q_p) using Rational and SCS Curve Number methods. 4. To develop knowledge in the hydraulic design of highway culverts, roadside open channels, and flood routing.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Describe the hydrologic cycle, drainage basin morphometry, and perform watershed boundary delineation. b) Analyze precipitation data, assess rain gauge network adequacy, and adjust missing data using double-mass curves. c) Construct Intensity-Duration-Frequency (IDF) curves from historical rainfall records for specified return periods. d) Compute infiltration losses and effective rainfall using the Horton equation and ϕ-index method. e) Analyze storm hydrographs, perform baseflow separation, and derive Direct Runoff Hydrographs (DRH). f) Derive Unit Hydrographs (UH) from storm records and apply Snyder and SCS Synthetic Unit Hydrograph methods. g) Estimate peak storm runoff discharge (Q_p) using the Rational Method ($Q = CIA$) and SCS Curve Number (CN) method. h) Calculate time of concentration (T_c) for agricultural and urban watersheds using Kirpich and FAA equations. i) Perform hydraulic design of highway box and pipe culverts under inlet control and outlet control conditions. j) Design roadside drainage ditches and channels using the Manning equation and permissible shear stress limits.

k) Perform hydrologic channel routing using the Muskingum method and conduct statistical flood frequency analysis.

l) Apply fluid mechanics and hydrologic principles to highway surface drainage problems.

m) Produce highway drainage design solutions satisfying flood risk, public safety, and environmental criteria.

n) Analyze hydrologic field rainfall/streamflow data to draw hydraulic design conclusions.

o) Work collaboratively in teams to prepare complete highway watershed hydrologic design reports.

p) Communicate hydraulic design calculations through standard engineering sheets.

q) Utilize hydrologic/hydraulic software (HY-8, HEC-HMS, HEC-RAS) for culvert and watershed analysis.

11. Teaching and Learning Methods

1. Lectures
2. Tutorials
3. Homework and design assignments
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and FHWA hydraulics manuals
7. Seminars
8. Hydraulic calculation exercises
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Hydrologic calculation sheets and homework.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)

1	2 theo.	a, l, p	Hydrologic Cycle Components, drainage basin characteristics, watershed delineation	1	3
2	2 theo.	b, n, p	Precipitation Types, rain gauges, station consistency (Double-Mass Curve)	1-6	1-3
3	2 theo.	b, c, l, p	Rainfall Intensity, Duration, Frequency analysis, building IDF curves	1-9	1-3
4	2 theo.	d, l, p	Evapotranspiration, soil moisture, infiltration process in watersheds	1-9	1-3
5	2 theo.	d, l, p	Infiltration Equations (Horton equation) and ϕ-index determination	1-9	1-3
6	2 theo.	e, n, p	Streamflow Measurement Methods, stage-discharge rating curves	1-9	1-3
7	2 theo.	e, l, p	Hydrograph Components: Baseflow separation, Direct Runoff Hydrograph (DRH)	1-9	1-3
8	2 theo.	f, l, p	Unit Hydrograph (UH) Definition, assumptions, derivation from storm data	1-9	1-3
9	2 theo.	f, l, p	Synthetic Unit Hydrograph Methods (Snyder method, SCS dimensionless UH)	1-9	1-3
10	2 theo.	g, h, l, p	Peak Runoff Estimation: Rational Method ($Q = CIA$) and runoff coefficient C	1-9	1-3
11	2 theo.	h, l, p	Time of Concentration (T_c) formulas (Kirpich, FAA equations)	1-9	1-3
12	2 theo.	g, h, l, p	SCS Curve Number (CN) Method for runoff volume and peak discharge	1-9	1-3
13	2 theo.	i, m, p, q	Highway Culvert Hydraulics: Inlet control	1-9	1-3

			vs Outlet control design nomographs		
14	2 theo.	j, m, p	Roadside Ditch Hydraulic Design using Manning equation & permissible velocity	1-9	1-3
15	2 theo.	k, l, m, o, p	Reservoir and Channel Flood Routing (Muskingum method), statistical frequency	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Applied Hydrology*, Ven Te Chow, David R. Maidment, Larry W. Mays, McGraw-Hill, 1988. 2. *Hydrology and Floodplain Analysis*, Philip B. Bedient, Wayne C. Huber, Pearson. **References:** 1. *FHWA Hydraulic Design of Highway Culverts* (HDS-5), Federal Highway Administration. **Others:** 1. Class notes and culvert design nomographs.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Hydrologic/Hydraulic Software (HY-8, HEC-HMS). 2. Excel spreadsheets for hydrograph convolution and routing.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Field visits to highway culvert and bridge drainage sites.

15. Admissions	Details
Pre-requisites	R.E 320
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	Instructor Academic Profile
Primary Instructor	Lecturer Dr.Zaid Ali kadhim Ph.D. Civil Engineering – Structural zaidalzaidi20142016@gmail.com
Co-Instructor	N/A

Course 16: Computer Applications in Roads Engineering (IV)

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Computer Applications in Roads Engineering (IV) / R.E 436
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	2nd Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (1 Theory + 2 Practical Lab)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To present structural FEA software tools (STAAD Pro / ETABS) for 3D modeling and moving load analysis of bridges.

	2. To build capacity in traffic capacity simulation and Level of Service (LOS) analysis using Highway Capacity Software (HCS). 3. To model signalized and unsignalized intersections, multilane highways, and two-lane rural roads in HCS. 4. To integrate CAD geometric corridor data with structural FEA and traffic capacity software outputs.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Build 3D structural frame and plate element models of bridge structures in STAAD Pro / ETABS. b) Apply AASHTO HL-93 moving vehicle live loads and extract bending moment, shear force, and deflection envelopes. c) Model signalized and unsignalized intersections in Highway Capacity Software (HCS). d) Evaluate control delay, queue lengths, volume-to-capacity ratios, and Level of Service (LOS) using HCS. e) Evaluate two-lane highway and multilane highway segment capacity and performance in HCS. f) Integrate CAD geometric corridor data with structural finite element models and traffic capacity outputs. g) Apply computer software algorithms to solve bridge structural and traffic capacity problems. h) Produce integrated FEA and traffic engineering solutions meeting AASHTO and HCM constraints.

i) Work collaboratively in laboratory teams to deliver multi-software bridge and traffic project files.

j) Recognize professional ethics and verification responsibilities when relying on computer outputs.

k) Communicate structural and traffic analysis results through professional software reports.

l) Master advanced engineering software packages (STAAD Pro, ETABS, HCS) for professional practice.

11. Teaching and Learning Methods

1. Theoretical lectures explaining software algorithms
2. Computer laboratory sessions
3. Homework and software project assignments
4. Tests and Practical Exams
5. In-Class questions and software troubleshooting
6. Connection between theory and software operations
7. Seminars
8. Hands-on computer exercises
9. Software project reports and presentations

12. Assessment methods

1. Practical Examinations, Software Tests, and Quizzes.
2. Weekly software design files and project submissions.
3. Student engagement during laboratory sessions.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (1 th., 2 lab)	a, g, k, l	STAAD Pro / ETABS Interface, node and member creation, material assignment	1	3
2	3 (1 th., 2 lab)	a, g, k, l	Assigning Member Cross-Sections (steel rolled shapes, concrete T-beams)	1-6	1-3

3	3 (1 th., 2 lab)	a, b, g, k	Support Conditions Definition, dead load, live load, and wind load application	1-9	1-3
4	3 (1 th., 2 lab)	b, g, k, l	Moving Load Generator setup in STAAD Pro for HL-93 truck loading	1-9	1-3
5	3 (1 th., 2 lab)	b, g, k, l	Structural Analysis Execution, shear force and bending moment diagrams	1-9	1-3
6	3 (1 th., 2 lab)	b, g, k, l	Frame Reinforcement Design Output and deflection check	1-9	1-3
7	3 (1 th., 2 lab)	a, b, g, k	Modeling Multi-Span Bridge Deck Structures and diaphragm beams	1-9	1-3
8	3 (1 th., 2 lab)	a, b, g, k	3D Finite Element Plate/Shell Modeling for bridge deck slabs	1-9	1-3
9	3 (1 th., 2 lab)	c, d, g, k	Introduction to Highway Capacity Software (HCS): Signalized intersection module	1-9	1-3
10	3 (1 th., 2 lab)	c, d, g, k	Inputting Traffic Volumes, peak hour factor (PHF), geometry, signal timing	1-9	1-3
11	3 (1 th., 2 lab)	c, d, g, k	HCS Capacity Analysis Output: Delay, queue length, Level of Service (LOS)	1-9	1-3
12	3 (1 th., 2 lab)	c, d, g, k	Unsignalized TWSC and AWSC Intersection Analysis in HCS	1-9	1-3
13	3 (1 th., 2 lab)	e, g, k, l	Two-Lane Highway and Multilane Highway Segment Capacity Evaluation	1-9	1-3

14	3 (1 th., 2 lab)	f, g, h, k	Integration of Civil 3D Alignment Data with structural and traffic models	1-9	1-3
15	3 (1 th., 2 lab)	a-l	Final Integrated Computer Applications Project Submission and Practical Exam	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *STAAD Pro Structural Analysis Reference Manual*, Bentley Systems. 2. *Highway Capacity Manual* (HCM 6th Edition), Transportation Research Board. **References:** 1. *HCS Software User Guide*, McTrans, University of Florida. **Others:** 1. Lab exercise sheets and sample structural/traffic datasets.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Specialized Computer Lab equipped with STAAD Pro, ETABS, and HCS software licenses. 2. Available websites related to McTrans and Bentley Systems.
Community-based facilities (include for example, guest Lectures, internship, field studies)	Demonstrations led by certified structural FEA and traffic modeling software specialists.

15. Admissions	**Details**
Pre-requisites	R.E 435
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	Instructor Academic Profile
Primary Instructor	Assist. Prof. Dr..Abeer Saeed Zebalah Ph.D. Civil Engineering – Geotechnics abeer.alkraway@qu.edu.iq
Co-Instructor	Assistant Lecturer Rand Muhammed Jasim M.Sc. Civil Engineering rand.mohammed.eng@qu.edu.iq

Course 17: Engineering Ethics

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Engineering Ethics / R.E 446
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	2nd Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	30 hrs. / 2 hrs. per week (2 Theory)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To develop an understanding of moral theories, professional engineering codes of ethics (ASCE, NSPE, IEEE), and legal duties. 2. To present procedures for analyzing ethical dilemmas regarding public health, safety, risk assessment, and liability.

	3. To build capacity in identifying workplace issues like conflicts of interest, confidentiality, trade secrets, and whistleblowing. 4. To develop knowledge in environmental ethics, sustainable development, and anti-corruption in public works contracts.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Explain fundamental moral theories, philosophical frameworks, and principles of engineering professionalism. b) Analyze professional codes of ethics of major engineering institutions (ASCE, NSPE, IEEE, Iraqi Engineers Union). c) Apply moral reasoning, line-drawing methods, and conflict resolution techniques to ethical engineering dilemmas. d) Evaluate the engineer's paramount duty to protect public health, safety, and welfare in infrastructure projects. e) Analyze risk assessment, safety factors, and failure case studies of major engineering disasters. f) Understand tort law, professional negligence, legal liability, strict liability, and expert witness responsibilities. g) Identify workplace ethical issues including conflicts of interest, confidentiality, trade secrets, and non-disclosure. h) Evaluate moral justifications, proper procedures, legal protections, and consequences of whistleblowing. i) Apply environmental ethics and sustainable development principles to civil and transportation infrastructure. j) Analyze social responsibilities of engineers, global ethics, and cultural factors in international practice. k) Recognize anti-corruption standards, bidding integrity, extortion, bribery, and kickback prevention in public contracts.

l) Understand intellectual property rights, patents, copyrights, trademarks, and software licensing ethics.

m) Recognize ethical and professional responsibilities in engineering situations and make informed judgments.

n) Evaluate the impact of engineering solutions in global, economic, environmental, and societal contexts.

o) Function effectively in team debates and discussions on complex engineering ethics case studies.

p) Communicate ethical arguments and legal case analyses through structured analytical essays and oral debates.

11. Teaching and Learning Methods

1. Lectures
2. Interactive case study analyses
3. Group debates and student discussions
4. Tests and Exams
5. In-Class questions and discussions
6. Connection between theory and real engineering disasters
7. Seminars
8. Essay writing exercises
9. Reports and presentations

12. Assessment methods

1. Examinations, Tests, and Quizzes.
2. Case study analytical essays and debate checks.
3. Student engagement during lectures.

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	2 theo.	a, m, p	Definition of Ethics, engineering professionalism, moral frameworks, and values	1	3
2	2 theo.	b, m, p	Code of Ethics of Professional	1-6	1-3

			Engineering Societies (ASCE, NSPE, IEEE)		
3	2 theo.	c, m, p	Moral Reasoning, ethical problem-solving techniques, and line-drawing method	1-9	1-3
4	2 theo.	d, m, n, p	Engineer's Primary Responsibility to public health, safety, and welfare	1-9	1-3
5	2 theo.	e, m, n, p	Risk Assessment, safety factors, accepting risk, case study of structural failure	1-9	1-3
6	2 theo.	f, m, p	Liability, professional negligence, tort law, and strict liability in construction	1-9	1-3
7	2 theo.	g, m, p	Workplace Ethics: Conflict of interest definitions, types, and mitigation strategies	1-9	1-3
8	2 theo.	g, m, p	Confidentiality, proprietary information, trade secrets, and non-disclosure	1-9	1-3
9	2 theo.	h, m, o, p	Whistleblowing: Moral justifications, procedures, protection, and consequences	1-9	1-3
10	2 theo.	i, m, n, p	Environmental Ethics, sustainable development, ecological impact of highways	1-9	1-3
11	2 theo.	j, m, n, p	Social Responsibility of engineers, global ethics, and cultural context	1-9	1-3
12	2 theo.	k, m, p	Bidding Integrity, bribery, extortion, kickbacks, and anti-corruption measures	1-9	1-3
13	2 theo.	l, m, p	Intellectual Property Rights: Patents,	1-9	1-3

			copyrights, trademarks, software ethics		
14	2 theo.	m, p	Expert Testimony, forensic engineering, acting as an ethical expert witness	1-9	1-3
15	2 theo.	a-p	Comprehensive Case Study Analysis Review and Final Ethical Essay Presentations	1-9	1-3

14. Infrastructure	**Details**
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *Ethics in Engineering*, Mike W. Martin, Roland Schinzinger, 4th Edition, McGraw-Hill, 2005. 2. *Engineering Ethics: Concepts and Cases*, C. E. Harris, M. S. Pritchard, Cengage. **References:** 1. *ASCE Code of Ethics*, American Society of Civil Engineers. **Others:** 1. Case study documentation of famous engineering disasters.
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Multimedia room for case study video documentaries. 2. Available websites related to National Institute for Engineering Ethics (NIEE).
Community-based facilities (include for example, guest Lectures, internship, field studies)	Guest lectures by senior engineering union ethics board members.

15. Admissions	Details
Pre-requisites	/
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	Instructor Academic Profile
Primary Instructor	Lecturer Saba Mohammed Shaheed M.Sc. Civil Engineering – Soil Mechanics saba.shheed@qu.edu.iq
Co-Instructor	N/A

Course 18: Graduation Project (II)

No. & Field Header	Specification Details
1. Teaching Institution	College of Engineering / University of Al-Qadisiyah
2. University Department/Centre	Roads and Transportation Engineering
3. Course title/code	Graduation Project (II) / R.E 445-B
4. Programme(s) to which it contributes	Roads and Transportation Engineering Program
5. Modes of Attendance offered	Semester System ; Day Program, full-time face-to-face on campus. 15-week regular semester.
6. Semester/Year	2nd Semester / Academic Year 2025–2026
7. Number of hours tuition (total)	45 hrs. / 3 hrs. per week (1 Advising + 2 Practical/Lab)
8. Date of production/revision of this specification	1-4-2026
9. Aims of the Course	**The aims of the course are:** 1. To execute detailed engineering calculations, software modeling (Civil 3D, STAAD Pro, HCS), and structural/geometric design. 2. To evaluate economic feasibility (B/C ratio, NPV), environmental impacts, and traffic safety implications of proposed designs.

	3. To write a well-structured graduation thesis formatted strictly to College of Engineering academic guidelines. 4. To design scientific posters, deliver PowerPoint presentations, and defend thesis findings orally before an examining committee.

10. Learning Outcomes, Teaching, Learning and Assessment Method
By the end of this course, the student should be able to : a) Execute detailed geometric and structural design calculations for highways, bridges, and pavement layers. b) Perform advanced computer simulation and FEA modeling (Civil 3D corridor, STAAD Pro frame, HCS capacity). c) Perform quantity takeoff, cost estimation, and evaluate economic feasibility (B/C ratio, NPV) of proposed designs. d) Conduct Environmental Impact Assessment (EIA) and traffic safety audits for the engineering project. e) Compile a comprehensive graduation thesis formatted strictly to College of Engineering academic guidelines. f) Design scientific posters and deliver oral PowerPoint presentations for formal academic examination. g) Apply engineering, science, and mathematics principles to solve complex infrastructure design problems. h) Apply engineering design to produce solutions meeting safety, public health, welfare, and economic needs. i) Communicate effectively with a range of audiences through written thesis books and oral defenses. j) Recognize ethical and professional responsibilities and evaluate global, economic, and environmental impacts.

k) Function effectively on a student project team, establishing goals and meeting project deadlines.

l) Develop and conduct appropriate experimentation, analyze data, and use engineering judgment.

m) Acquire and apply new knowledge as needed using appropriate learning strategies and software tools.

11. Teaching and Learning Methods

1. Weekly faculty advisor supervision sessions
2. Independent field surveys and laboratory experiments
3. Computer software modeling and design
4. In-Class questions and discussions
5. Connection between theory and actual engineering projects
6. Seminars and draft thesis reviews
7. Oral rehearsal presentations
8. Thesis book, poster, and final oral defense

12. Assessment methods

1. Faculty advisor evaluation (20%).
2. Examining committee evaluation (35%).
3. Written thesis document evaluation (15%).
4. Final oral defense examination (15%).

13. Course Structure

Week	Hours	Learning Outcomes (10)	Unit Module/Topic	Teaching Method (11)	Assessment Method (12)
1	3 (1 adv., 2 lab)	a, g, h, i	Detailed Geometric Design Calculations for highway alignment / bridge components	1	3
2	3 (1 adv., 2 lab)	b, g, h, m	Computer Simulation Execution (Civil 3D corridor, FEA structural analysis)	1-6	1-3
3	3 (1 adv., 2 lab)	a, b, g, h	Structural Pavement Design Calculations / Bridge element reinforcement	1-8	1-3

4	3 (1 adv., 2 lab)	b, g, h, m	Traffic Capacity Analysis and Level of Service (LOS) evaluation in HCS	1-8	1-3
5	3 (1 adv., 2 lab)	c, g, h, i	Quantity Surveying and Cost Estimation for proposed engineering project	1-8	1-3
6	3 (1 adv., 2 lab)	d, h, i, j	Environmental Impact Assessment (EIA) and traffic safety audit	1-8	1-3
7	3 (1 adv., 2 lab)	a-d, g, h	Results Synthesis, preparing comparative design alternatives	1-8	1-3
8	3 (1 adv., 2 lab)	c, d, g, h, j	Economic Evaluation (B/C ratio, NPV) and project feasibility review	1-8	1-3
9	3 (1 adv., 2 lab)	e, i, j	Writing Conclusions and Engineering Recommendations chapter	1-8	1-3
10	3 (1 adv., 2 lab)	e, i, j	Compiling Complete Thesis Draft (Chapters 1 to 5) formatted to college style	1-8	1-3
11	3 (1 adv., 2 lab)	e, i, j, k	Advisor Thesis Review, corrections, and plagiarism software check	1-8	1-3
12	3 (1 adv., 2 lab)	e, i, j	Printing, binding final thesis copies, and submitting to project committee	1-8	1-3
13	3 (1 adv., 2 lab)	f, i, j, m	Preparing Final Defense PowerPoint Slides and scientific poster	1-8	1-3
14	3 (1 adv., 2 lab)	f, i, j, k	Rehearsal Presentation and oral defense practice	1-8	1-3
15	3 (1 adv., 2 lab)	a-m	Final Project Oral Defense Presentation before scientific examining committee	1-8	1-4

14. Infrastructure	Details
Required reading: • CORE TEXTS • COURSE MATERIALS • OTHER	**Text Books:** 1. *College of Engineering Graduation Project Writing & Formatting Guidebook*. 2. AASHTO, ACI, AISC, ASTM, and FHWA Official Design Standards. **References:** 1. Peer-reviewed journal papers (ASCE Journal of Transportation Engineering).
Special requirements (include for example workshops, periodicals, IT software, websites)	1. Soil/Highway Testing Laboratories. 2. CAD/FEA Computer Lab (Civil 3D, STAAD Pro, HCS, MS Excel). 3. Plagiarism detection software (Turnitin).
Community-based facilities (include for example, guest Lectures, internship, field studies)	Field traffic surveys and site soil sampling. Consultations with resident engineers on active construction sites.

15. Admissions	Details
Pre-requisites	R.E 445-A
Minimum number of students	/
Maximum number of students	70

16. Course Instructor	Instructor Academic Profile
Primary Instructor	VARIBLES
Co-Instructor	N/A