

**Curriculum
for
Bachelor of Science in
Civil Engineering Technology
(2026)**



**Higher Education Commission
Islamabad
Curriculum Division**



Curriculum for Bachelor of Science in Civil Engineering Technology



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Curriculum for
Bachelor of Science in Civil Engineering Technology



Acronyms, Abbreviations & Definitions

Acronym/Abbreviation	Definition
AI	Artificial Intelligence
BDEP	Broadly-Defined Engineering Problem
BIM	Building Information Modeling
BSCET	Bachelor of Science in Civil Engineering Technology
CET	Civil Engineering Technology
CLO	Course Learning Outcome
CPD	Continuing Professional Development
Cr. Hrs.	Credit Hours
GIS	Geographic Information System
GPS	Global Positioning System
HEC	Higher Education Commission
HEI	Higher Education Institution
IEA	International Engineering Alliance
Lab	Laboratory
MOOC	Massive Open Online Course
NCRC	National Curriculum Review Committee
NQF	National Qualifications Framework
NTC	National Technology Council
OBE	Outcome-Based Education
PEO	Program Educational Objective
PLO	Program Learning Outcome
RCC	Reinforced Cement Concrete



Curriculum for
Bachelor of Science in Civil Engineering Technology



SA	Engineering Technologist Graduate Attribute Profile
SDG	Sustainable Development Goal
SIT	Supervised Industrial Training
SK	Sydney Accord Knowledge and Attitude Profile
SP	Range of Broadly-defined Engineering Problem Identification and Solving Attributes
TA	Range of Broadly-defined Engineering Activities Attributes
TC	Engineering Technologist Professional Competence Profile
Th	Theory
UTM	Universal Testing Machine



Curriculum for Bachelor of Science in Civil Engineering Technology



Contents

Acknowledgements.....	2
Acronyms, Abbreviations & Definitions	3
Contents	5
Preamble	9
Scope	10
Rationale	10
Vision Statement	11
Mission Statement	11
Program Educational Objectives (PEOs).....	11
Program Learning Outcomes (PLOs)	11
1. Introduction	14
2. Curriculum Development Methodology	15
2.1 Benchmarking	15
2.2 Curriculum Development Cycle	15
2.3 Historical Timeline of NCRC Meetings	15
3. Curriculum Detail	16
3.1 Program Structure.....	16
3.2 General Education Courses	20
3.3 Interdisciplinary Courses.....	22
4. Admission Criteria	23
5. Semester-wise Scheme of Studies	23
6. Course Codes.....	28
7. Elective Courses	29
8. Course Contents.....	30
8.1 Quantitative Reasoning-I.....	31
8.2 Functional English	33
8.3 Applications of Information and Communication Technologies.....	35
8.4 Materials and Methods of Construction.....	37



Curriculum for
Bachelor of Science in Civil Engineering Technology



8.5	Architecture and Town Planning	39
8.6	Electro-Mechanical Technology	41
8.7	Quantitative Reasoning-II.....	43
8.8	Applied Economics	45
8.9	Expository Writing.....	47
8.10	Applied Chemistry.....	49
8.11	Fehm-e-Quran-I.....	51
8.12	Surveying.....	53
8.13	Engineering Mechanics	56
8.14	Professional Ethics	58
8.15	Islamic Studies.....	60
8.16	Pakistan Studies	62
8.17	Fehm-e-Quran-II	64
8.18	Civil Engineering Drawing, Drafting and Interpretation.....	66
8.19	Soil Mechanics	69
8.20	Fluid Mechanics	72
8.21	Environmental Engineering.....	75
8.22	Civics and Community Engagement.....	78
8.23	Ideology and Constitution of Pakistan	80
8.24	Technopreneurship	82
8.25	Concrete Technology.....	84
8.26	Transportation and Highway Technology.....	86
8.27	Mechanics of Solids.....	89
8.28	Geology	91
8.29	Reinforced and Prestressed Concrete.....	93
8.30	Engineering Hydrology	95
8.31	Computer-Aided Drawing and Building Information Modeling.....	98
8.32	Irrigation Engineering.....	100
8.33	Water Supply Systems.....	103
8.34	Occupational Health and Safety Management	106



Curriculum for
Bachelor of Science in Civil Engineering Technology



8.35	Quantity Surveying and Estimation.....	108
8.36	Maintenance and Repair of Civil Works.....	110
8.37	Geotechnical Investigation and Foundations.....	113
8.38	GIS and Remote Sensing	115
8.39	AI in Civil Engineering Technology	117
8.40	Construction Project Administration	120
8.41	Digital Engineering Tools	124
8.42	Building Codes and Compliance.....	126
8.43	Ground Improvement Techniques	128
8.44	Smart Technologies for Facilities Management	130
8.45	Land Reclamation and Drainage Technology	133
8.46	Applied Hydraulics	136
8.47	Construction Equipment and Jobsite Practices.....	139
8.48	Construction of Steel Structures	142
8.49	Pavement Construction and Rehabilitation	144
9.	Supervised Industrial Training.....	147
9.1	Background	147
9.2	Objectives.....	147
9.3	Responsibility of HEI: Placement in SIT Program	147
9.4	Responsibilities of Students	148
9.5	Training Progress Assessment and Review by HEI	148
9.6	Changing Student Placement During SIT	149
9.7	Daily Training Logbook	149
9.8	Industrial Training Report.....	149
9.9	Guideline for Preparation of Industrial Training Report	149
9.10	SIT Assessment.....	152
9.11	Completion of Industrial Training	152
10.	Guidelines for Community Service: BS Civil Engineering Technology Programs	153
10.1	Objectives.....	153
10.2	Guidelines for Activities	154



Curriculum for Bachelor of Science in Civil Engineering Technology



10.3	Assessment Mechanism.....	154
10.4	Proposed Semester-wise Community-Service Activity Plan	155
10.5	HEC Guidelines and Benchmarks	156
10.6	Recognition upon Completion of Community-Service Hours	157
11.	Framework for Integration of International Certifications and Massive Open Online Courses (MOOCs) into Undergraduate Engineering Technology Programs	158
11.1.	Background	158
11.2.	Objectives.....	158
11.3.	Scope.....	158
11.4.	Approved MOOC Platforms.....	158
11.5.	International Practices	159
11.6.	National Practices	159
11.7.	Credit Hour Equivalence	160
11.8.	Implementation Framework	160
11.9.	Roles and responsibilities.....	161
11.10.	Quality Assurance and Monitoring	161
11.11.	Exemplary Recommended Courses	161
11.12.	Conclusion.....	166
11.13.	References.....	166
Appendix A: Minutes of the Preliminary Meeting of the National Curriculum Review Committee (NCRC) for BS Civil Engineering Technology.....		167
Appendix B: Range of Problem Identification and Solving		174
Appendix C: Range of Engineering Activities		175
Appendix D: Sydney Accord Knowledge and Attitude Profile		176
Appendix E: Engineering Technologist Graduate Attribute Profile		177
Appendix F: Engineering Technologist Professional Competence Profile.....		179
Appendix G: Sample Broadly-Defined Engineering Problem		181
Appendix H: Definitions of Terms		186
Appendix I: National and International Benchmarking for BS Civil Engineering Technology Curriculum 2026		188
Appendix J: Introduction to Foreign Language and Culture		193



Curriculum for Bachelor of Science in Civil Engineering Technology



Preamble

The Bachelor of Science in Civil Engineering Technology (BSCET) curriculum is designed to prepare graduates for the application, implementation, and management of civil engineering technologies in the construction, infrastructure, and built environment sectors. The curriculum is developed in accordance with the Higher Education Commission (HEC) Undergraduate Education Policy, the requirements of the National Technology Council (NTC), Pakistan, and the National Qualifications Framework (NQF) of Pakistan, and is aligned with the educational principles and expectations of the International Engineering Alliance (IEA) and the Sydney Accord for Engineering Technologists.

The curriculum follows an Outcome-Based Education (OBE) approach and integrates engineering technology knowledge with laboratory experimentation, field practice, digital applications, project-based learning, industrial exposure, and professional development. It develops a broad foundation in civil engineering technology, including surveying, construction materials and methods, structural and geotechnical applications, transportation, water and environmental systems, construction management, testing, maintenance, and rehabilitation.

The curriculum responds to the changing nature of civil engineering practice by incorporating contemporary technologies and approaches, including Building Information Modeling (BIM), artificial intelligence (AI), Geographic Information Systems (GIS), remote sensing, drone-based and automated surveying, smart infrastructure, structural health monitoring, digital asset management, and sustainable construction technologies. These are complemented by an emphasis on safety, environmental responsibility, climate resilience, disaster risk reduction, and the responsible use of resources.

Recognizing the transformation of the built environment in the era of Industry 5.0, the curriculum builds on these contemporary technologies by emphasizing human-centric innovation, sustainability, resilience, responsible resource use, digital transformation, and interdisciplinary collaboration. This approach prepares graduates to apply emerging technologies responsibly and contribute effectively to resilient, sustainable, and technology-enabled built environments.

The curriculum provides opportunities for students to develop their capabilities through practical laboratory work, field activities, design and implementation projects, industrial training, internships, and capstone projects. It also encourages innovation, entrepreneurship, professional development, and responsible technological practice, enabling graduates to contribute to infrastructure development and the sustainable advancement of society.

The curriculum is aligned with relevant United Nations Sustainable Development Goals (SDGs) and reflects the requirements of national and international engineering technology practice while maintaining a strong application-oriented character appropriate for Civil Engineering Technology.



Curriculum for Bachelor of Science in Civil Engineering Technology



Scope

The Bachelor of Science in Civil Engineering Technology covers the practical application of civil engineering knowledge and technologies required for the planning, development, investigation, testing, construction, operation, maintenance, rehabilitation, and improvement of civil infrastructure.

The program provides a broad foundation across structural and materials, transportation and highways, geotechnical and foundations, hydraulics and water resources, environmental systems, surveying, and construction management. Students also develop competence in computer-aided drafting and design, digital engineering applications, quality control, materials and structural testing, construction practices, quantity surveying, and infrastructure maintenance.

The program emphasizes the transition from classroom knowledge to field application through laboratory experimentation, surveying and fieldwork, project-based learning, industrial training, internships, and capstone projects. This enables students to understand how engineering technologies are selected, applied, monitored, and improved in practical settings.

The program also provides opportunities to apply emerging technologies and sustainable practices in civil engineering projects, including digital modeling, spatial technologies, automated surveying, smart infrastructure, sustainable materials, and infrastructure monitoring.

Rationale

The Bachelor of Science in Civil Engineering Technology addresses the growing need for practically oriented professionals who can support the development, construction, operation, maintenance, and rehabilitation of civil infrastructure. Increasing urbanization, infrastructure expansion, climate-related risks, aging infrastructure, and the demand for more efficient construction practices require graduates who can combine engineering technology knowledge with practical field capabilities.

The construction and infrastructure sectors are also undergoing rapid technological transformation. Digital modeling, spatial technologies, automated surveying, artificial intelligence, smart infrastructure, structural health monitoring, sustainable materials, and data-driven asset management are increasingly influencing professional practice. These developments require an educational framework that extends beyond conventional civil engineering technology and incorporates relevant digital and interdisciplinary applications.

The revised curriculum, therefore, strengthens practical learning, digital competence, sustainable construction, industry exposure, safety, innovation, and interdisciplinary application while retaining the essential civil engineering technology foundation. It responds to the needs of employers, professional practice, technological developments, and Pakistan's infrastructure priorities.



Curriculum for Bachelor of Science in Civil Engineering Technology



The program further responds to the evolving requirements of Industry 5.0 by developing practical competencies for human-centric, sustainable, resilient, and digitally enabled civil engineering solutions. By integrating emerging technologies with responsible technological practice, interdisciplinary collaboration, and resource-conscious approaches, the curriculum prepares graduates to respond effectively to changing industry needs while addressing sustainability, climate resilience, and disaster risk reduction.

The curriculum provides a pathway for graduates to enter professional practice, pursue advanced education and professional development, participate in research and innovation, and undertake entrepreneurial activities within the broad civil engineering and built-environment domain.

Vision Statement

To be a nationally and internationally recognized Civil Engineering Technology program known for excellence in applied education, innovation, professional practice, and sustainable infrastructure development.

Mission Statement

To provide quality outcome-based education, applied learning, research, and industry engagement that prepare Civil Engineering Technology graduates for practical professional practice, innovation, and entrepreneurship, while developing the technical, digital, managerial, communication, and professional capabilities required to contribute to safe, sustainable, and resilient infrastructure.

Program Educational Objectives (PEOs)

PEO-1: Graduates apply technical knowledge, practical skills, digital tools, innovation, and engineering management principles to execute broadly defined civil engineering activities.

PEO-2: Graduates pursue professional growth through lifelong learning, effective communication, collaborative teamwork, and leadership within the civil engineering technology domain.

PEO-3: Graduates uphold ethical and professional standards and contribute to safe, sustainable, and environmentally responsible engineering solutions that support community well-being and socio-economic development.

Program Learning Outcomes (PLOs)

PLO-1 Engineering Knowledge:

Apply knowledge of mathematics, natural science, computing and engineering fundamentals and an engineering specialization as specified in SK1 to SK4 respectively to defined and applied engineering procedures, processes, systems or methodologies.



Curriculum for Bachelor of Science in Civil Engineering Technology



PLO-2 Problem Analysis:

Identify, formulate, research literature and analyze broadly-defined engineering problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialization. (SK1 to SK4)

PLO-3 Design/development of solutions:

Design solutions for broadly-defined engineering technology problems and contribute to the design of systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required. (SK5)

PLO-4 Investigation:

Conduct investigations of broadly-defined engineering problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions. (SK8)

PLO-5 Tool Usage:

Select and apply, and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to broadly-defined engineering problems. (SK2 and SK6)

PLO-6 The Engineer and the World:

When solving broadly-defined engineering problems, analyze and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks, and the environment. (SK1, SK5, and SK7)

PLO-7 Ethics:

Understand and commit to professional ethics and norms of engineering technology practice including compliance with national and international laws. Demonstrate an understanding of the need for diversity and inclusion. (SK9)

PLO-8 Individual and Collaborative Team work:

Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings. (SK9)

PLO-9 Communication:

Communicate effectively and inclusively on broadly-defined engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, taking into account cultural, language, and learning differences.



Curriculum for
Bachelor of Science in Civil Engineering Technology



PLO-10 Project Management and Finance:

Apply knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.

PLO-11 Lifelong learning:

Recognize the need for, and have the ability for i) independent and lifelong learning and ii) critical thinking in the face of new specialist technologies. (SK8)



Curriculum for Bachelor of Science in Civil Engineering Technology



1. Introduction

Curriculum is the total learning experience of a student within the educational process. The term refers specifically to a planned sequence of instruction and to the student's experiences in terms of the educator's or institution's instructional goals. Curriculum is a systematic and intended packaging of competencies (i.e., knowledge, skills, and attitudes, underpinned by values) that learners should acquire through organized learning experiences.

Curriculum forges learners' lifelong learning competencies, as well as social attitudes and skills, such as tolerance and respect, constructive handling of diversity, peaceful conflict management, promotion and respect of human rights, gender equality, justice, and inclusiveness. At the same time, the curriculum must be singularly aligned to national development goals and produce human resources that become an effective factor of production in the economy.

Curriculum is thus the foundation on which the edifice of academic programs designed for focused outcomes rests, equipping graduates with the desired skill sets. The engineering technology curriculum aims to produce proficient engineering technology graduates who meet the demands of both national and international job markets. The curriculum conforms substantially to the Sydney Accord, an international agreement for the mutual recognition of accredited engineering technology qualifications, and aligns with the Graduate Attributes and Professional Competences defined by the International Engineering Alliance (IEA) [Refer to Appendices B–F].

The curriculum of the Bachelor of Science in Civil Engineering Technology program is developed and reviewed by HEC's National Curriculum Review Committee (NCRC) [Refer to Appendix A].

2. Curriculum Development Methodology

2.1 Benchmarking

The curriculum for Civil Engineering Technology is benchmarked against HEC's Undergraduate Education Policy and developed in accordance with the NTC Curriculum Framework. It is substantially aligned with the Sydney Accord Graduate Attributes and the IEA framework pertaining to engineering technology programs [Refer to Appendices B–F].

The course of studies clearly defines and differentiates the program from the Bachelor of Science in Civil Engineering by the contact hours spent in classrooms, laboratories, and industry. Ideally, an engineering program is designed with a classroom-to-practical-training contact-hour ratio of 70:30 to emphasize design aspects. For engineering technology programs, however, the contact-hour ratio is reversed to 30:70, providing more opportunities for hands-on and psychomotor training.

The course learning outcomes (CLOs) and their mapping to program learning outcomes (PLOs) mentioned in this document serve as guidelines for HEIs.

2.2 Curriculum Development Cycle

Curriculum development is a rigorous process and entails the following steps:

- Nominations are requested from academic circles and relevant industry forums to constitute a National Curriculum Review Committee (NCRC) comprising leading national experts.
- From the nominations received, the NCRC is finalized and notified by the NTC (HEC).
- A preliminary meeting of the NCRC, spanning three days, is held to establish the framework and benchmarking issues, and assign different facets of curriculum development to smaller teams within the NCRC.
- NCRC members elect a Convenor, a co-convenor, and a secretary from among themselves for the proceedings of the NCRC, after mutual consultation.
- A draft of the program curriculum is prepared by the NCRC at the end of the Preliminary Meeting and two online meetings.
- The final NCRC meeting, lasting three days, is held to finalize the NCRC members' recommendations and prepare a final curriculum document.
- The entire cycle of curriculum development is completed in two months.

2.3 Historical Timeline of NCRC Meetings

The historical timeline of NCRC meetings to develop the Bachelor of Science in Civil Engineering Technology is listed below:

- Preliminary Meeting [Refer to Appendix A]
- Final Meeting



Curriculum for Bachelor of Science in Civil Engineering Technology



3. Curriculum Detail

3.1 Program Structure

The degree program follows the HEC Undergraduate Education Policy 2023, Version 1.1, and comprises eight regular semesters (four years), with a total of 139 credit hours. The total number of credit hours is reasonably set to achieve the Program Learning Outcomes (PLOs).

Bachelor of Science in Civil Engineering Technology Program			
Parameter	HEC Framework	Framework – A (SIT in 8th Semester Only)	Framework – B (SIT in 7 th & 8 th Semesters)
Program Type	Semester System	Semester System	Semester System
Program Duration	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years
Semester Duration	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams
Total Number of Courses	-	49	44
Engineering Technology Domain Courses	-	34	29
Non-Engineering Technology Domain Courses	15	15	15
Total Credit Hours	124 – 148	139	139
Engineering Technology Domain Credit Hours	-	105	105
Non-Engineering Technology Domain Credit Hours	34	34	34
Interdisciplinary Credit Hours	12	12	12
Professional Certification Credit Hours	-	3	3
No. of Credit Hours per Semester	15 – 21	15 – 21	15 – 21
** Elective courses are included under Framework A, where SIT is conducted in Semester VIII only.			
1 credit hour: (1) For theory: 1 contact hour per week for a minimum of 16 weeks for theory. (2) For lab: 3 contact hours per week for a minimum of 16 weeks for lab.			



Curriculum for Bachelor of Science in Civil Engineering Technology



Bachelor of Science in Civil Engineering Technology Program		
Parameter		Details
Total Credit Hours of Program		139 credit hours
Discipline-Related Courses/ Major	General Education Courses	34 credit hours (15 courses)
	Compulsory Major	89 credit hours (29 courses)
	Electives Major	16 credit hours (5 courses) – Framework A
	Professional Certification	3 credit hours
Supervised Industrial Training (SIT)		16 credit hours (Framework A) / 32 credit hours (Framework B)
Capstone Project		6 credit hours (2 courses)
Program Duration		Minimum: 4 Years Maximum: 6 Years (Further extendable to another year, subject to the approval of the university's statutory body, following the provisions of HEC Undergraduate Education Policy 2023 V 1.1)
Semester Duration		16–18 weeks for regular semesters (1–2 weeks for examination) 8–9 weeks for summer semesters (1 week for examination)
Course Load (per semester)		15–21 credit hours for regular semesters Credit hours may be offered in summer/winter semesters in accordance with HEC guidelines. (For remedial/deficiency/failure/repetition courses only)
3 Credit Hours (Theory)		3 classes (1 hour each) OR 2 classes (1.5 hours each) OR 1 class (3 hours) per week throughout the semester.
1 Credit Hour (Practical/Laboratory)		1 credit hour of practical work requires three contact hours per week throughout the semester.



Curriculum for Bachelor of Science in Civil Engineering Technology



Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework							
Knowledge Area	Name of Course	Credit Hours (Th-Lab)	Weekly Contact Hours (Th-Lab)	Total Credit Hours		Number of Courses	
				As per the Scheme of Studies	As per HEC Guidelines	As per the Scheme of Studies	As per HEC Guidelines
Civil Engineering Technology (Foundation)	Materials and Methods of Construction	3 (2-1)	5 (2-3)	27	-	11	-
	Architecture and Town Planning	2 (2-0)	2 (2-0)				
	Surveying	3 (1-2)	7 (1-6)				
	Engineering Mechanics	2 (1-1)	4 (1-3)				
	Civil Engineering Drawing, Drafting and Interpretation	2 (1-1)	4 (1-3)				
	Soil Mechanics	3 (1-2)	7 (1-6)				
	Fluid Mechanics	3 (2-1)	5 (2-3)				
	Environmental Engineering	3 (2-1)	5 (2-3)				
	Concrete Technology	2 (1-1)	4 (1-3)				
	Mechanics of Solids	3 (2-1)	5 (2-3)				
	Occupational Health and Safety Management	1 (1-0)	1 (1-0)				
Civil Engineering Technology (Breadth)	Engineering Hydrology	2 (1-1)	4 (1-3)	6	-	3	-
	Maintenance and Repair of Civil Works	1 (1-0)	1 (1-0)				
	Construction Project Administration	3 (2-1)	5 (2-3)				
Civil Engineering Technology (Depth)	Transportation and Highway Technology	4 (2-2)	8 (2-6)	28	-	10	-
	Reinforced and Prestressed Concrete	3 (2-1)	5 (2-3)				



Curriculum for Bachelor of Science in Civil Engineering Technology



	Computer-Aided Drawing and Building Information Modeling	3 (1-2)	7 (1-6)				
	Irrigation Engineering	3 (2-1)	5 (2-3)				
	Water Supply Systems	2 (1-1)	4 (1-3)				
	Quantity Surveying and Estimation	2 (1-1)	4 (1-3)				
	Geotechnical Investigation and Foundations	2 (1-1)	4 (1-3)				
	Project Part – I	3 (0-3)	9 (0-9)				
	Project Part – II	3(0-3)	9 (0-9)				
	Professional Certification (Internship)	3 (3-0)	3 (3-0)				
Civil Engineering Technology (Electives)* <i>(5 courses to be selected from the approved elective pool)</i>	Digital Engineering Tools	3 (2-1)	5 (2-3)	16	-	5	-
	Building Codes and Compliance	3 (3-0)	3 (3-0)				
	Ground Improvement Techniques	3 (2-1)	5 (2-3)				
	Smart Technologies for Facilities Management <i>(Compulsory Elective)</i>	4 (3-1)	6 (3-3)				
	Land Reclamation and Drainage Technology	3 (2-1)	5 (2-3)				
	Applied Hydraulics	3 (2-1)	5 (2-3)				
	Construction Equipment and Jobsite Practices	3 (2-1)	5 (2-3)				
	Construction of Steel Structures	3 (2-1)	5 (2-3)				



Curriculum for Bachelor of Science in Civil Engineering Technology



	Pavement Construction and Rehabilitation	3 (2-1)	5 (2-3)				
Interdisciplinary	Electro-Mechanical Technology	3 (2-1)	5 (2-3)	12	-	4	-
	Geology	3 (2-1)	5 (2-3)				
	GIS and Remote Sensing	3 (2-1)	5 (2-3)				
	AI in Civil Engineering Technology	3 (1-2)	7 (1-6)				
Training	Supervised Industrial Training – Semester VIII	16 (0-16)	48 (0-48)	Framework A – 16		Framework A – 1	
	Supervised Industrial Training – Semester VII & VIII	32 (0-32)	96 (0-96)	Framework B – 32		Framework B – 2	
Total Credit Hours and Courses (including Engineering Technology Domain, Interdisciplinary Courses, and SIT)				105 Credit Hours		Framework A 34 Courses Framework B 29 Courses	
* Elective courses shall be included under Framework A, where SIT is conducted in Semester VIII only.							

3.2 General Education Courses: 34 Credits (15 Courses)

As per HEC UGE Policy V 1.1 and subsequent notifications, the following courses are mandatory for every undergraduate degree program; hence, they are included in the schemes of the BS CET program.

S. No.	GE Course Category	No. of Courses	Credit Hours
1	Arts and Humanities	1	2
2	Natural Sciences	1	3 (2-1)
3	Social Sciences	1	2
4	Functional English, Expository Writing	2	6
5	Quantitative Reasoning	2	6
6	Islamic Studies / Ethics	1	2
7	Ideology and Constitution of Pakistan	1	2



Curriculum for Bachelor of Science in Civil Engineering Technology



8	Applications of Information and Communication Technologies	1	3 (2-1)
9	Entrepreneurship	1	2
10	Civics and Community Engagement	1	2
11	Pakistan Studies	1	2
12	Fehm-e-Quran	2	2
	Total	15	34

Note: In the course categories from Serial Numbers 4–12, HEC has developed model course outlines for the guidance of the Institutions. For the course categories from Serial Numbers 1–3, as a choice in course selection is available, the same was deliberated in detail in the NCRC meetings; the recommended courses are given below.

S. No.	GE Course Categories and Titles	No. of Courses	Credit Hours
1	<i>Arts & Humanities</i> Professional Ethics Foreign Language*	1	2
2	<i>Natural Sciences</i> Applied Chemistry	1	3 (2-1)
3	<i>Social Sciences</i> Applied Economics	1	2
4 5	Functional English (3-0) Expository Writing (3-0)	2	6
6 7	<i>Quantitative Reasoning</i> Quantitative Reasoning – I (3-0) Quantitative Reasoning – II (3-0)	2	6
8	Islamic Studies / Ethics	1	2
9	Ideology and Constitution of Pakistan	1	2
10	Applications of Information and Communication Technologies	1	3 (2-1)
11	<i>Entrepreneurship</i> Technopreneurship	1	2
12	Civics and Community Engagement	1	2
13	Pakistan Studies	1	2
14	<i>Fehm-e-Quran</i> Fehm-e-Quran – I (0-1)	2	2

15	Fehm-e-Quran – II (0-1)		
	Total	15	34
<i>*Institutional Elective: HEIs may offer "Foreign Language" at their discretion, based on institutional requirements and availability of resources.</i>			

3.3 Interdisciplinary Courses: Min 12 Credit Hours

As per HEC UGE Policy V 1.1, interdisciplinary courses comprising 12 credit hours are required in four-year undergraduate degree programs to complement a holistic understanding of the major. The matter was thoroughly deliberated at the NCRC meetings, where it was emphasized that, to effectively utilize the interdisciplinary course component, a list of courses should be provided to ensure that no important area is left unattended. Universities may add courses to this list following approval by the relevant statutory bodies of the HEI.

S. No.	Interdisciplinary Courses	Credit Hours
1	Geology	3 (2-1)
2	GIS and Remote Sensing	3 (2-1)
3	Electro-Mechanical Technology	3 (2-1)
4	AI in Civil Engineering Technology	3 (1-2)
	Total	12

4. Admission Criteria

Criteria for admission in the Bachelor of Science in Civil Engineering Technology program are defined in NTC's Program Accreditation Policy and Procedures Manual for Engineering & Other Technologies, Clause 3.2.4.1. The salient features for eligibility for admission are:

- 1) Minimum 50% marks in DAE/F.Sc. (Pre-Engineering)
or other equivalent qualifications such as A-level/ICS/B.Sc. (Sports and Hafiz-e-Quran marks are not included), and
- 2) Entrance Test
- 3) Weightage:
 - 70% for academics (DAE/FSc, etc.)
 - 30% for Entrance Test

5. Semester-wise Scheme of Studies

The semester-wise Scheme of Studies for the Bachelor of Science in Civil Engineering Technology program spans four years (eight semesters), comprising a total of 139 credit hours, along with the weekly contact hours for each course.

SEMESTER – I				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
NSC-111	Quantitative Reasoning – I	General Education (Natural Sciences)	3-0	3-0
HUM-112	Functional English	General Education (Arts and Humanities)	3-0	3-0
COMP-113	Applications of Information and Communication Technologies	General Education (Computing)	2-1	2-3
CET-114	Materials and Methods of Construction	Major Civil Engineering Technology Foundation	2-1	2-3
CET-115	Architecture and Town Planning	Major Civil Engineering Technology Foundation	2-0	2-0
IDS-116	Electro-Mechanical Technology	Interdisciplinary	2-1	2-3
Sub Total			17 (14-3)	23 (14-9)



Curriculum for
Bachelor of Science in Civil Engineering Technology



SEMESTER – II				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
NSC-121	Quantitative Reasoning – II	General Education (Natural Sciences)	3-0	3-0
SSC-122	Applied Economics	General Education (Social Sciences)	2-0	2-0
HUM-123	Expository Writing	General Education (Arts and Humanities)	3-0	3-0
NSC-124	Applied Chemistry	General Education (Natural Sciences)	2-1	2-3
HUM-125	Fehm-e-Quran – I (for Muslim Students)/ Any course of GE (for Non-Muslim Students)	General Education (Arts and Humanities)	0-1	0-3
CET-126	Surveying	Major Civil Engineering Technology Foundation	1-2	1-6
CET-127	Engineering Mechanics	Major Civil Engineering Technology Foundation	1-1	1-3
Sub Total			17 (12-5)	27 (12-15)

SEMESTER – III				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
HUM-211	Professional Ethics/ Foreign Language	General Education (Arts and Humanities)	2-0	2-0
HUM-212	Islamic Studies (Religious Education)/ Ethics (for Non-Muslim Students)	General Education (Arts and Humanities)	2-0	2-0
HUM-213	Pakistan Studies	General Education (Arts and Humanities)	2-0	2-0
HUM-214	Fehm-e-Quran – II (for Muslim Students)/ Any course of GE (for Non-Muslim Students)	General Education (Arts and Humanities)	0-1	0-3
CET-215	Civil Engineering Drawing, Drafting and Interpretation	Major Civil Engineering Technology Foundation	1-1	1-3



Curriculum for Bachelor of Science in Civil Engineering Technology



CET-216	Soil Mechanics	Major Civil Engineering Technology Foundation	1-2	1-6
CET-217	Fluid Mechanics	Major Civil Engineering Technology Foundation	2-1	2-3
CET-218	Environmental Engineering	Major Civil Engineering Technology Foundation	2-1	2-3
Sub Total			18 (12-6)	30 (12-18)

SEMESTER – IV				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
HUM-221	Civics and Community Engagement	General Education (Arts and Humanities)	2-0	2-0
HUM-222	Ideology and Constitution of Pakistan	General Education (Arts and Humanities)	2-0	2-0
MGM-223	Technopreneurship	General Education (Management Sciences)	2-0	2-0
CET-224	Concrete Technology	Major Civil Engineering Technology Foundation	1-1	1-3
CET-225	Transportation and Highway Technology	Major Civil Engineering Technology Depth	2-2	2-6
CET-226	Mechanics of Solids	Major Civil Engineering Technology Foundation	2-1	2-3
IDS-227	Geology	Interdisciplinary	2-1	2-3
Sub Total			18 (13-5)	28 (13-15)

SEMESTER – V				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
CET-311	Reinforced and Prestressed Concrete	Major Civil Engineering Technology Depth	2-1	2-3
CET-312	Engineering Hydrology	Major Civil Engineering Technology Breadth	1-1	1-3
CET-313	Computer-Aided Drawing and Building Information Modeling	Major Civil Engineering Technology Depth	1-2	1-6
CET-314	Irrigation Engineering	Major Civil Engineering Technology Depth	2-1	2-3



Curriculum for Bachelor of Science in Civil Engineering Technology



CET-315	Water Supply Systems	Major Civil Engineering Technology Depth	1-1	1-3
CET-316	Occupational Health and Safety Management	Major Civil Engineering Technology Foundation	1-0	1-0
CET-317	Project Part – I	Major Civil Engineering Technology Depth	0-3	0-9
Sub Total			17 (8-9)	35 (8-27)

SEMESTER – VI				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
CET-321	Quantity Surveying and Estimation	Major Civil Engineering Technology Depth	1-1	1-3
CET-322	Maintenance and Repair of Civil Works	Major Civil Engineering Technology Breadth	1-0	1-0
CET-323	Geotechnical Investigation and Foundations	Major Civil Engineering Technology Depth	1-1	1-3
IDS-324	GIS and Remote Sensing	Interdisciplinary	2-1	2-3
IDS-325	AI in Civil Engineering Technology	Interdisciplinary	1-2	1-6
CET-326	Construction Project Administration	Major Civil Engineering Technology Breadth	2-1	2-3
CET-327	Project Part – II	Major Civil Engineering Technology Depth	0-3	0-9
Sub Total			17 (8-9)	35 (8-27)

SEMESTER – VII				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
CET-XXX	Compulsory Elective – I	Major Civil Engineering Technology Breadth/Depth	3-1	3-3
CET-XXX	Elective – II	Major Civil Engineering Technology Breadth/Depth	2-1	2-3
CET-XXX	Elective – III	Major Civil Engineering Technology Breadth/Depth	2-1	2-3
CET-XXX	Elective – IV	Major Civil Engineering Technology Breadth/Depth	2-1	2-3
CET-XXX	Elective – V	Major Civil Engineering Technology Breadth/Depth	2-1	2-3
Sub Total			16 (11-5)	26 (11-15)



Curriculum for Bachelor of Science in Civil Engineering Technology



OR				
SEMESTER – VII				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
SIT-411	Supervised Industrial Training (Compulsory)	Major Civil Engineering Technology Depth	0-16	0-48
Sub Total			16 (0-16)	48 (0-48)

SEMESTER – VIII				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
SIT-421	Supervised Industrial Training (Compulsory)	Major Civil Engineering Technology Depth	0-16	0-48
Sub Total			16 (0-16)	48 (0-48)

Total Credit Hours and Contact Hours in Four Years (when optional/elective courses are conducted instead of SIT in Semester VII – Framework A)	81+58= 139	81+174 = 255
Theory vs. Practical Distribution	Theory (58.27%) Practical (41.73%)	Theory (31.76%) Practical (68.24%)
Total Credit Hours and Contact Hours in Four Years (when SIT is conducted in both Semesters VII and VIII – Framework B)	65+74 = 139	65+222 = 287
Theory vs. Practical Distribution	Theory (46.76%) Practical (53.24%)	Theory (22.64%) Practical (77.36%)

LIST OF ELECTIVES				
S. No.	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
1.	Digital Engineering Tools	Major Civil Engineering Technology Breadth	2-1	2-3
2.	Building Codes and Compliance	Major Civil Engineering Technology Breadth	3-0	3-0

3.	Ground Improvement Techniques	Major Civil Engineering Technology Depth	2-1	2-3
4.	Smart Technologies for Facilities Management (Compulsory Elective)	Major Civil Engineering Technology Depth	3-1	3-3
5.	Land Reclamation and Drainage Technology	Major Civil Engineering Technology Depth	2-1	2-3
6.	Applied Hydraulics	Major Civil Engineering Technology Depth	2-1	2-3
7.	Construction Equipment and Jobsite Practices	Major Civil Engineering Technology Depth	2-1	2-3
8.	Construction of Steel Structures	Major Civil Engineering Technology Depth	2-1	2-3
9.	Pavement Construction and Rehabilitation	Major Civil Engineering Technology Depth	2-1	2-3

6. Course Codes

Course Codes are defined below:

- The program spans four years, with two semesters per year, Fall and Spring (with a possible Summer Semester).
- Each course has a unique three-letter prefix, followed by a three-digit code
- Letters are acronyms for course descriptions, and numbers define the chronological position in the academic year and the sequence number in the program.

Digits in the course code are defined in the table below:

1 ST DIGIT	2 ND DIGIT	3 RD DIGIT
Denotes Year (1,2,3,4)	Denotes Semester within the Academic Year (1, 2)	Denotes Course Sequence within the Semester (1, 2, 3, ...)

- The letter prefix identifies the relevant knowledge area, discipline, or course category, while the numerical code indicates the chronological position of the course within the academic program.

COURSE CODE PREFIXES AND DESCRIPTIONS		
S. No.	Course Code Prefix	Description
1.	CET	Major Civil Engineering Technology – Foundation / Breadth / Depth
2.	HUM	Arts and Humanities
3.	NSC	Natural Sciences
4.	SSC	Social Sciences

5.	COMP	Computing
6.	MGM	Management Sciences
7.	IDS	Interdisciplinary Studies
8.	SIT	Supervised Industrial Training

7. Elective Courses

The lists of elective courses, grouped across depth and breadth categories, are presented below, showing credit hours and weekly contact hours.

ELECTIVE BREADTH COURSES				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
CET-411	Digital Engineering Tools	Major Civil Engineering Technology Breadth	2-1	2-3
CET-412	Building Codes and Compliance	Major Civil Engineering Technology Breadth	3-0	3-0

ELECTIVE DEPTH COURSES				
Course Code	Course Title	Knowledge Area/Domain	Credit Hrs. (Th-Lab)	Weekly Contact Hrs. (Th-Lab)
CET-413	Ground Improvement Techniques	Major Civil Engineering Technology Depth	2-1	2-3
CET-414	Smart Technologies for Facilities Management (Compulsory Elective)	Major Civil Engineering Technology Depth	3-1	3-3
CET-415	Land Reclamation and Drainage Technology	Major Civil Engineering Technology Depth	2-1	2-3
CET-416	Applied Hydraulics	Major Civil Engineering Technology Depth	2-1	2-3
CET-417	Construction Equipment and Jobsite Practices	Major Civil Engineering Technology Depth	2-1	2-3
CET-418	Construction of Steel Structures	Major Civil Engineering Technology Depth	2-1	2-3
CET-419	Pavement Construction and Rehabilitation	Major Civil Engineering Technology Depth	2-1	2-3



Curriculum for Bachelor of Science in Civil Engineering Technology



8. Course Contents

The primary goal of this curriculum is to be substantially compliant with international standards set by frameworks such as the IEA and the Sydney Accord (SA).

Program Learning Outcomes (PLOs), Course Learning Outcomes (CLOs), and Bloom's Taxonomy Levels are expected learning outcomes and are aligned with standards set by IEA and SA.

8.1 Quantitative Reasoning-I

Course Code and Title: NSC-111 Quantitative Reasoning-I		Credits Hours: 3+0	Prerequisite: None
Knowledge and Attitude Profile: SK2 (Conceptually-based mathematics)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC3 (Problem analysis) - TC12 (Judgment)	
Course Objectives			
Quantitative Reasoning-I is an introductory-level undergraduate course that focuses on the fundamentals of quantitative concepts and analysis. The course is designed to familiarise students with the basic concepts of mathematics and statistics and to develop their ability to analyse and interpret quantitative information. Through a combination of theoretical concepts and practical exercises, this course will enable students to cultivate their quantitative literacy and problem-solving skills while effectively expanding their academic horizons and breadth of knowledge in their specific field of study.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Fundamental numerical literacy to enable them to work with numbers, understand their meanings, and present data accurately.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Understand the fundamentals of mathematics and basic statistical concepts.	C2 (Cognitive) Understand	PLO-2 / SA2 (Problem Analysis)
CLO-3	Basic ability to interpret data present in various formats, including but not limited to tables, graphs, charts, and equations, etc.	C2 (Cognitive) Understand	PLO-5 / SA5 (Tool Usage)
Course Outline for Theory			
Numerical Literacy: Number system and basic arithmetic operations; Units and their conversions, dimensions, area, perimeter, and volume; Rates, ratios, proportions, and percentages; Types and sources of data; Measurement scales; Tabular and graphical presentation of data; Quantitative reasoning exercises using number knowledge. Fundamental Mathematical Concepts: Basics of geometry (lines, angles, circles, polygons, etc.); Sets and their operations; Relations, functions, and their graphs; Exponents, factoring, and simplifying algebraic expressions; Algebraic and graphical solutions of linear and quadratic equations and Inequalities; Quantitative reasoning exercises using fundamental mathematical concepts.			



Curriculum for Bachelor of Science in Civil Engineering Technology



- **Fundamental Statistical Concepts:** Population and sample; Measures of central tendency, dispersion and data interpretation; Rules of counting (multiplicative, permutations and combinations); Data visualization; Basic probability theory; Introduction to random variables and their probability distributions; Quantitative reasoning exercises using fundamental statistical concepts; Use of related software SPSS/Minitab/PHStat/R/STATA for basic quantitative reasoning using statistical analysis and basic data visualization.

Recommended Books

1. Bennett, J. O., & Briggs, W. L. (2018). *Using and understanding mathematics: A quantitative reasoning approach* (7th ed.). Pearson.
2. Bueno de Mesquita, E., & Fowler, A. (2021). *Thinking clearly with data: A guide to quantitative reasoning and analysis*. Princeton University Press.
3. Burzynski, D., & Ellis, W. (2013). *Fundamentals of mathematics*. OpenStax CNX.
4. Chatfield, C. (1983). *Statistics for technology: A course in applied statistics* (3rd ed.). Chapman and Hall/CRC.
5. Lock, R. H., Lock, P. F., Lock Morgan, K., Lock, E. F., & Lock, D. F. (2020). *Statistics: Unlocking the power of data* (3rd ed.). Wiley.
6. Madison, B. L., & Bressoud, D. M. (Eds.). (2003). *Quantitative reasoning for the information age*. Mathematical Association of America.
7. Rosen, K. H. (2019). *Discrete mathematics and its applications* (8th ed.). McGraw-Hill.
8. Sevilla, A., & Somers, K. (2013). *Quantitative reasoning: Tools for today's informed citizen* (2nd ed.). Wiley.
9. Zaslow, E. (2020). *Quantitative reasoning: Thinking in numbers*. Cambridge University Press.

8.2 Functional English

Course Code and Title: HUM-112 Functional English		Credits Hours: 3+0	Prerequisite: None
Knowledge and Attitude Profile: SK1 (Theory-based understanding of the natural and social sciences)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): SDG 4 (Quality Education)		Professional Competence Profile: - TC10 (Communication and Collaboration) - TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
This course is designed to provide students with essential English communication skills for real-world use. Students strengthen grammar, vocabulary, and sentence structure, as well as listening and reading comprehension. It covers professional writing, public speaking, and everyday conversation for academic and career success. The course also emphasizes inclusive, culturally aware communication for diverse, global audiences. Additionally, the course will enable students to navigate the globalized world with ease and effectiveness, thereby improving their functional interactions.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Apply enhanced English communication skills through effective use of word choice, grammar, and sentence structure.	C3 (Cognitive) Apply	PLO-9 / SA9 (Communication)
CLO-2	Recognize intercultural variations in the use of the English language and effectively adapt their communication style and content based on diverse cultural and social contexts.	C2 (Cognitive) Understand	PLO-6 / SA6 (The Engineer and the World)
CLO-3	Effectively express information, ideas, and opinions in written and spoken English.	A2 (Affective) Respond	PLO-11 / SA11 (Lifelong learning)
Course Outline for Theory			
Foundations of Functional English: Vocabulary building (contextual usage, synonyms, antonyms, and idiomatic expressions); communicative grammar (subject-verb agreement, verb tenses, fragments, run-ons, modifiers, articles, word classes, etc.) Word formation (affixation, compounding, clipping, back formation, etc.) Sentence structure (simple, compound, complex, and compound-complex); sound production and pronunciation. Comprehension and Analysis: Understanding purpose, audience, and context; contextual interpretation (tones, biases, stereotypes, assumptions, inferences, etc.) Reading strategies			

(skimming, scanning, SQ4R, critical reading, etc.) Active listening (overcoming listening barriers, focused listening, etc.).

- **Effective Communication:** Principles of communication (clarity, coherence, conciseness, courteousness, correctness, etc.) Structuring documents (introduction, body, conclusion, and formatting). As part of the overall learning requirements, students will also be exposed to relevant simulations, role-plays, and real-life scenarios. They will be required to apply skills acquired throughout the course in a final project.

Lab Work Outline for Practical (Optional)

As part of the overall learning requirements, students will also be exposed to relevant simulations, role-plays, and real-life scenarios, and will be required to apply skills acquired throughout the course in a final project.

Recommended Books

1. Azar, B. S. (2009). *Understanding and using English grammar* (4th ed.). Pearson Education.
2. Downes, C. (2008). *Cambridge English for job-hunting*. Cambridge University Press.
3. Hutchinson, T., & Waters, A. (1987). *English for specific purposes: A learning-centred approach*. Cambridge University Press.
4. James, M., & Merickel, A. P. (2012). *Reading literature and writing argument* (5th ed.). Pearson.
5. Johns, J., & Lenski, S. (2018). *Improving reading: Strategies, resources, and Common Core connections* (7th ed.). Kendall Hunt Publishing.
6. Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge University Press.
7. Murphy, R. (2019). *English grammar in use: A self-study reference and practice book for intermediate learners of English* (5th ed.). Cambridge University Press.
8. Straus, J. (2014). *The blue book of grammar and punctuation: An easy-to-use guide with clear rules, real-world examples, and reproducible quizzes* (11th ed.). Jossey-Bass.
9. Swan, M. (2017). *Practical English usage* (4th ed.). Oxford University Press.

8.3 Applications of Information and Communication Technologies

Course Code and Title: COMP-113 Applications of Information and Communication Technologies		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: SK2 (Conceptually-based mathematics)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): - SDG 8 (Decent Work and Economic Growth) - SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: - TC9 (Manage engineering activities) - TC10 (Communication and Collaboration) - TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
This course is designed to provide students with an exploration of the practical applications of Information and Communication Technologies (ICT) and software tools across various domains. To provide students with hands-on experience with ICT tools and software applications so they can use technology to solve everyday problems, boost productivity, and innovate across different fields.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Apply common ICT tools and software to solve real-life, professional, and academic problems.	C3 (Cognitive) Apply	PLO-6 / SA6 (The Engineer and the World)
CLO-2	Use digital platforms for effective communication, collaboration, and productivity.	P4 (Psychomotor) Respond	PLO-5 / SA5 (Tool Usage)
CLO-3	Understand the ethical and legal considerations in the use of ICT platforms and tools.	C2 (Cognitive) Understand	PLO-7 / SA7 (Ethics)
Course Outline for Theory			
Introduction to Information and Communication Technologies: Components of Information and Communication Technologies (basics of hardware, software, ICT platforms, networks, local and cloud data storage, etc.). Scope of Information and Communication Technologies (use of ICT in education, business, governance, healthcare, digital media and entertainment, etc.). Emerging technologies and future trends. Basic ICT Productivity Tools: Effective use of popular search engines (e.g., Google, Bing, etc.) to explore the World Wide Web. Formal communication tools and etiquette (Gmail, Microsoft Outlook, etc.). Microsoft Office Suite (Word, Excel, PowerPoint). Google Workspace (Google Docs, Sheets, Slides). Dropbox (Cloud storage and file sharing), Google Drive (Cloud storage with Google Docs			

integration), and Microsoft OneDrive (Cloud storage with Microsoft Office integration). Evernote (note-taking and organization applications) and OneNote (Microsoft's digital notebook for capturing and organizing ideas). Video Conferencing (Google Meet, Microsoft Teams, Zoom, etc.) Social media applications (LinkedIn, Facebook, Instagram, etc.).

- **ICT in Education:** Working with learning management systems (Moodle, Canvas, Google Classroom, etc.) Sources of online education courses (Coursera, edX, Udemy, Khan Academy, etc.) Interactive multimedia and virtual classrooms.
- **ICT in Health and Well-being:** Health and fitness tracking devices and applications (Google Fit, Samsung Health, Apple Health, Xiaomi Mi Band, Runkeeper, etc.). Telemedicine and online health consultations (QLADOC, Seha Kahani, Marham, etc.).
- **ICT in Personal Finance and Shopping:** Online banking and financial management tools (JazzCash, Easypaisa, Zon PayMax, ILINK, and MN Keenu Wallet, etc.). E-commerce platforms (Dapki, Telemart, Shophive, etc.).
- **Digital citizenship and online Etiquette:** Digital identity and online reputation. Netiquette and respectful online communication. Cyberbullying and online harassment.
- **Ethical Considerations in Use of ICT Platforms and Tools:** Intellectual property and copyright issues. Ensuring originality in content creation by avoiding plagiarism and unauthorized use of information sources. Content accuracy and integrity (ensuring that the content shared through ICT platforms is free from misinformation, fake news, and manipulation).

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

- Guided tutorials and exercises to ensure that students are proficient in commonly used software applications such as word processing software (e.g., Microsoft Word), presentation software (e.g., Microsoft PowerPoint), and spreadsheet software (e.g., Microsoft Excel), among other tools. Students may be assigned practical tasks that require them to create documents, presentations, and spreadsheets, etc.
- Assigning tasks that involve creating, managing, and organizing files and folders on both local and cloud storage systems. Students will practice file naming conventions, creating directories, and using cloud storage solutions (e.g., Google Drive, OneDrive).
- The use of online learning management systems (LMS), where students can access course materials, submit assignments, participate in discussion forums, and take quizzes or tests. This will provide students with practical experience with online platforms commonly used in education and the workplace.

Recommended Books

1. Evans, A., Martin, K., & Poatsy, M. A. (2020). *Technology in action* (16th ed.). Pearson Education.
2. Gaskin, S., Vargas, A., & McLellan, C. (2013). *GO! with Microsoft Office 2013* (Vol. 1). Pearson Education.
3. Grauer, R. T., & Poatsy, M. A. (2012). *Exploring Microsoft Office 2010* (Vol. 1, 2nd ed.). Pearson Education.
4. O'Leary, T. J., O'Leary, L. I., & O'Leary, D. (2023). *Computing essentials* (29th ed.). McGraw-Hill.

8.4 Materials and Methods of Construction

Course Code and Title: CET-114 Materials and Methods of Construction		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: SK3 (Engineering fundamentals)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC5 (Evaluation)	
Course Objectives			
The course aims to develop an understanding of construction materials, construction methods, site practices, quality control, safety, and sustainable applications in civil engineering projects.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the characteristics and applications of commonly used construction materials.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Select suitable construction materials and construction methods according to engineering requirements and site conditions.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform basic laboratory tests and field practices related to construction materials and interpret experimental results.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-4	Present construction practices, material testing results, and technical observations effectively through written and oral communication.	A2 (Affective) Responding	PLO-9 / SA9 Communication
Course Outline for Theory			
Materials of Construction: Constituents, types, properties of cement; preparation, setting, hardening, and application of lime, comparison of lime and cement based on characteristics and cost. Properties, preparation, and application of mortars. Components, properties, types, and manufacturing of concrete; properties of water used for concrete mix. Physical and mechanical properties and application of steel; physical and mechanical properties of aluminium. Manufacturing, standard tests			

for brick/block, ceramic stones properties, qualities, use in building construction, extraction, and processing of stones. Aggregates (coarse and fine) properties, standard tests (abrasion tests, crushing strength, gradation, weathering, etc.). Types, uses, seasoning, and preservation of wood or timber for construction. Types, composition, preparation, and application of paints, varnishes, fillers in construction; composition, varieties, properties, and uses of glass, plastics, laminates, and adhesives in construction. Properties and uses of asphalt, bitumen, rubber, asbestos and its products, plastic pipes, reinforced plastics.

- **Methods of Construction:** Bonds in brick masonry and their formation in construction, corbel, cornice, string course, parapets, and slip joints. Masonry block. Stone masonry, Uses of stone in civil engineering. Use of Gabion walls. Scaffolding work design and its importance in construction work. R. B. beams, columns, lintels, and slab construction in buildings. ASTM Standards and testing of bricks. Hand tools for construction. Foundation for walls and piers. Load-bearing walls in brick and masonry construction, composite walls, cavity construction, concrete-framed structures, panel walls, and external finishes. Reinforced concrete, materials in roof and floor construction, and floor finishes. Internal walls and partitions; surface finishes to internal walls and ceiling; doors and windows; staircases; and damp-proofing of walls and ceiling. Fire-resistant construction. Tunnel and cofferdam construction. Formwork for slabs, beams, columns & walls, etc. Formwork for shells. Standards, inspection, and quality control of materials.
- ASTM standards, material testing, inspection, and quality control in construction works.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Standard consistency test and fineness of cement.
2. Standard sizes of bricks and blocks.
3. Determination of water absorption of bricks and stone.
4. Determination of efflorescence of brick.
5. Determination of compressive strength of brick/block.
6. Determination of moisture content of wood.
7. Determination of specific gravity of wood.
8. Fineness modulus of various sands.
9. Abrasion test of coarse aggregate.
10. Crushing strength of coarse aggregates.
11. Field visit to observe formwork, scaffolding, and reinforcement erection of a construction project.
12. Field visit/video observation to observe the concreting of a building.

Recommended Books

1. Allen, E., & Iano, J. (2025). *Fundamentals of building construction: Materials and methods* (8th ed.). Wiley.
2. Ching, F. D. K. (2020). *Building construction illustrated* (6th ed.). Wiley.
3. Mamlouk, M. S., & Zaniewski, J. P. (2020). *Materials for civil and construction engineers* (4th ed.). Pearson.
4. Nunnally, S. W. (2021). *Construction methods and management* (9th ed.). Pearson.

8.5 Architecture and Town Planning

Course Code and Title: CET-115 Architecture and Town Planning		Credits Hours: 2+0	Prerequisite: None
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK7 (Knowledge of the role of technology in society)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 9 (Industry, Innovation and Infrastructure) - SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC6 (Protection of society)	
Course Objectives			
This course introduces students to the historical evolution of architecture across major world civilizations, from prehistoric times to the modern era, with an emphasis on the social, cultural, and religious influences that shape architectural styles. It covers key principles of architectural aesthetics, materials, and building components, as well as an introduction to the fundamentals of town planning and land-use practices.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the evolution of architecture within historical, social, and cultural contexts.	C2 (Cognitive) Understand	PLO-6 / SA6 (The Engineer and the World)
CLO-2	Explain the aesthetic principles, material properties, and planning considerations of architectural building components, including walls, openings, roofs, columns, etc.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-3	Apply the fundamental objectives, methods, and components of town planning in land-use patterns and civic infrastructure.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
Course Outline for Theory			
Architecture: Historical Development; General introduction to history of architecture; Emergence/Development of Islamic Architecture; Geographical, climatic, religious, social and historical influences; Architectural beauty; Qualities, Factors and Use of Materials; Strength, vitality, grace, breadth and scale; Proportion, colour and balance; Stone, wood, metals, concrete, composites, ceramics. Architectural Aspects of Building Planning: Walls and their construction; Openings and their position, character, and shape; Roofs and their development and employment; Columns and their position,			

form, and decoration; Moldings and their form and decoration; Ornament as applied to any building.

- **Town Planning:** Definitions; Trends in Urban growth; Objectives of town planning; Modern planning in Pakistan and abroad; Preliminary Studies; Study of natural resources, economic resources, legal and administrative problems; Civic surveys; Preparation of relevant maps; Land Use Patterns, Street Patterns; Various theories of land use patterns; Location of Parks and recreation facilities; Public and semi-public buildings; Civic centers, commercial centers, local shopping centers; Public schools, industry & residential areas; Layout of streets, road crossings & lighting.
- **Community Planning:** City Extensions and Urban Planning; Suburban development; Neighborhood Units; Satellite Towns and Garden City; Issues related to inner city urban design and emergence/upgradation of squatter settlements.

Recommended Books

1. Ching, F. D. K. (2023). *Architecture: Form, space, and order* (5th ed.). Wiley.
2. Emmitt, S. (2010). *Managing interdisciplinary projects: A primer for architecture, engineering and construction*. Routledge.
3. Unwin, R. (2022). *Town planning in practice: An introduction to the art of designing cities and suburbs* (Reprint ed.). FQ Legacy Books.
4. Ye, Y., & Bauer, K. W. (2026). *City planning for civil engineers, environmental engineers, and surveyors* (2nd ed.). CRC Press.

8.6 Electro-Mechanical Technology

Course Code and Title: IDS-116 Electro-Mechanical Technology		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: SK1 (Theory-based understanding of the natural and social sciences)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 4 (Quality Education) - SDG 7 (Affordable and Clean Energy) - SDG 9 (Industry, Innovation and Infrastructure) - SDG 12 (Responsible Consumption and Production)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC2 (Comprehend and apply local knowledge) - TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
This course is designed to help students understand, analyze, and apply fundamental concepts in electricity, magnetism, circuits, electronic devices, thermodynamics, gas laws, heat-power cycles, and IC engines. The course enables students to analyze electrical circuits, energy conversion systems, and thermal equipment used in engineering practice.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Understand fundamental concepts of electricity, magnetism, DC, and AC circuits.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze the operation of transformers, batteries, and basic electronic components such as diodes and transistors.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Understand gas laws, laws of thermodynamics, and properties of steam and gases.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
Course Outline for Theory			
Introduction to Electrostatics: Definition and concept of Voltage, Current, Power, and Energy. Independent and Dependent Sources. Concept of Electric Field, Equipotential Surfaces. Permittivity. Electric stress, stored energy, motion of a charged particle in a uniform electrostatic field, and calculation of capacitance. Electromagnetism: Concept of magnetic field, permeability, and magnetic properties of			

ferromagnetic materials. The magnetic circuit. Generation of EMF, Faraday's laws of electromagnetic induction.

- **Electric Circuit:** Resistivity, Ohm's Law, Kerchief's laws, Simple D.C network problems, Temperature coefficient. Series and Parallel Combinations of Elements, Voltage Division and Current Division.
- **Alternating currents:** Mean and RMS values, the effects of resistance, inductance, and capacitance in an AC circuit, vertical representation of power, and power factor. Difference between AC and DC.
- **Secondary Batteries:** Types, construction, charging and discharging rate, efficiency, care and maintenance.
- **Transformers:** The magnetic circuit of transformers, Transformation ratio, voltage, current, and power relationships.
- **Electronics:** Physics of semiconductors, concept of Doping, formation of P and N-type semiconductor diodes, transistors, and simple rectifier circuits.
- **Basic Concepts of Gases and Vapors:** Define and differentiate between gases and vapors. Use PV diagrams and specific heats C_p and C_v to analyze gas behavior. Apply Boyle's Law, Charles Law, Avogadro's Law, and Dalton's Law to solve problems.
- **Laws of Thermodynamics:** State and apply 1st Law and 2nd law of thermodynamics, Energy conservation. Direction of heat flow, entropy, irreversibility; understand reversibility, adiabatic expansion, expansion curves.
- **Thermodynamic Cycles:** Analyze and draw TS and PV diagrams for power cycles. Calculate the Air Standard Efficiency ASE of cycles. Understand the working and efficiency of Carnot, Stirling, Ericsson, Joule, Otto, and Diesel cycles. Explain how heat is transformed into work.
- **Entropy and Processes:** Calculate the change in entropy for heating at constant volume and constant pressure. Understand the general case of entropy change for real processes.
- **Air Compressors:** Understand the working of single-stage air compressors. Calculate volumetric efficiency and power requirement. Identify applications in construction and industry.
- **Steam and Properties:** Understand formation of steam: sensible heat, latent heat, superheated steam. Use steam tables to find enthalpy, volume, and other properties of water and superheated steam. Calculate work done using steam.

Recommended Books

1. Hughes, E., Hiley, J., Brown, K., & Smith, I. M. (2016). *Hughes electrical and electronic technology* (12th ed.). Pearson Education.
2. Hutchinson, T., & Waters, A. (2010). *English for specific purposes: A learning-centred approach*. Cambridge University Press. (Original work published 1987)
3. Smith, I. M., & Hosie, K. T. (1994). *Basic electrical engineering science*. Longman.
4. Theraja, B. L., & Theraja, A. K. (2005). *A textbook of electrical technology*. S. Chand & Company.

8.7 Quantitative Reasoning-II

Course Code and Title: NSC-121 Quantitative Reasoning-II		Credits Hours: 3+0	Prerequisite: Quantitative Reasoning-I
Knowledge and Attitude Profile: SK2 (Conceptually-based mathematics)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC3 (Problem analysis) - TC12 (Judgment)	
Course Objectives			
Quantitative Reasoning-II is a sequential undergraduate course that focuses on logical reasoning, supported by mathematical and statistical concepts and modeling/analysis techniques, to equip students with the analytical skills and critical thinking abilities necessary to navigate the complexities of the modern world. The course is designed to familiarise students with the quantitative concepts and techniques required to interpret and analyze numerical data, and to inculcate in them the logical reasoning needed to construct and evaluate arguments, identify fallacies, and think systematically. Building on the prerequisite course Quantitative Reasoning (I), this course will enable students to further their quantitative, logical, and critical reasoning abilities to complement their specific major/field of study.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Understand logical reasoning and basic quantitative modeling and analysis.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Apply logical reasoning, mathematical analysis, and statistical analysis skills to solve quantitative modeling problems.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Ability to critically evaluate quantitative information to make evidence-based decisions through appropriate computational tools.	C3 (Cognitive) Apply	PLO-5 / SA 5 (Tool usage)
Course Outline for Theory			
Logic, Logical and Critical Reasoning: Introduction and importance of logic; Inductive, deductive, and abductive approaches of reasoning; Propositions, arguments (valid; invalid), logical connectives, truth tables, and propositional equivalences; Logical fallacies; Venn Diagrams; Predicates and quantifiers; Quantitative reasoning exercises using logical reasoning concepts and Techniques. Mathematical Modeling and Analyses: Introduction to deterministic models; Use of linear functions for modeling in real-world situations; Modeling with the system of linear equations and their			

solutions; Elementary introduction to derivatives in mathematical modeling; Linear and exponential growth and decay models; Quantitative reasoning exercises using mathematical modeling.

- **Statistical Modeling and Analyses:** Introduction to probabilistic models; Bivariate analysis, scatter plots; Simple linear regression model and correlation analysis; Basics of estimation and confidence interval; Testing of hypothesis (z-test; t-test); Statistical inference in decision making; Quantitative reasoning exercises using statistical modeling; Quantitative reasoning exercises using number knowledge.

Recommended Books

1. Bennett, J. O., Briggs, W. L., & Badalamenti, A. (n.d.). *Using and understanding mathematics: A quantitative reasoning approach*.
2. Babones, S. (Ed.). (2013). *Applied statistical modeling*. SAGE Publications.
3. Bennett, J. O., & Briggs, W. L. (2018). *Using and understanding mathematics: A quantitative reasoning approach* (7th ed.). Pearson.
4. Bluman, A. G. (2021). *Elementary statistics: A step-by-step approach* (11th ed.). McGraw-Hill.
5. Budnick, F. S. (1993). *Applied mathematics for business, economics, and the social sciences* (4th ed.). McGraw-Hill.
6. Epp, S. S. (2019). *Discrete mathematics with applications* (5th ed.). Cengage Learning.
7. Green, S. W., & Wolf, I. K. (2014). *Barron's SAT* (27th ed.). Barron's Educational Series.
8. Mann, P. S. (2020). *Introductory statistics* (10th ed.). Wiley.
9. Rosen, K. H. (2019). *Discrete mathematics and its applications* (8th ed.). McGraw-Hill.

8.8 Applied Economics

Course Code and Title: SSC-122 Applied Economics		Credits Hours: 2+0	Prerequisite: None
Knowledge and Attitude Profile: • SK2 (Conceptually-based mathematics) • SK3 (Engineering fundamentals)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 8 (Decent Work and Economic Growth) • SDG 17 (Partnerships for the Goals)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC6 (Protection of society) • TC10 (Communication and Collaboration)	
Course Objectives			
This course is designed to introduce students to the fundamental concepts and principles of engineering economics and their application in decision-making processes. The course enables students to analyze and evaluate engineering projects using economic techniques such as cost analysis, comparison of alternatives, and financial feasibility assessment. It also develops students’ understanding of economic factors involved in engineering and managerial decisions for effective resource utilization.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the concepts related to economics and its importance for civil engineers.	C2 (Cognitive) Understand	PLO-6 / SA6 (The Engineer and the World)
CLO-2	Perform economic analysis for different civil engineering projects.	C4 (Cognitive) Analyze	PLO-10 / SA10 (Project Management and Finance)
CLO-3	Interpret supply and demand related to civil engineering technology in economic terms.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
Course Outline for Theory			
• Fundamentals of Economics: Basic concepts of project Economy; Consumer and Producer goods; Goods and services; Price-supply-demand relationship; Equilibrium, Elasticity of demand & supply; Measures of economic worth, non-monetary values; Theory of pricing; Theory of production; Laws of return.			

- **Capital Financing and Allocation:** Funding, funding agencies, and planning commission; Capital Budgeting, allocation of capital among independent projects; Financing with debt capital; Financing with equity capital; Trading on equity; Financial leveraging.
- **Business Organization and Industrial Relationship:** Types of ownership; Types of stocks, partnership and joint companies; Banking and Specialized credit institutions; Labor problems, labor organization, prevention and settlement of disputes, Markets, competition and monopoly.
- **Depreciation and Taxes:** Depreciation; Economic life; Methods of depreciation; Profits and returns on capital, productivity of capital; Gain (loss) on the disposal of an asset; Depreciation as a tax shield.
- **Comparing Alternatives:** Present economy; Selection among machines, materials, processes, and designs; Payback period method; Present worth method; Uniform annual cost method; Rate of return method; Alternatives having identical lives. Alternatives having different lives; Industrial Relations: Labor problems; Labor organizations; Prevention & Settlement of disputes.

Recommended Books

1. Collier, C. A., & Ledbetter, W. B. (1982). *Engineering economic and cost analysis*. Harper & Row.
2. Holm, L. (2019). *Construction accounting and financial management for construction project managers*. Routledge.
3. Park, C. S. (2012). *Fundamentals of engineering economics* (3rd ed.). Pearson Education.
4. Peterson, S. J. (n.d.). *Construction accounting and financial management* (Latest ed.).
5. White, J. A., Agee, M. H., & Case, K. E. (1984). *Principles of engineering economic analysis* (2nd ed.). John Wiley & Sons.

8.9 Expository Writing

Course Code and Title: HUM-123 Expository Writing		Credits Hours: 3+0	Prerequisite: Functional English
Knowledge and Attitude Profile: - SK1 (Theory-based understanding of the natural and social sciences) - SK9 (Ethics, inclusive behaviour and conduct)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): SDG 4 (Quality Education)		Professional Competence Profile: - TC10 (Communication and Collaboration) - TC11 (Continuing professional development and lifelong learning)	
Course Objectives			
This course is designed to refine students’ expository writing skills by enabling them to produce clear, concise, and coherent texts; analyze complex ideas; integrate information; support viewpoints with credible sources; and apply critical thinking and ethical writing practices.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Understand the essentials of the writing process, integrating pre-writing, drafting, editing, and proofreading to produce well-structured essays.	C2 (Cognitive) Understand	PLO-9 / SA9 (Communication)
CLO-2	Demonstrate mastery of diverse expository types to address different purposes and audiences.	C3 (Cognitive) Apply	PLO-11 / SA11 (Lifelong learning)
CLO-3	Uphold ethical practices to maintain originality in expository writing.	A3 (Affective) Value	PLO-11 / SA11 (Lifelong learning)
Course Outline for Theory			
Introduction to Expository Writing: Understanding expository writing (definition, types, purpose, and applications); Characteristics of effective expository writing (clarity, coherence, and organization); Introduction to paragraph writing. The Writing Process: Pre-writing techniques (brainstorming, free-writing, mind-mapping, listing, questioning, and outlining, etc.); Drafting (three-stage process of drafting techniques); Revising and editing (ensuring correct grammar, clarity, coherence, conciseness, etc.); Proofreading (fine-tuning of the draft); Peer review and feedback (providing and receiving critique). Essay Organization and Structure: Introduction and hook (engaging readers and introducing the			

topic); Thesis statement (crafting a clear and focused central idea); Body Paragraphs (topic sentences, supporting evidence, and transitional devices); Conclusion (types of concluding paragraphs and leaving an impact); Ensuring cohesion and coherence (creating seamless connections between paragraphs).

- **Different Types of Expository Writing:** Description, Illustration, Classification, Cause and Effect (exploring causal relationships and outcomes); Process analysis (explaining step-by-step procedures); Comparative analysis (analyzing similarities and differences).
- **Writing for Specific Purposes and Audiences:** Different types of purposes (to inform, to analyze, to persuade, to entertain, etc.); Writing for academic audiences (formality, objectivity, and academic conventions); Writing for public audiences (engaging, informative, and persuasive language; Different tones and styles for specific purposes and audiences).
- **Ethical Considerations:** Ensuring original writing (finding credible sources, evaluating information, etc.); Proper citation and referencing (APA, MLA, or other citation styles); Integrating quotes and evidence (quoting, paraphrasing, and summarising); Avoiding plagiarism (ethical considerations and best practices).

Lab Work Outline for Practical (Optional)

As part of the overall learning requirements, students will build a writing portfolio of a variety of expository texts and present it at the end of the course to showcase proficiency in expository writing.

Recommended Books

1. Downes, C. (2008). *Cambridge English for job-hunting*. Cambridge University Press.
2. James, M., & Merickel, A. P. (2012). *Reading literature and writing argument* (5th ed.). Pearson.
3. Johns, J., & Lenski, S. (2018). *Improving reading: Strategies, resources, and Common Core connections* (7th ed.). Kendall Hunt Publishing.
4. Johnson-Sheehan, R., & Paine, C. (2024). *Writing today* (5th ed.). Pearson.
5. Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge University Press.
6. Swan, M. (2017). *Practical English usage* (4th ed.). Oxford University Press.

8.10 Applied Chemistry

Course Code and Title: NSC-124 Applied Chemistry		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: - SK1 (Theory-based understanding of the natural and social sciences) - SK3 (Engineering fundamentals)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC6 (Protection of society) - TC10 (Communication and Collaboration) - TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
The Engineering Chemistry course is designed to provide students with fundamental knowledge of chemistry and its applications in civil engineering technology. The course develops students’ understanding of chemical processes, thermodynamic principles, and physico-chemical properties of engineering materials and water systems. It also enables students to analyze water quality parameters and apply chemical concepts to solve engineering and environmental problems in civil engineering practice.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Apply knowledge of chemistry in various industrial processes for civil engineering materials.	C3 (Cognitive) Apply	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Explain the thermodynamic and physico-chemical properties of water for water quality analysis.	C2 (Cognitive) Understand	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform experiments and calculations to determine conductivity, boiling point, pH, concentration, etc.	P2 (Psychomotor) Perform	PLO-4 / SA4 (Investigation)
Course Outline for Theory			
Introduction: Periodic table; Atoms and molecules’ structure; Introduction to chemical equations and calculations; Types of Chemical Reactions; Basic concept of Chemical bonding and Intra-molecular forces. Properties of Gas and Liquids: Gas Laws; Kinetic gas equation; Surface Tension; Viscosity; Osmosis;			



Curriculum for Bachelor of Science in Civil Engineering Technology



Osmotic Pressure; pH-Buffer solution; Spectrophotometer; Basic concepts of Colloidal Chemistry.

- **Chemistry of Construction Materials:** Cement Raw materials, manufacturing process, composition, and Bogue's compounds; The chemistry of setting, hardening, and hydration process; Types of cement and ceramic materials; Nano Materials and Pozzolanic materials (Definition, properties, and applications); Water chemistry and chemistry of admixtures.
- **Corrosion and its Control:** Definition of corrosion and factors affecting corrosion rate; Theories of Dry (chemical) corrosion; Pilling Bedworth rule and Wet corrosion in acidic atmosphere by hydrogen evolution mechanism; Metal coatings; Inorganic coatings; Organic coatings; Use of paints varnishes and enamels; Internal corrosion preventive measures; Alloying (with reference to passivating, neutralizing and inhibition), and heat treatment (quenching, annealing).
- **Electro and Thermochemistry:** Laws of Electrolysis; E.M.F. series; corrosion (theories, inhibition & protection); Chemical thermodynamics; Hess's Law; Heat of reaction; Relation between H and U measurement of heat reaction; Bomb Calorimeter.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Introduction to the common apparatus, glassware and chemical reagents used in chemistry lab.
2. Determination of the heat of neutralization of an acid with a base.
3. Demonstrate the conductivity of different solutions.
4. Demonstrate the electroplating of copper metal on an iron strip using copper sulfate solution.
5. Study the reactive strength of cement constituents.
6. Determine the boiling point of Ethyl alcohol.
7. Purification of impure copper sulfate by crystallization.
8. To perform electrolysis of water to produce hydrogen gas and oxygen gas.
9. Determine the concentration of the given solution of HCl.
10. Determine the pH of the given solutions.

Recommended Books

1. Barrow, G. M. (1984). *Physical chemistry* (5th ed.). McGraw-Hill.
2. Dara, S. S. (2003). *A textbook of engineering chemistry* (10th ed.). S. Chand.
3. Kemp, W. (2002). *Organic spectroscopy* (3rd ed.). Palgrave.
4. Kuriacose, J. (1984). *Chemistry in engineering and technology* (Vols. 1–2). McGraw-Hill.
5. March, J. (2004). *Advanced organic chemistry: Reactions, mechanisms, and structure* (4th ed.). John Wiley & Sons.
6. Puri, B. R., Sharma, L. R., & Pathania, M. S. (n.d.). *Principles of physical chemistry* (42nd ed.). Vishal Publishing Co.
7. Willard, H. H., Merritt, L. L., Dean, J. A., & Settle, F. A. (n.d.). *Instrumental methods of analysis* (Latest ed.). Wadsworth Publishing Company.

8.11 Fehm-e-Quran-I

Course Code and Title: HUM-125 Fehm-e-Quran-I	Credits Hours: 0+1	Prerequisite: None	
Knowledge and Attitude Profile: - SK1 (Theory-based understanding of the natural and social sciences) - SK9 (Ethics, inclusive behaviour and conduct)	Range of Problem Identification and Solving: -	Range of Engineering Activities: -	
Sustainable Development Goals (SDGs): - SDG 4 (Quality Education) - SDG 16 (Peace, Justice and Strong Institutions)	Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC8 (Ethics) - TC11 (Continuing Professional Development and Lifelong learning)		
Course Objectives			
This course, Understanding of Qur’an, is designed to equip students with the essential skills to comprehend the Qur’an directly in its original Arabic. In line with HEC instructions, this course is mandatory at BS, MS, and PhD levels across all disciplines in Pakistani universities to ensure Qur’anic understanding as part of higher education. The course introduces learners to the Muallim-ul-Qur’an System developed by Dr. Ubaid-ur- Rehman Bashir, a structured and progressive method that enables comprehension of the Qur’an without prior grammar study. Instead of heavy grammatical rules, students learn through direct translation, vocabulary recognition, and step-by-step practice, making the method easy, accessible, and effective. Supported by core textbooks, multimedia resources, and guided exercises, the course gradually develops the capacity to understand Qur’anic verses without reliance on translations. Alongside linguistic and analytical skills, it nurtures spiritual reflection, ethical awareness, and practical application, empowering learners to integrate Qur’anic principles into their academic, professional, and personal lives and to engage meaningfully in interfaith dialogue and community development.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Identify key Qur’anic vocabulary, pronouns, and basic sentence structures from Units 1–6 of Muallim-ul-Qur’an.	C2 (Cognitive) Understand	PLO-7 / SA7 (Ethics)
CLO-2	Complete assigned tasks with active individual participation and effective contribution towards the team’s assignments.	A2 (Affective) Responding	PLO-8 / SA8 (Individual and Collaborative Team work)

CLO-3	Apply acquired vocabulary and structural knowledge to translate Qur'anic words, phrases, and simple present-tense sentences directly from the text.	C3 (Cognitive) Application	PLO-11 / SA 11 (Lifelong Learning)
Course Outline for Theory			
• Introduction to Arabic Linguistic Rules. • Proper Nouns: Masculine and Feminine. • Common Nouns and Types of Plurals. • Coordinating Particle “و” (And). • Demonstrative Nouns for Masculine and Feminine (هذا، هذه، ذلك، تلك). • Laam for Emphasis (التأكيد لام). • Superlative Degree in Arabic Grammar. • Emphatic Particle (إن) and Its Usage. • Prepositions Arabic (إلى، من، على، في، الباء). • Negation in Arabic Grammar (لا، النافية ما النافية). • Exceptive Particle (إلا). • Subordinating Conjunction (أن). • Introduction to the Verb “Kana” (كان). • Vocative Particles (النداء حروف). • Translation and Interpretation of Quranic Words and Sentences. • Sentence Structure and Basic Quranic Grammar. • Revision of Linguistic Concepts and Practical Exercises.			
Recommended Books			
Course Book: 1. Dr. Ubaid-ur-Rehman. (n.d.). Muallim-ul-Qur'an (Vols. 1–3). Reference Material: 1. Digital & Multimedia Resources. 2. Website: www.muallimulquran.com. 3. Flipbook editions of Vol. I–III. 4. Confirmation videos for self-assessment. 5. Workbooks, quizzes, question papers, and supplementary slides (online). 6. YouTube Playlist. 7. Muallim-ul-Qur'an Video Lectures (Dr. Ubaid-ur-Rehman).			

8.12 Surveying

Course Code and Title: CET-126 Surveying		Credits Hours: 1+2	Prerequisite: None
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK9 (Ethics, inclusive behavior and conduct)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC2 (Comprehend and apply local knowledge) - TC3 (Problem analysis) - TC5 (Evaluation) - TC10 (Communication and Collaboration)	
Course Objectives			
This course equips technologists with practical knowledge and skills in surveying, using both conventional and modern surveying instruments. It also develops the ability to perform engineering survey computations and topographic mapping for civil engineering projects.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Describe surveying techniques related to Civil Engineering technology.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Perform computations related to engineering surveying applications.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Operate various surveying equipment for measurements with required accuracy.	P3 (Psychomotor) Guided Response	PLO-5 / SA5 (Tool Usage)
CLO-4	Participate willingly in group activities during the fieldwork of survey experiments.	A2 (Affective) Responding	PLO-8 / SA8 (Individual and Collaborative Team work)



Curriculum for Bachelor of Science in Civil Engineering Technology



Course Outline for Theory

- **Introduction:** Introduction to Surveying; Classification of surveys; Surveying Techniques, Measurements, and their Units.
- **Computation of Areas and Volume:** Fundamentals of Volume Computation; Computation of areas by using mid-ordinate rule; average ordinate rule; trapezoidal and Simpson rule; Computation of areas by means of planimeter; Computation of areas by co-ordinates; topography and counter field work; error analysis and field practicalities.
- **Traversing with Theodolite and total station:** Adjustment of transit theodolite; traversing with theodolite; Traverse computations; Angle measurement; Closing error and its adjustment; Atmospheric and physical corrections; Computation of omitted measurements; High-precision observation techniques and differential level variations.
- **Trigonometric Leveling:** Determination of Reduced levels of elevated objects when the base is accessible and inaccessible (differential leveling); specialized engineering applications (tunnel and shaft alignment).
- **Tachometric Surveying:** System of tachometry; Principles and field procedures of tachometry; errors in tachometry; Use of tachometry for traversing.
- **Highway Curves:** Introduction to curves; Types of curves; Simple circular curves; Compound curves; Reverse curves; Transition curves; Vertical curves; Computation and setting out of curves by different methods.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. To run out a survey line using ranging rods (Direct & Indirect ranging).
2. To measure the horizontal distance between two terminal stations by different methods. (Pacing, Measuring Tape, and Chain).
3. To determine the horizontal distance between the two terminal stations on sloping ground by (i) the stepping method, (ii) Using a theodolite.
4. To set out a baseline and perpendicular line/offsets in the field using an optical square and the 3-4-5 method.
5. Layout of rooms of a house by the offset method using Pythagoras' theorem.
6. To measure the magnetic bearing of a line with the help of a prismatic compass.
7. Introduction to Auto Level and its temporary adjustment, and to determine staff reading on natural ground by using Auto Level.
8. To draw a profile (L-section) and cross-sectional leveling of an existing road by obtaining data using an Auto Level. (In two Sessions)
9. Introduction to the digital theodolite, its temporary adjustment, and determining horizontal angle, vertical angle, and bearing.
10. To determine the latitude and departure of lines and calculate the area of a closed traverse by the coordinates method.
11. To determine the Horizontal distances and Vertical distances by Tachometric Surveying.
12. To determine the independent coordinates of an existing building by Theodolite.



Curriculum for
Bachelor of Science in Civil Engineering Technology



13. To measure the Heights of buildings and determine R.L at the top of an elevated object by Trigonometric Leveling.
14. To perform Contouring activity using a Total Station.
15. To perform a stake-out activity using a Total Station.
16. To perform the open-ended lab.

Recommended Books

1. Aftab, A. (n.d.). *Surveying & leveling CT-114* (Latest ed.).
2. Basak, N. N. (n.d.). *Surveying & leveling* (Latest ed.).
3. Kennie, T. J. M., & Petrie, G. (n.d.). *Engineering surveying technology* (Latest ed.).
4. Nathanson, J. A., & Kissam, P. (n.d.). *Surveying practice* (Latest ed.).
5. Punmia, B. C. (n.d.). *Surveying* (Vols. 1–2, Latest ed.).
6. Shaikh, M. A. (n.d.). *Advanced civil engineering surveying* (Latest ed.).

8.13 Engineering Mechanics

Course Code and Title: CET-127 Engineering Mechanics		Credits Hours: 1+1	Prerequisite: None
Knowledge and Attitude Profile: • SK2 (Conceptually-based mathematics) • SK3 (Engineering fundamentals)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis)	
Course Objectives			
The course aims to develop a basic understanding of engineering mechanics with emphasis on statics, including force systems, moments, couples, equilibrium of particles and rigid bodies, support reactions, friction, centroids, and area moments of inertia. The course enables students to draw free-body diagrams, solve simple equilibrium problems, and verify statics principles through laboratory experiments.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain basic principles of statics, force systems, moments, couples, equilibrium, supports, friction, centroids, and area moments of inertia.	C1 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Apply scalar/vector methods and free-body diagrams to solve simple statics problems involving resultants, moments, support reactions, friction, centroids, and area moments of inertia.	C3 (Cognitive) Apply / Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform laboratory experiments related to force systems, moments, equilibrium, support reactions, friction, and centroid determination.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-4	Prepare and present laboratory observations, calculations, and comparisons between theoretical and experimental results.	A2 (Affective) Responding	PLO-9 / SA9 (Communication)
Course Outline for Theory			
• Introduction to engineering mechanics; scope of statics in civil engineering technology; basic			

quantities, units, and idealizations.

- Scalars and vectors; resolution of forces into rectangular components; addition of concurrent coplanar forces.
- Resultant of coplanar force systems, including concurrent, parallel, and general force systems.
- Moment of a force, Varignon's theorem, couples, and equivalent force-couple systems.
- Free-body diagrams; equilibrium of particles under coplanar concurrent force systems.
- Equilibrium of rigid bodies in two dimensions; support types, support reactions, and simple loading conditions.
- Distributed loading and replacement by equivalent resultant force for simple beam-type members without drawing SFD/BMD.
- Friction on horizontal and inclined planes; coefficient of friction, angle of friction, and simple civil engineering applications.
- Centroid and center of gravity of lines, areas, and simple composite plane figures.
- Area moment of inertia of basic and composite sections using the parallel-axis theorem.
- Introductory application of statics to simple structural components through free-body diagrams only.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Introduction to mechanics laboratory, safety instructions, apparatus handling, observation sheets, and lab report writing.
2. Verification of the parallelogram law and the triangle law of forces using a force table.
3. Verification of Lami's theorem for a particle in equilibrium.
4. Determination of resultant of coplanar concurrent forces.
5. Verification of the principle of moments and Varignon's theorem.
6. Experimental study of the equilibrium of a rigid body under coplanar forces.
7. Determination of support reactions of a simply supported member under point loads only.
8. Determination of the coefficient of friction on horizontal and inclined plane surfaces.
9. Determination of centroid/center of gravity of regular and irregular plane figures.
10. Determination of area moment of inertia of simple composite sections by calculation and model-based demonstration.
11. Mini practical assignment: preparation of free-body diagrams and reaction calculations for a simple civil engineering component.

Recommended Books

1. Beer, F. P., Johnston, E. R., Mazurek, D. F., Cornwell, P. J., & Self, B. P. (2021). *Vector mechanics for engineers: Statics and dynamics* (13th ed.). McGraw-Hill Education.
2. Hibbeler, R. C. (2022). *Engineering mechanics: Statics & dynamics* (15th ed.). Pearson.
3. Kassimali, A. (2020). *Structural analysis* (6th ed.). Cengage Learning.
4. Meriam, J. L., & Kraige, L. G. (2018). *Engineering mechanics: Statics and dynamics* (9th ed.). Wiley.

8.14 Professional Ethics

Course Code and Title: HUM-211 Professional Ethics		Credits Hours: 2+0	Prerequisite: None
Knowledge and Attitude Profile: • SK2 (Conceptually-based mathematics) • SK8 (Engagement with the current technological literature)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): • SDG 4 (Quality Education) • SDG 16 (Peace, Justice and Strong Institutions)		Professional Competence Profile: • TC8 (Ethics) • TC11 (Continuing Professional Development and Lifelong learning) • TC12 (Judgment)	
Course Objectives			
This course is designed to provide students with a fundamental exploration of ethics and its practical applications in diverse contexts. Students will be introduced to the genealogy of the subject and will be able to understand and analyze moral dilemmas and contemporary issues using ethical reasoning and decision-making skills. The course content has been designed to enable learners to examine their personal values, cultivate ethical qualities, and foster social responsibility in both personal and professional spheres.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Understand the conceptual development of ethics and its diverse philosophical traditions, including contributions from key thinkers.	C2 (Cognitive) Understand	PLO-7 / SA7 (Ethics)
CLO-2	Articulate ethical dilemmas using various ethical theories.	A3 (Affective) Value	PLO-7 / SA7 (Ethics)
CLO-3	Apply ethical principles to analyze and address contemporary issues, demonstrating ethical reasoning and decision-making skills.	C4 (Cognitive) Analyze	PLO-11 / SA 11 (Lifelong learning)
Course Outline for Theory			
• What is Ethics: Definitions and significance of ethics; Difference and interplay between ethics, morality, and virtue. • Types of Ethics: Theoretical ethics: Normative ethics, Descriptive ethics, Meta-ethics; Applied ethics: Business ethics, Environmental ethics, Biomedical ethics, Media ethics, Subject-related ethics. • Major Theories of Ethics – Ethical Decision Making (not limited to): Virtue ethics; Egoism; Utilitarianism; Deontological ethics.			



Curriculum for Bachelor of Science in Civil Engineering Technology



- **Moral Sensitivity:** Ethics of difference and alterity; Normative and informational biases; Decision heuristics (stereotypical imaging etc.); Ethical dilemmas.
- **Applied Ethics (not limited to):** Ethics and media and new media; Ethics and artificial intelligence; Ethics and the environment.

Recommended Books

1. Cahn, S. M., & Markie, P. (2019). *Ethics: History, theory, and contemporary issues* (7th ed.). Oxford University Press.
2. DesJardins, J. R. (2013). *Environmental ethics: An introduction to environmental philosophy* (5th ed.). Wadsworth.
3. Fasching, D. J., deChant, D., & Lantigua, D. M. (2011). *Comparative religious ethics: A narrative approach to global ethics* (2nd ed.). Wiley-Blackwell.
4. Ferrell, O. C., Fraedrich, J., & Ferrell, L. (2026). *Business ethics: Ethical decision making and cases* (14th ed.). Cengage.
5. MacIntyre, A. (2007). *After virtue: A study in moral theory* (3rd ed.). University of Notre Dame Press.
6. May, L., Collins-Chobanian, S., & Wong, K. (2011). *Applied ethics: A multicultural approach* (5th ed.). Prentice Hall.
7. Shafer-Landau, R. (2023). *The fundamentals of ethics* (6th ed.). Oxford University Press.
8. Thiroux, J. P., & Krasemann, K. W. (2012). *Ethics: Theory and practice* (11th ed.). Pearson.
9. Vaughn, L. (2024). *Bioethics: Principles, issues, and cases* (6th ed.). Oxford University Press.
10. Velasquez, M. G. (2017). *Business ethics: Concepts and cases* (8th ed.). Pearson.
11. White, J. E. (2012). *Contemporary moral problems: War, terrorism, torture and assassination* (4th ed.). Wadsworth/Cengage.
12. Wilkins, L., Painter, C., & Patterson, P. (2022). *Media ethics: Issues and cases* (10th ed.). Rowman & Littlefield.

8.15 Islamic Studies

Course Code and Title: HUM-212 Islamic Studies		Credits Hours: 2+0	Prerequisite: None
Knowledge and Attitude Profile: - SK1 (Theory-based understanding of the natural and social sciences) - SK9 (Ethics, inclusive behavior and conduct)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): - SDG 4 (Quality Education) - SDG 5 (Gender Equality)		Professional Competence Profile: - TC6 (Protection of society) - TC8 (Ethics) - TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
This course is designed to provide students with a comprehensive overview of the fundamental aspects of Islam, its benefits, practices, history, and influence on society. It will further provide students with a solid foundation for understanding Islam from academic and cultural perspectives. Through this course, students will gain a deeper understanding of Islam’s multifaceted dimensions, enabling them to navigate complex discussions about its historical and contemporary roles and fostering empathy, respect, and informed dialogue.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Demonstrate enhanced knowledge of Islamic foundational beliefs, practices, historical development, spiritual values, and ethical principles.	C2 (Cognitive) Understand	PLO-7 / SA7 (Ethics)
CLO-2	Describe basic sources of Islamic law and their application in daily life.	C2 (Cognitive) Understand	PLO-11 / SA11 (Lifelong learning)
CLO-3	Identify and discuss contemporary issues within the Muslim world, including social challenges, gender roles, and interfaith interactions.	C2 (Cognitive) Understand	PLO-6 / SA6 (The Engineer and the World)
Course Outline for Theory			
Introduction to Islam: Definition of Islam and its core beliefs; The Holy Quran (introduction, revelation, and compilation); Hadith and Sunnah (compilation, classification, and significance); Key theological concepts and themes (Tawhid, Prophethood, Akhira, etc.). Sirah of the Holy Prophet (Peace Be Upon Him) as Uswa-i-Hasana: Life and legacy of the Holy Prophet PBUH; Diverse roles of the Holy Prophet PBUH: As an individual, as an educator, as a			

peacemaker, as a leader, as a military leader, etc.

- **Islamic History and Civilization:** World before Islam; The Rashidun Caliphate and expansion of Islamic rule; Muslims' contributions to philosophy, science, medicine, mathematics, and culture.
- **Islamic Jurisprudence (Fiqh):** Fundamental sources of Islamic jurisprudence; Pillars of Islam and their significance; Major schools of Islamic jurisprudence; Significance and principles of Ijtihad.
- **Family and Society in Islam:** Status and rights of women in Islamic teachings; Marriage. Family and gender roles in Islamic jurisprudence; Family structure and values in Muslim society.
- **Islam in the modern world:** Relevance of Islam in the modern world (globalization, challenges, and prospects); Islamophobia, interfaith dialogue, and multiculturalism; Islamic responses to social, ethical, and technological changes.
- **Introduction to Islamic Trade and Finance:** Islamic Financing Structures; The stability of the Islamic Financial System; Financial Engineering; Regulation of Islamic Financial Institutions.

Recommended Books

1. Ahmad, A. (n.d.). *Women and social justice: An Islamic paradigm*.
2. Ahmad, K. (1963). *Islami nazaria-e-hayat*. IPS Press.
3. Ahmad, K. (1975). *Islam: Its meaning and message*. Islamic Foundation.
4. Al-Azami, M. M. (n.d.). *The five pillars of Islam: A journey through the divine acts of worship*.
5. Hussain, M. (2012). *The five pillars of Islam: A framework for Islamic values and character building*. Kube Publishing.
6. Mawdudi, A. A. (1960). *Towards understanding Islam*. Islamic Publications.
7. Mawdudi, A. A. (2013). *Islamic civilization: Foundations, belief & principles*. Islamic Foundation.
8. Renard, J. (n.d.). *An introduction to Islamic theology*.

8.16 Pakistan Studies

Course Code and Title: HUM-213 Pakistan Studies		Credits Hours: 2+0	Prerequisite: None
Knowledge and Attitude Profile: SK7 (Knowledge of the role of technology in society)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): - SDG 4 (Quality Education) - SDG 16 (Peace, Justice and Strong Institutions)		Professional Competence Profile: - TC6 (Protection of society) - TC8 (Ethics)	
Course Objectives			
This course is designed to provide students with a comprehensive exploration of Pakistan's identity, spanning geographical, historical, and cultural dimensions. It delves into the diverse landscapes, ancient civilizations, and rich cultural heritage that define Pakistan. Moreover, it examines the socio-cultural and political transformations in Pakistan over time, including democratic transitions and military interventions. This course aims to inculcate in students a nuanced understanding of Pakistan's past, present, and potential future trajectories, enabling them to evaluate the complex dynamics shaping the nation's development critically.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Describe the geographical, historical, and political aspects of Pakistan.	C2 (Cognitive) Understand	PLO-6 / SA6 (The Engineer and the World)
CLO-2	Understand the society and culture of Pakistan.	C2 (Cognitive) Understand	PLO-6 / SA6 (The Engineer and the World)
CLO-3	Understand and explain the socio-economic developments in Pakistan.	C2 (Cognitive) Understand	PLO-11 / SA 11 (Lifelong learning)
CLO-4	Analyze contemporary issues and challenges faced by Pakistan and their implications for the future.	C4 (Cognitive) Analyze	PLO-7 / SA7 (Ethics)
Course Outline for Theory			
Introduction to Pakistan: Geographical location and significance; Historical background: Ancient civilizations in the region; Factors leading to the creation of Pakistan. Political History of Pakistan: Formative phase; Military interventions and democratic transitions. Geography of Pakistan: Physiography: Mountains, plains, plateaus, deserts, valleys, and coastal areas; River systems: Indus River and its tributaries; Climatic regions of Pakistan. Society and Culture of Pakistan: Socio-cultural diversity; Languages and literature of Pakistan.			

- **Economic Development of Pakistan:** Agriculture and industrial sectors of Pakistan; Economic challenges of Pakistan.
- **Contemporary Issues:** Foreign relations of Pakistan; Security challenges: terrorism, extremism, and regional conflicts; Environmental problems and sustainable development (SDGs); Media and social change.

Recommended Books

1. Burke, S. M. (1973). *Pakistan's foreign policy: An historical analysis*. Oxford University Press.
2. Hayat, S. (Ed.). (2023). *Pakistan studies: A book of readings*. Sang-e-Meel Publications.
3. Horton, P. B., & Hunt, C. L. (1964). *Sociology*. McGraw-Hill.
4. Husain, I. (1999). *Pakistan: The economy of an elitist state*. Oxford University Press.
5. Jahangir, U. (n.d.). *Physical geography of Pakistan*.
6. Jalal, A. (1985). *The sole spokesman: Jinnah, the Muslim League, and the demand for Pakistan*. Cambridge University Press.
7. Khan, A. J. (Ed.). (n.d.). *Pakistan's cultural heritage: Socio-economic and technological aspects*.
8. Khan, F. K. (1991). *A geography of Pakistan: Environment, people, and economy*. Oxford University Press.
9. Khan, H. (2001). *Constitutional and political history of Pakistan*. Oxford University Press.
10. Kokab, R. U. (2018). *Separatism in East Pakistan: A study of failed leadership*. Oxford University Press.
11. Qureshi, I. H. (1965). *The struggle for Pakistan*. University of Karachi.
12. Rahman, T. (1996). *Language and politics in Pakistan*. Oxford University Press.
13. Rumi, R. (2018). *Being Pakistani: Society, culture and the arts*. HarperCollins.
14. Saeed, A., & Sarwar, K. M. (n.d.). *Trek to Pakistan*.
15. Sayeed, K. B. (1968). *Pakistan, the formative phase, 1857–1948* (2nd ed.). Oxford University Press.
16. Sayeed, K. B. (1980). *Politics in Pakistan: The nature and direction of change*. Praeger.
17. Talbot, I. (1998). *Pakistan: A modern history*. St. Martin's Press.
18. Wolpert, S. (1984). *Jinnah of Pakistan*. Oxford University Press.
19. Ziring, L. (1997). *Pakistan in the twentieth century: A political history*. Oxford University Press.

8.17 Fehm-e-Quran-II

Course Code and Title: HUM-214 Fehm-e-Quran-II		Credits Hours: 0+1	Prerequisite: Fehm-e-Quran-I
Knowledge and Attitude Profile: • SK1 (Theory-based understanding of the natural and social sciences) • SK9 (Ethics, inclusive behavior and conduct)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): • SDG 4 (Quality Education) • SDG 16 (Peace, Justice and Strong Institutions)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC8 (Ethics) • TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
This course, <i>Understanding of Qur'an</i> , is designed to equip students with the essential skills to comprehend the Qur'an directly in its original Arabic. In line with HEC instructions, this course is mandatory at BS, MS, and PhD levels across all disciplines in Pakistani universities to ensure Qur'anic understanding as part of higher education. The course introduces learners to the <i>Muallim-ul-Qur'an System</i> developed by Dr. Ubaid-ur-Rehman Bashir, a structured and progressive method that enables comprehension of the Qur'an without prior grammar study. Instead of heavy grammatical rules, students learn through direct translation, vocabulary recognition, and step-by-step practice, making the method easy, accessible, and effective. Supported by core textbooks, multimedia resources, and guided exercises, the course gradually develops the capacity to understand Qur'anic verses without reliance on translations. Alongside linguistic and analytical skills, it nurtures spiritual reflection, ethical awareness, and practical application, empowering learners to integrate Qur'anic principles into their academic, professional, and personal lives and to engage meaningfully in interfaith dialogue and community development.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Identify Qur'anic vocabulary, pronouns, and sentence structures in Units 1–6 of Muallim-ul-Qur'an.	C2 (Cognitive) Understand	PLO-7 / SA7 (Ethics)
CLO-2	Explain grammatical and linguistic rules of Qur'anic nominal sentences, plurals, compounds, and particles.	C2 (Cognitive) Understand	PLO-9 / SA9 (Communication)
CLO-3	Apply acquired vocabulary and grammar to translate Qur'anic words, phrases, and present-tense sentences directly from the text.	C3 (Cognitive) Application	PLO-11 / SA 11 (Lifelong learning)

Course Outline for Theory

- Introduction to Quranic Arabic Grammar.
- Present Tense Forms in Quranic Arabic (المضارع الفعل).
- Singular, Dual, and Plural Verb Structures.
- Present Tense for Masculine Singular and Plural.
- Present Tense for مخاطب and متكلم Forms.
- Negative Imperative Forms in Quranic Arabic.
- Conditional Sentences and (مؤول مصدر).
- Laam-ut-Ta'leel (لام التعليل) and Laam-ul-Juhood (لام الجحود).
- Object Pronouns with Present Tense Verbs.
- Passive Voice in Present and Past Tense.
- Past Tense Forms in Quranic Arabic (الماضي الفعل).
- Past Tense for غائب, مخاطب, and متكلم Forms.
- Feminine Forms in Past Tense.
- Imperative Verbs for Singular and Plural (الأمر فعل).
- Quranic Adjective Compounds (وموصوف صفة).
- Possessive Construction (إليه ومضاف مضاف).
- Active and Passive Participles (المفعول اسم الفاعل، اسم).
- Dual Forms in Arabic Grammar (المتنى).
- Personal and Possessive Pronouns in Quranic Arabic.
- Pronouns with Prepositions.
- Adverbs (حال) in Quranic Sentences.
- Masculine Sound Plurals (السالمة المذكر جمع).
- Demonstrative Pronouns (أولئك هؤلاء).
- Common Quranic Particles and Expressions.
- Verbal Sentences in Quranic Arabic (الفعلية الجملة).
- Translation and Understanding of Quranic Words, Phrases, Sentences, and Verses.

Recommended Books

Course Book:

1. Dr. Ubaid-ur-Rehman. (n.d.). Muallim-ul-Qur'an (Vols. 1–3).

Reference Material:

1. Digital & Multimedia Resources.
2. Website: www.muallimulquran.com.
3. Flipbook editions of Vol. I–III.
4. Confirmation videos for self-assessment.
5. Workbooks, quizzes, question papers, and supplementary slides (online).
6. YouTube Playlist.
7. Muallim-ul-Qur'an Video Lectures (Dr. Ubaid-ur-Rehman).

8.18 Civil Engineering Drawing, Drafting and Interpretation

Course Code and Title: CET-215 Civil Engineering Drawing, Drafting and Interpretation		Credits Hours: 1+1	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK4 (Engineering specialist knowledge) • SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 9 (Industry, Innovation and Infrastructure) • SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC4 (Design and development of solutions) • TC6 (Protection of society)	
Course Objectives			
Upon successful completion of this course, students will be able to prepare and interpret architectural, structural, and civil engineering drawings using standard drafting practices and modern CAD tools. They will develop the skills required to produce accurate construction drawings, reinforcement detailing, and technical documentation for buildings and civil engineering infrastructure in accordance with engineering standards.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the fundamental principles, conventions, symbols, scales, and standards used in architectural, structural, and civil engineering drawings.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Interpret architectural and structural drawings of buildings and civil infrastructure, including bridges, culverts, dams, retaining walls, airport facilities, jetties, quay walls, and steel structures.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Prepare accurate architectural and structural drawings, including plans, elevations, sections, dimensions, reinforcement details, and schedules, using standard drafting practices.	P3 (Psychomotor) Guided Response	PLO-3 / SA3 (Design/development of solutions)
CLO-4	Produce detailed civil engineering drawings using appropriate CAD/digital drafting tools and apply relevant drawing conventions and standards.	P4 (Psychomotor) Mechanism	PLO-5 / SA5 (Tool Usage)

CLO-5	Communicate technical information through clear, accurate, and properly documented engineering drawings and drawing sheets.	A3 (Affective) Valuing	PLO-9 / SA9 (Communication)
Course Outline for Theory			
• Drawing Basics: Elements of architectural planning and design; conceptual, schematic, and working drawings and details of residential, commercial, religious, recreational, industrial, clinical, hospital, and educational buildings; Details of doors, windows, staircases, etc. • Elements of structural drawing and detailing: Preparation of foundation plan, structural framing, slab details, staircase details, water tanks, beam and column elevations and sections, mostly pertaining to reinforced concrete structures; plumbing and electrical detailing pertaining to residential units. • Drawings Interpretation: General understanding and reading of the following drawings: architectural and structural detail drawings of bridges (concrete, steel etc.); architectural and structural detail drawings of culverts; architectural and structural detail drawings of dams (concrete, earthen etc.); architectural and structural detail drawings of retaining walls (gravity, cantilever, counterfort, etc.); architectural and structural detail drawings of airport building; architectural and structural detail drawings of jetties, quay walls; architectural and structural detail drawings of industrial building; details of steel roof truss, connection details and fabrication drawings.			
Lab Work Outline for Practical			
As part of the overall learning requirements, the course will include: 1. Draw a Plan and section of isolated and combined footing showing reinforcement; also draw the Schedule of Footing. 2. Draw a four-storied building column's elevation and cut section at each floor, reducing the reinforcement and cross-section of the column. 3. Draw the schedule of beams; also, draw the typical elevation of the beam, showing Bottom bar, Extra bottom bar, Hanger bar, Top bar, Extra Top bar, and rings. 4. Draw a single-span beam elevation and its Section showing reinforcement using a bent-up bar. 5. Draw a three-span RCC Beam elevation and its section showing reinforcement, and also develop a schedule of beams. 6. Draw a Plan (13 X 17) and its cross-section of a single-span RCC Slab, showing reinforcement. Short way #3@6"c/c long way #3@9"c/c, Slab thickness 6". 7. Draw a plan and cross-section of a one-way slab of three spans showing reinforcement. 8. Draw a plan and a cross-section of a septic tank. 9. Draw a Plan of a 120 sq. yard residential bungalow. 10. Draw elevation and section of bridges showing the components of a bridge, like Pile, Pile cap, Abutment, Transom, Diaphragm. 11. Draw the elevation and section of the girder showing pre-stress and non-prestress reinforcement. 12. Draw elevation, section, and reinforcement drawing of the culvert. 13. Draw elevation, section, and reinforcement drawings of Cantilever Retaining Walls. 14. Draw Elevation, section, and reinforcement drawing of Counterfort Retaining Walls. 15. Draw a general layout of an Airport showing the typical cross-section of the runway. 16. Draw elevation and section of Jetties and Quay Walls.			



Curriculum for Bachelor of Science in Civil Engineering Technology



Recommended Books

1. Bhatt, N. D. (n.d.). *Engineering drawing*.
2. Goetsch, D. L., Chalk, W. S., Nelson, J. A., & Richman, R. L. (n.d.). *Technical drawing* (5th ed.).
3. Greenbaum, A., & Chartier, T. P. (2012). *Numerical methods*. Princeton University Press.
4. Kreyszig, E. (2006). *Advanced engineering mathematics* (9th ed.). Wiley.
5. Luzadder, W. J., & Duff, J. M. (n.d.). *Fundamentals of engineering drawing: With an introduction to interactive computer graphics for design and production*.
6. O'Leary, D. P. (2008). *Scientific computing with case studies*. Society for Industrial and Applied Mathematics.
7. Siddique, Z. A. (n.d.). *Basics of engineering drawing*.
8. Smith, P. (n.d.). *Drawing for engineering*.
9. Van Der Westhuizen, J. A. (n.d.). *Drawing for civil engineering*.

8.19 Soil Mechanics

Course Code and Title: CET-216 Soil Mechanics		Credits Hours: 1+2	Prerequisite: None
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK8 (Engagement with the current technological literature)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 9 (Industry, Innovation and Infrastructure) - SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC2 (Comprehend and apply local knowledge) - TC3 (Problem analysis) - TC5 (Evaluation) - TC10 (Communication and Collaboration)	
Course Objectives			
This course provides technologists with a fundamental understanding of soil behavior and its engineering properties. It develops practical skills to perform laboratory and field tests for soil identification, characterization, and engineering analysis. The course also enables students to apply basic soil mechanics concepts in solving geotechnical problems in civil engineering projects.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Discuss fundamentals of soil properties, behavior, and classification systems.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Solve various problems related to soil permeability, consolidation, and shear strength.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform various experiments of soil mechanics related to index properties, permeability, and shear strength of soil.	P5 (Psychomotor) Adaptation	PLO-9 / SA9 (Communication)
CLO-4	Demonstrate responsibility and teamwork during soil mechanics laboratory activities.	A3 (Affective) Adopt	PLO-8 / SA8 (Individual and Collaborative Teamwork)

Course Outline for Theory

- **Introduction:** Importance of mechanics of soils in Civil Engineering Technology, Origin of soils, soil formation, soil types.
- **Index Properties of Soil:** Phase diagrams of soil, Phase relations of soil: water content, void ratio, porosity, degree of saturation, air content, percentage air voids, unit weights, and specific gravity.
- **Soil Classification:** Grain size distribution, Atterberg limits, AASHTO classification system, Unified soil classification system, Identification and classification of expansive soils, collapsible and dispersion soils, field identification of soils.
- **Permeability and Seepage of Soil:** Permeability, Darcy's law, Factors affecting permeability, Permeability of stratified soils, flow nets, Laboratory and field determination of permeability.
- **Consolidation:** Introduction to Consolidation, Laboratory consolidation tests, Graphical representation of data, Compression index, Coefficient of compressibility, Calculation of void ratio and coefficient of volume change, Degree of consolidation, Primary and secondary consolidation, Determination of pre-consolidation pressure and over-consolidation ratio, normally and pre-consolidated clays.
- **Shear Strength:** Mohr-Coulomb failure theory, Laboratory measurement of shear strength parameters: shear box test, unconfined compression test, vane shear test, and triaxial shear test.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Introduction to the Soil Mechanics Laboratory and HSE (Health, Safety, and Environment) measures
2. Collection of soil samples from fields and preparing the representative soil sample for laboratory testing:
 - a) Quartering Method b) Riffle Box Method
3. To determine the water content of a soil sample by:
 - a) Oven Drying Method b) Hot Plate Method c) Sand Bath Method
 - d) Speedy Moisture Tester e) Infrared Moisture Tester
4. To determine the particle size distribution of coarse-grained soil by Sieve Analysis.
5. To determine the particle size distribution of fine-grained soil by Hydrometer Analysis and pipette analysis.
6. To determine the liquid limit of fine-grained soil by Casagrande Apparatus and/or Fall Cone (Penetrometer) Method
7. To determine the shrinkage limit of fine-grained soil.
8. To determine the specific gravity of soil by the Density Bottle Method.
9. To determine the coefficient of permeability of coarse-grained soil by the Constant Head Method.
10. To determine the coefficient of permeability of fine-grained soil by the Falling Head Method.
11. To determine consolidation parameters of saturated fine-grained soil by the One-Dimensional Consolidation Test.
12. To determine the free swell of clayey soils.
13. To determine the minimum and maximum dry density of cohesionless soil sample by Vibrating Table.
14. To determine the shear strength parameters of sandy/clayey soil by the Direct Shear Box Test.
15. To determine the shear strength of clayey soil by Unconfined Compression Test and Pocket

Penetrometer Test.

16. To determine the shear strength of a clayey soil by the Laboratory Vane Shear Test.
17. To determine the shear strength of fine-grained and coarse-grained soils by the CU -Tri-Axial Test.
18. To determine the shear strength of fine-grained and coarse-grained soils by the CD-Tri-Axial Test.
19. To determine the shear strength of fine-grained and coarse-grained soils by the UU-Tri-Axial Test.
20. To determine the sand equivalent value of sand.
21. To perform the open-ended lab.

Recommended Books

1. Das, B. M. (n.d.). *Principles of geotechnical engineering* (Latest ed.). Brooks/Cole.
2. Fratta, D., Aguetant, J., & Roussel-Smith, L. (n.d.). *Introduction to soil mechanics laboratory testing* (Latest ed.).
3. Holtz, R. D., Kovacs, W. D., & Sheahan, T. C. (n.d.). *An introduction to geotechnical engineering* (Latest ed.).
4. Kalinski, M. E. (n.d.). *Soil mechanics lab manual* (Latest ed.).
5. Qureshi, M. S., & Akbar, A. (n.d.). *Fundamentals of soil mechanics* (Latest ed.).
6. Smith, J. (n.d.). *Elements of soil mechanics* (Latest ed.).

8.20 Fluid Mechanics

Course Code and Title: CET-217 Fluid Mechanics		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: SK3 (Engineering fundamentals)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC2 (Comprehend and apply local knowledge) - TC3 (Problem analysis) - TC10 (Communication and Collaboration)	
Course Objectives			
Understand the fundamental principles of fluid statics, kinematics, and dynamics, including pressure measurement, Bernoulli’s equation, and flow regimes, and apply these concepts to analyze flow measurement devices, pipe systems, and open channel flows for practical engineering solutions.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the basic concepts of fluid statics, kinematics, and dynamics.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Solve various problems related to fluid at rest and motion.	C3 (Cognitive) Solve	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform experiments in the laboratory to verify the theoretical principles of fluid mechanics.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-4	Contribute actively to the lab work of basic fluid mechanics.	A2 (Affective) Responding	PLO-9 / SA9 Communication
Course Outline for Theory			
Introduction: Fluid mechanics, hydrostatics, kinematics, hydrodynamics, hydraulics, solids and fluids, liquids and gases, units, and dimensions.			

• Physical properties of fluids: Specific weight, density, specific volume, surface tension, compressibility, viscosity, units of viscosity, measurement of viscosity, Newton's equation of viscosity. • Fluid Statics: Pressure intensity and pressure head: pressure-specific weight relationship, absolute and gauge pressure, measurement of pressure, Piezometer, Manometer, Pressure Transducers. Differential manometer and Bourden gauge. Forces on submerged planes and curved surfaces: applications. Buoyancy and floatation, Equilibrium of floating and submerged bodies. • Fluid Kinematics: Steady and unsteady flow, laminar and turbulent flow, uniform, and non-uniform flow. Pathlines, streamlines, and stream tubes, Velocity and discharge, Equation of continuity for compressible and incompressible fluids. • Hydrodynamics: Different forms of energy in a flowing liquid, head, Bernoulli's equation and its application, Energy line and Hydraulic gradient line, free and forced vortex. • Flow Measurement: Orifices and mouthpieces, Weirs and notches, Pitot tube and pitot-static tube, Venturimeter, Salt velocity method, Color velocity method, Radioisotope methods. • Uniform Flow in Open Channels: Chezy's and Manning's equations, economical channel sections. • Steady Flow through Pipes: Losses in pipelines, minor and major losses, Darcy-Weisbach equation for major loss of head in pipes (application using relevant tool), Pipes in series and parallel, Transmission of energy through pipes.
Lab Work Outline for Practical
As part of the overall learning requirements, the course will include: 1. Introduction to Practical contents, Equipment, and HSE (Health, Safety, and Environment) measures. 2. Demonstration of the Hydraulics Bench. 3. To perform an experiment for the determination of the viscosity of a given fluid (oil/water) by using a falling-sphere type viscometer. 4. To check the accuracy of the Bourdon gauge through its calibration by means of a dead weight apparatus. 5. To conduct an experiment for the magnitude of the hydrostatic force on a partially submerged surface and locate the center of pressure. 6. To conduct an experiment for the magnitude of the hydrostatic force on a fully submerged surface and locate the center of pressure. 7. To conduct an experiment for the metacentric height and locate the positions of various important points of a floating body. 8. To conduct an experiment for the measurement of the pressure using a manometer. 9. To perform an experiment for the study of Laminar, transitional, and Turbulent Flow using Reynolds' concept equipment 10. To conduct an experiment for the coefficient of discharge of a rectangular and triangular Notch. 11. To conduct an experiment for the hydraulic coefficients of an orifice. 12. To verify Bernoulli's theorem for the steady flow of water. 13. To measure the flow of incompressible fluid in pipes using flow meters.
Recommended Books
1. Daugherty, R. L., Franzini, J. B., & Finnemore, E. J. (n.d.). <i>Fluid mechanics with engineering applications</i> (Latest ed.). McGraw-Hill.



Curriculum for
Bachelor of Science in Civil Engineering Technology



2. Fox, J. A. (n.d.). *An introduction to engineering fluid mechanics* (Latest ed.). Macmillan.
3. Massey, B. S. (n.d.). *Mechanics of fluids* (Latest ed.). Van Nostrand Reinhold
4. Webber, N. B. (n.d.). *Fluid mechanics for civil engineers* (Latest ed.). Chapman & Hall.

8.21 Environmental Engineering

Course Code and Title: CET-218 Environmental Engineering		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 3 (Good Health and Well-being) • SDG 6 (Clean Water and Sanitation) • SDG 11 (Sustainable Cities and Communities) • SDG 12 (Responsible Consumption and Production) • SDG 13 (Climate Action)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC3 (Problem analysis) • TC6 (Protection of society) • TC10 (Communication and Collaboration)	
Course Objectives			
After completion of this course, students will be able to explain the fundamental principles of environmental engineering, environmental pollution, sustainability concepts, and their applications in civil engineering technology, and describe the principles and functions of wastewater management, solid waste management, and environmental monitoring systems used in civil engineering technology projects.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain environmental laws, sustainability concepts, EIA procedures, environmental pollution, and environmental management principles related to civil engineering projects.	C2 (Cognitive) Understand	PLO-7 / SA7 (Ethics)
CLO-2	Analyze sources, impacts, and control measures of air, water, wastewater, noise, and solid waste pollution systems.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Apply engineering principles for wastewater treatment, sewer systems, solid waste management, environmental monitoring, and sustainable environmental solutions.	C3 (Cognitive) Apply	PLO-3 / SA3 (Design/development of solutions)
CLO-4	Perform laboratory experiments and environmental quality analysis using standard methods, environmental instruments, GIS tools, and monitoring equipment.	P4 (Psychomotor) Mechanism	PLO-4 / SA4 (Investigation)

CLO-5	Prepare and present technical reports, environmental assessment studies, and interpret monitoring results related to sustainability and environmental engineering practices.	A2 (Affective) Responding	PLO-9 / SA9 (Communication)
Course Outline for Theory			
• Introduction to Environmental Engineering: Environment, ecosystem, and ecological balance; Principles of environmental sustainability and sustainable development; Sustainable Development Goals (SDGs) and climate change challenges; Environmental ethics and professional responsibilities; Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE) procedures; Pakistan Environmental Protection Act (PEPA) and environmental regulations; National Environmental Quality Standards (NEQS) and WHO environmental guidelines. • Environmental Pollution: Air, water, soil, and noise pollution and their characteristics; Sources, impacts, and control measures of environmental pollution; Greenhouse gases, global warming, and climate change impacts; Carbon footprint and environmental sustainability concepts; Urban environmental challenges and pollution management strategies. • Solid Waste Management: Municipal, industrial, and hazardous solid wastes; Waste characterization and waste generation sources; Collection, transportation, and handling of solid waste; Recycling, reuse, and circular economy approaches; Composting and waste-to-energy technologies; Landfill planning, operation, and environmental management. • Wastewater Engineering: Wastewater generation, sources, and characteristics; Primary, secondary, and tertiary wastewater treatment processes; Sludge treatment and management techniques; Wastewater reuse, recycling, and resource recovery; Pollution prevention and sustainable wastewater management practices. • Sewers: Classification of sewage and sewerage systems; Combined and separate sewer systems and their applications; Sewer appurtenances, sewer testing, and maintenance practices; Introduction to wastewater collection and conveyance systems. • Environmental Monitoring and Smart Technologies: Environmental sensors and monitoring instruments; Air and water quality monitoring techniques; GIS applications in environmental management and pollution mapping; IoT applications and smart technologies in environmental systems.			
Lab Work Outline for Practical			
As part of the overall learning requirements, the course will include: 1. Determination of Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and Volatile Suspended Solids (VSS) in a wastewater sample. 2. Determination of Biological Oxygen Demand (BOD₅). 3. Determination of Chemical Oxygen Demand (COD). 4. Determination of Dissolved Oxygen (DO) in wastewater sample. 5. Determination of moisture content in solid waste using the direct weight loss method. 6. Measurement and analysis of environmental noise levels using sound level meters at different locations. 7. Determination of NO_x and SO_x, CO, CO₂, and H₂S by hand meters.			



Curriculum for Bachelor of Science in Civil Engineering Technology



8. Calculation and interpretation of the Water Quality Index using experimentally determined parameters.
9. Introduction to GIS applications for environmental monitoring, waste management, and pollution mapping.
10. Preparation of a basic EIA report for a small civil engineering or infrastructure project.
11. Design and perform an open-ended laboratory investigation addressing broadly-defined engineering activities and real-world engineering problems.
12. Study of treatment units, operational procedures, and environmental management practices through a treatment plant visit.

Recommended Books

1. Davis, M. L., & Masten, S. J. (2021). *Principles of environmental engineering and science* (4th ed.). McGraw-Hill Education.
2. Rangwala, S. C. (2017). *Fundamentals of water supply and sanitary engineering* (31st ed.). Charotar Publishing House.
3. Reinhart, D. R. (2018). *Solid waste engineering* (2nd ed.). Cengage Learning.
4. Revelle, C. S. (2003). *Civil and environmental systems engineering* (2nd ed.). Pearson Education.
5. Sharma, V. (2005). *Comprehensive environmental studies*. Tata McGraw-Hill.

8.22 Civics and Community Engagement

Course Code and Title: HUM-221 Civics and Community Engagement		Credits Hours: 2+0	Prerequisite: None
Knowledge and Attitude Profile: SK1 (Theory-based understanding of the natural and social sciences)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): - SDG 16 (Peace, Justice and Strong Institutions) - SDG 17 (Partnership for the Goals)		Professional Competence Profile: - TC8 (Ethics) - TC10 (Communication and Collaboration) - TC11 (Continuous professional development and lifelong learning)	
Course Objectives			
Upon completion of this course, students will be equipped with the knowledge and skills in civics, citizenship, and community engagement to participate inclusively and make a positive impact in society.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Demonstrate fundamental understanding of civics, government, citizenship, and civil society.	C2 (Cognitive) Understand	PLO-6 / SA6 (The Engineer and the World)
CLO-2	Understand the concept of community and recognize the significance and groups of community engagement for individuals.	C2 (Cognitive) Understand	PLO-8 / SA8 (Individual and Collaborative Team work)
CLO-3	Demonstrate the importance of diversity and inclusivity for societal harmony and peaceful coexistence.	A3 (Affective) Value	PLO-7/ SA7 (Ethics)
Course Outline for Theory			
Civics and Citizenship: Concepts of civics, citizenship, and civic engagement. Foundations of modern society and citizenship. Types of citizenship: active, participatory, digital, etc. State, Government and Civil Society: Structure and functions of government in Pakistan. The relationship between democracy and civil society. Right to vote and the importance of political participation and representation. Rights and Responsibilities: Overview of fundamental rights and liberties of citizens under the Constitution of Pakistan 1973.Civic responsibilities and duties, ethical considerations in civic engagement (accountability, non-violence, peaceful dialogue, civility, etc.). Community Engagement: Concept, nature, and characteristics of community. Community			

development and social cohesion. Approaches to effective community engagement. Case studies of successful community-driven initiatives.

- **Advocacy and Activism:** Public discourse and public opinion, Role of advocacy in addressing social issues. Social action movements.
- **Digital Citizenship and Technology:** The use of digital platforms for civic engagement. Cyber ethics and responsible use of social media. Digital divides and disparities (access, usage, socioeconomic, geographic, etc.) and their impact on citizenship; Diversity, Inclusion and Social Justice: Understanding diversity in society (ethnic, cultural, economic, political, etc.). Youth, women, and minorities' engagement in social development. Addressing social inequalities and injustices in Pakistan. Promoting inclusive citizenship and equal rights for societal harmony and peaceful co-existence.

Lab Work Outline for Practical (Optional)

As part of the overall learning requirements, the course may have one or a combination of the following practical activities:

- **Community Storytelling:** Students can collect and share stories from community members. This could be done through oral histories, interviews, or multimedia presentations that capture the lived experiences and perspectives of diverse individuals.
- **Community Event Planning:** Students can organize a community event or workshop that addresses a specific issue or fosters community interaction. This can be a health fair, an environmental cleanup, a cultural festival, or an educational workshop.
- **Service-Learning:** Students can collaborate with a local nonprofit organization or community group. They can actively contribute by volunteering their time and skills to address a particular community need, such as tutoring, mentoring, or supporting vulnerable populations.
- **Cultural Exchange Activities:** Students can organize a cultural exchange event that celebrates the diversity within the community. This could include food tastings, performances, and presentations that promote cross-cultural understanding.

Recommended Books

1. Feldpausch, B. J., & Omilian, S. M. (2018). *Community engagement: Principles, strategies, and practices*. Cognella.
2. Kymlicka, W., & Norman, W. (Eds.). (2000). *Citizenship in diverse societies*. Oxford University Press.
3. McGraw-Hill Education. (2010). *Civics today: Citizenship, economics, & you*. McGraw-Hill.
4. Pike, G., & Selby, D. (1988). *Global teacher, global learner*. Hodder & Stoughton.
5. Youniss, J., & Levine, P. (Eds.). (2009). *Engaging young people in civic life*. Vanderbilt University Press.

8.23 Ideology and Constitution of Pakistan

Course Code and Title: HUM-222 Ideology and Constitution of Pakistan		Credits Hours: 2+0	Prerequisite: None
Knowledge and Attitude Profile: - SK1 (Theory-based understanding of the natural and social sciences) - SK8 (Engagement with the current technological literature)		Range of Problem Identification and Solving: -	Range of Engineering Activities: -
Sustainable Development Goals (SDGs): SDG 16 (Peace, Justice and Strong Institutions)		Professional Competence Profile: - TC6 (Protection of society) - TC7 (Legal, regulatory, and cultural) - TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
This course is designed to provide students with a fundamental exploration of the ideology and the constitution of Pakistan. The course focuses on the underlying principles, beliefs, and aspirations that have been instrumental in shaping Pakistan's creation and development as a sovereign state. Moreover, the course will enable students to understand the core provisions of the Constitution of the Islamic Republic of Pakistan concerning the fundamental rights and responsibilities of Pakistani citizens, enabling them to function in a socially responsible manner.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Demonstrate enhanced knowledge of the basis of the ideology of Pakistan with special reference to the contributions of the founders of Pakistan.	C2 (Cognitive) Understand	PLO-11 / SA 11 (Lifelong learning)
CLO-2	Demonstrate fundamental knowledge about the Constitution of Pakistan 1973 and its evolution with special reference to the state structure.	C2 (Cognitive) Understand	PLO-6 / SA6 (The Engineer and the World)
CLO-3	Explain the guiding principles on the rights and responsibilities of Pakistani citizens as enshrined in the Constitution of Pakistan 1973.	C2 (Cognitive) Understand	PLO-7 / SA7 (Ethics)
Course Outline for Theory			
Introduction to the Ideology of Pakistan: Definition and significance of ideology; Historical context of the creation of Pakistan (with emphasis on socio-political, religious, and cultural dynamics of British India between 1857 till 1947); Contributions of founding fathers of Pakistan in the freedom			

movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah, etc.; Contributions of women and students in the freedom movement for separate homeland for Muslims of British India.

- **Two-Nation Theory:** Evolution of the Two-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress Ministries 1937, Lahore Resolution 1940); Role of communalism and religious differences.
- **Introduction to the Constitution of Pakistan:** Definition and importance of a constitution; Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949); Overview of constitutional developments in Pakistan.
- **Constitution and State Structure:** Structure of Government (executive, legislature, and judiciary); Distribution of powers between federal and provincial governments; 18th Amendment and its impact on federalism.
- **Fundamental Rights, Principles of Policy and Responsibilities:** Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan, 1973 (Articles 8–28); Overview of Principles of Policy (Articles 29–40); Responsibilities of the Pakistani citizens (Article 5).
- **Constitutional Amendments:** Procedures for amending the Constitution; Notable constitutional amendments and their implications.

Recommended Books

1. Aziz, K. K. (1967). *The making of Pakistan: A study in nationalism*. Chatto & Windus.
2. Choudhury, G. W. (1959). *Constitutional development in Pakistan*. Longmans, Green.
3. Cohen, S. P. (2004). *The idea of Pakistan*. Brookings Institution Press.
4. Government of Pakistan. (1973). *The Constitution of the Islamic Republic of Pakistan, 1973*.
5. Hussain, M. (2020). *The Parliament of Pakistan: A history of institution-building and (un)democratic practices, 1971–1977*. Oxford University Press.
6. Iqbal, J. (1959). *The ideology of Pakistan and its implementation*. Ferozsons.
7. Jalal, A. (2014). *The struggle for Pakistan: A Muslim homeland and global politics*. Belknap Press of Harvard University Press.
8. Khan, H. (2001). *Constitutional and political history of Pakistan*. Oxford University Press.
9. Mahmood, S. (1999). *Pakistan: Political roots and development, 1947–1999*. Oxford University Press.
10. Mujahid, S. (1974). *Ideology of Pakistan*. Islamic Research Institute.
11. Qureshi, I. H. (1965). *The struggle for Pakistan*. University of Karachi.
12. Sayeed, K. B. (1968). *Pakistan: The formative phase* (2nd ed.). Oxford University Press.
13. Talbot, I. (2012). *Pakistan: A new history*. Hurst.
14. Ziring, L. (1997). *Pakistan in the twentieth century: A political history*. Oxford University Press.

8.24 Technopreneurship

Course Code and Title: MGM-223 Technopreneurship		Credits Hours: 2+0	Prerequisite: None
Knowledge and Attitude Profile: • SK1 (Theory-based understanding of the natural and social sciences)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 8 (Decent Work and Economic Growth) • SDG 9 (Industry, Innovation and Infrastructure) • SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: • TC6 (Protection of society) • TC7 (Legal, regulatory, and cultural) • TC8 (Ethics) • TC10 (Communication and Collaboration) • TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
This course is designed to promote entrepreneurial spirit and outlook among students, encouraging them to think critically, identify opportunities, and transform their ideas into successful ventures. Students gain practical knowledge and skills to start and manage a business, including how to handle challenges.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Understand the concept of Technopreneurship and the characteristics of a successful entrepreneur.	C2 (Cognitive) Understand	PLO-6 / SA6 (The Engineer and the World)
CLO-2	Understand basic regulatory requirements for starting a business in Pakistan, with a focus on export businesses.	C2 (Cognitive) Understand	PLO-11 / SA11 (Lifelong learning)
CLO-3	Analyze tech-based business ideas and build them individually or in teams.	C4 (Cognitive) Analyze	PLO-8 / SA8 (Individual and Collaborative Team work)
CLO-4	Organize innovative ideas suitable for commercialization.	A4 (Affective) Organize	PLO-10 / SA10 (Project Management and Finance)

Course Outline for Theory

- **Introduction to Entrepreneurship:** Definition and concept of entrepreneurship. Why become an entrepreneur? Entrepreneurial process. Role of entrepreneurship in economic development.
- **Entrepreneurial Skills:** Characteristics and qualities of successful entrepreneurs (including stories of successes and failures). Areas of essential entrepreneurial skills and abilities, such as creative and critical thinking, innovation, and risk-taking abilities.
- **Opportunity Recognition and Idea Generation:** Opportunity identification, evaluation, and exploitation; Innovative idea generation techniques for entrepreneurial ventures.
- **Fundamentals of Business Plan:** What is a business plan, who should write it, Scope and value of a business plan, Information needs, why some business plans fail.
- **Marketing and Sales:** Target market identification and segmentation, the Four Ps of Marketing, and developing a marketing strategy. Branding.
- **Financial Literacy:** Basic concepts of income, savings, and investments. Basic concepts of assets, liabilities, and equity. Basic concepts of revenue and expenses. Overview of cash flows. Overview of banking products, including Islamic modes of financing. Sources of funding for startups (angel financing, debt financing, equity financing, etc.).
- **Writing the Business Plan:** Introductory page, Executive summary, Environmental and Industry Analysis, Description of Venture, Production Plan, Marketing Plan, Organizational Plan, Assessment of Risk, Financial Plan.
- **Team Building for Startups:** Characteristics and features of effective teams. Team building and effective leadership for startups. Regulatory Requirements to Establish Enterprises in Pakistan. Types of enterprises (e.g., sole proprietorship; partnership; private limited companies, etc.). Intellectual property rights and protection. Regulatory requirements to register an enterprise in Pakistan, with special emphasis on export firms. Taxation and financial reporting obligations.

Recommended Books

1. Abrams, R. (2017). *Entrepreneurship: A real-world approach*. The Planning Shop.
2. Barringer, B. R., & Ireland, R. D. (2024). *Entrepreneurship: Successfully launching new ventures* (7th ed.). Pearson.
3. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2017). *Entrepreneurship* (10th ed.). McGraw-Hill Education.
4. Kuratko, D. F. (2016). *Entrepreneurship: Theory, process, and practice* (10th ed.). Cengage Learning.
5. Read, S., Sarasvathy, S. D., Dew, N., & Wiltbank, R. (2016). *Effectual entrepreneurship* (2nd ed.). Routledge.
6. Ries, E. (2011). *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*. Crown Business.
7. Szycher, M. (2015). *The guide to entrepreneurship: How to create wealth for your company and stakeholders*. CRC Press.
8. Timmons, J. A., Spinelli, S., Jr., & Adams, R. (2015). *New venture creation: Entrepreneurship for the 21st century* (10th ed.). McGraw-Hill Education.

8.25 Concrete Technology

Course Code and Title: CET-224 Concrete Technology		Credits Hours: 1+1	Prerequisite: None
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC2 (Comprehend and apply local knowledge) - TC3 (Problem analysis) - TC5 (Evaluation)	
Course Objectives			
The course aims to develop an understanding of concrete materials, properties of fresh and hardened concrete, mix design procedures, testing methods, and quality evaluation techniques used in concrete construction.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the properties and behavior of concrete constituents, fresh concrete, and hardened concrete.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze effects of mix proportions, water-cement ratio, and material properties on concrete performance.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform laboratory tests on concrete materials, including fresh and hardened concrete, and use non-destructive testing techniques.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-4	Present and interpret experimental results and concrete performance data effectively.	A2 (Affective) Responding	PLO-9/ SA9 Communication
Course Outline for Theory			
- Concrete constituents, properties of cement, sand, aggregates, and types of cement. - Properties and behavior of fresh concrete, workability, and effects of water-cement ratio and			

impurities.

- Properties of hardened concrete, including strength, elasticity, shrinkage, creep, and durability.
- Concrete mix design methods, mix proportions, workability, and strength requirements.
- Compressive strength testing of concrete using cube and cylinder specimens
- Destructive and non-destructive testing methods for quality assessment of concrete.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Gradation, specific gravity, and bulk density tests of fine and coarse aggregates.
2. Preparation and casting concrete specimens with varying water-cement ratios and workability conditions.
3. Slump test and compressive strength testing of concrete cubes and cylinders.
4. Study of the effects of mixing, compaction, and water-cement ratio on concrete strength.
5. Determination of initial and final setting time of cement.
6. Flexural strength and modulus of rupture testing of reinforced concrete beam specimens.
7. Non-destructive testing of concrete using rebound hammer and ultrasonic pulse velocity tests.

Recommended Books

1. Mehta, P. K., Monteiro, P. J. M., & Kuder, K. G. (2020). *Concrete: Microstructure, properties, and materials* (4th ed.). McGraw-Hill Education.
2. Neville, A. M. (2011). *Properties of concrete* (5th ed.). Pearson.
3. Shetty, M. S. (2019). *Concrete technology: Theory and practice* (8th ed.). S. Chand Publishing.
4. Wilson, M. L., & Tennis, P. D. (2021). *Design and control of concrete mixtures* (17th ed.). Portland Cement Association.

8.26 Transportation and Highway Technology

Course Code and Title: CET-225 Transportation and Highway Technology		Credits Hours: 2+2	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK6 (Engineering Technologies)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 9 (Industry, Innovation and Infrastructure) • SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis) • TC10 (Communication and Collaboration)	
Course Objectives			
This course provides technologists with fundamental knowledge of transportation systems, planning, and design. It develops practical understanding and skills in the field practices of highway and traffic engineering.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the concept of transportation systems and their planning.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Use fundamental concepts of Highway geometry, traffic operations, and Highway Design for effective traffic system implementation.	C3 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-3	Perform traffic surveys for data collection in the field and measure traffic operational conditions.	P4 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-4	Practice laboratory and field tests as required for highway materials.	A2 (Affective) Responding	PLO-8 / SA8 (Individual and Collaborative Team work)

Course Outline for Theory

- **Introduction to Transportation Systems and Planning:** Modes of transportation, Principles of planning for communication facilities (road network, railroad network & airport, port, and harbor facilities), Planning process and mode choice decisions, Typical Highway Cross-Section and types of cross sections, Highway Drainage, Overview of Intelligent Transportation System and Mass Transit Systems.
- **Geometric Features of Highway:** Functional classification of roads, Horizontal curves, Vertical Curves, Transition curves, Grades, Super-elevation, Attainment of super elevation, Sight Distances, Tangent Runout, Superelevation Runoff, Introduction to Civil 3D.
- **Traffic Operations:** Introduction, Design controls of Vehicle, Speed, Driver, Volume, level of service, Capacity Analysis, Traffic Management, micro simulation, Highway safety, Traffic control devices, Traffic signals, Traffic study including Traffic volume study, OD-Survey, travel time and delay study, Parking study, accident studies. Introduction to Queue Theory.
- **Introduction to Railway:** Elements of Railway Track, types of gauges, Types of rail sections, Components of railway track, fish plate, bearing plate, ballast, renewal of ballast, Layout of railway stations, points and crossings, railway yards, maintenance of railway tracks.
- **Pavement Types and Loads:** Types of Pavements, Pavement Layers, Wheel loads, Equivalent Single Axle load and Repetition, classification of commercial vehicles, contact area and tire pressure, Introduction to pavement construction/ Maintenance of pavement & Construction Equipment.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. To determine the Los Angeles abrasion value (% wear) of an aggregate sample.
2. To determine the flakiness and elongation index of aggregate.
3. To determine the aggregate impact value of the given aggregate sample.
4. To determine the aggregate crushing value of the given aggregate sample.
5. To determine the soundness of the aggregate using different chemicals.
6. To perform the sieve analysis test of coarse aggregate.
7. To determine specific gravity and absorption of aggregate.
8. To determine the specific gravity of bitumen.
9. To determine flash & fire points of bitumen.
10. To determine the ductility of bitumen.
11. To determine penetration grades of bitumen.
12. To determine the softening point of bitumen.
13. To perform a traffic survey to analyze the spot speed on selected roads using different methods.
14. To carry out an intersection traffic count, including turning movements at an intersection using manual and camera techniques.
15. To calculate the peak hour factor, ADT, and AADT of any selected road section.
16. To calculate the intersection delay at any selected signalized intersection.
17. To carry out a parking study in any parking lot.
18. To study the retroreflectivity of signboards.
19. To perform the open-ended lab.



Curriculum for
Bachelor of Science in Civil Engineering Technology



Recommended Books

1. Croney, D. (n.d.). *The design and performance of road pavements* (Latest ed.). HMSO.
2. Garber, N. J., & Hoel, L. A. (n.d.). *Traffic and highway engineering* (Latest ed.).
3. Khanna, S. K., & Justo, C. E. G. (n.d.). *Highway engineering* (Latest ed.). [Publisher not specified].
4. Salter, R. J. (n.d.). *Traffic engineering and design* (Latest ed.). McGraw-Hill.
5. Valli, P. P., & Valli, V. (n.d.). *AASHTO standards* (Latest ed.).
6. Wright, P. H., & Dixon, K. K. (n.d.). *Highway engineering* (Latest ed.).

8.27 Mechanics of Solids

Course Code and Title: CET-226 Mechanics of Solids		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: SK3 (Engineering fundamentals)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: TC3 (Problem analysis)	
Course Objectives			
The course aims to develop an understanding of stress, strain, deformation, and behavior of structural members subjected to different loading conditions, along with experimental evaluation of material properties and structural response.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain theories and principles of stress, strain, bending, deflection, and column behavior in structural members.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze structural members subjected to axial, bending, shear, and combined loading conditions.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform laboratory experiments related to mechanical properties, stresses, strains, and deflection of materials and structural members.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-4	Present and interpret experimental observations and analytical results effectively.	A2 (Affective) Responding	PLO-9 / SA9 Communication
Course Outline for Theory			
- Simple stress, strain, temperature stress, and compatibility of structural members. - Shear force and bending moment diagrams for determinate beams. - Theory of simple bending, shear stresses, and beam deflection methods. - Columns, struts, Euler formulas, and slenderness ratio. - Strain energy, impact loading, and behavior of members under combined loading.			

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Stress-strain behavior and elastic properties of engineering materials.
2. Yield strength and bending tests on steel, wood, and concrete specimens.
3. Study of shear center and biaxial bending behavior of structural sections.
4. Investigation of stress trajectories and deflection behavior of beam elements.

Recommended Books

1. Beer, F. P., Johnston, E. R., DeWolf, J. T., & Mazurek, D. F. (2020). *Mechanics of materials* (8th ed.). McGraw-Hill Education.
2. Craig, R. R. (2019). *Mechanics of materials* (4th ed.). Wiley.
3. Gere, J. M., & Goodno, B. J. (2018). *Mechanics of materials* (9th ed.). Cengage Learning.
4. Hibbeler, R. C. (2020). *Mechanics of materials* (11th ed.). Pearson.

8.28 Geology

Course Code and Title: IDS-227 Geology		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC3 (Problem analysis) - TC4 (Investigation) - TC8 (Ethics) - TC10 (Communication and Collaboration)	
Course Objectives			
After completion of this course, students will be able to understand the fundamentals of geology, formation and classification of rocks and minerals, geological structures, and their applications in civil engineering projects, including dams, tunnels, highways, bridges, and foundations.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Describe the basic concepts of geology, formation of rocks, minerals, and structural features of strata.	C1 (Cognitive) Remember	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Apply geological principles in the planning, investigation, and execution of civil engineering projects.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform laboratory and field-based geological investigations for identification and testing of rocks and minerals.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-4	Affectively Present and interpret laboratory observations, experimental results, and geological data.	A2 (Affective) Responding	PLO-9 / SA9 Communication

Course Outline for Theory	
• Introduction to Geology and its importance in Civil Engineering projects: Geological science and its subdivisions; Earth materials, earth processes and geological history; Structure and composition of the Earth; Geological time scale and principles of stratigraphy. • Minerals and Rocks: Introduction to minerals and rocks; Identification and crystal form of minerals; Rock cycle and rock-forming minerals; Igneous, sedimentary, and metamorphic rocks; Physical properties of rocks and minerals; Classification of rocks based on color, hardness, grain size, texture, strength, and weathering; Identification and engineering properties of common rocks, including shale, sandstone, and limestone. • Structural Geology: Introduction to structural geology; Dip and strike of strata; Folds and their types; Faults, their causes and classification; Joints and their classification; Field interpretation of folds, faults and joints; Geological structures due to denudation. • Engineering Applications: Role of geology in selection of sites for dams, reservoirs, tunnels, highways, bridges, and airfields; Geological considerations in foundations and slope stability; Brief introduction to local geology and engineering geological problems.	
Lab Work Outline for Practical	
As part of the overall learning requirements, the course will include: 1. Introduction to Engineering Geology Laboratory and HSE (Health, Safety, and Environment) measures. 2. Determination of the hardness of minerals using Mohs' scale. 3. Determination of streak of minerals. 4. Estimation of RQD, TCR, SCR, and Fracture Index using rock core samples. 5. Determination of compressive strength of rocks using Schmidt Hammer. 6. Determination of unconfined compressive strength of rocks. 7. Determination of the Point Load Strength Index of Rock. 8. Determination of properties of rock cores using the Ultrasonic Pulse Velocity method. 9. Determination of tensile strength of rocks using a UTM machine. 10. Determination of the slake durability index of rocks. 11. Identification of carbonates in rocks using the acid test. 12. Observation of folds using sandbox models. 13. Observation of different types of faults using sandbox models. 14. Site identification of folds and faults in rocks. 15. Preparation of geological cross-sections from geological maps. 16. Open-ended laboratory/project work related to engineering geology investigations.	
Recommended Books	
1. Attewell, P. B., & Farmer, I. W. (n.d.). <i>Principles of engineering geology and geotechnics</i> (Latest ed.). 2. Bell, F. G. (n.d.). <i>Engineering geology</i> (Latest ed.). 3. Blyth, F. G. H. (n.d.). <i>A geology for engineers</i> (Latest ed.). Arnold International. 4. Goodman, R. E. (n.d.). <i>Engineering geology: Rock in engineering construction</i> (Latest ed.). John Wiley & Sons. 5. Kesavulu, N. C. (n.d.). <i>A textbook of engineering geology</i> (Latest ed.).	

8.29 Reinforced and Prestressed Concrete

Course Code and Title: CET-311 Reinforced and Prestressed Concrete		Credits Hours: 2+1	Prerequisite: CET-224 Concrete Technology
Knowledge and Attitude Profile: SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: - TC3 (Problem analysis) - TC10 (Communication and Collaboration)	
Course Objectives			
The course aims to develop an understanding of reinforced concrete behavior, structural design principles, detailing practices, prestressing systems, serviceability requirements, and field execution techniques in concrete construction projects.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the behavior and design principles of reinforced and prestressed concrete structural members.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze reinforced concrete members for flexure, shear, bond, serviceability, and detailing requirements.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Prepare reinforcement detailing, bar bending schedules, and structural drawings for reinforced concrete members.	C3 (Cognitive) Apply	PLO-3 / SA3 (Design/development of solutions)
CLO-4	Present reinforcement detailing, structural drawings, and construction practices effectively through technical communication.	A2 (Affective) Responding	PLO-9 / SA9 (Communication)
Course Outline for Theory			
- Fundamental behavior and mechanics of reinforced concrete structural members. - Strength, deformation, cracking, and serviceability of reinforced concrete structures. - Shear strength, shear reinforcement, bond, and development length in reinforced concrete members. - Reinforcement detailing, bar bending schedules, and structural drawings.			

- Field execution challenges, reinforcement placement, seismic detailing, and construction joints.
- Principles, behavior, materials, systems, and losses in prestressed concrete.
- Precast concrete units, casting, curing, joints, and erection methods.
- Formwork, shuttering, shoring, scaffolding, and formwork design for RC members.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Core extraction and evaluation of in-situ concrete strength.
2. Permeability of concrete mixes.
3. Formwork preparation and casting of precast concrete units.
4. Study of prestressed concrete equipment and machinery.
5. Casting and testing of prestressed and precast concrete specimens (demonstration).
6. Structural evaluation using non-destructive techniques (tests and visuals).

Recommended Books

1. Lin, T. Y., & Burns, N. H. (2019). *Design of prestressed concrete structures* (3rd ed.). Wiley.
2. McCormac, J. C., & Brown, R. H. (2015). *Design of reinforced concrete* (10th ed.). Wiley.
3. Nilson, A. H., Darwin, D., & Dolan, C. W. (2015). *Design of concrete structures* (15th ed.). McGraw-Hill Education.
4. Wang, C. K., Salmon, C. G., & Pincheira, J. A. (2017). *Reinforced concrete design* (8th ed.). Oxford University Press.

8.30 Engineering Hydrology

Course Code and Title: CET-312 Engineering Hydrology		Credits Hours: 1+1	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK4 (Engineering specialist knowledge) • SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 6 (Clean Water and Sanitation) • SDG 11 (Sustainable Cities and Communities) • SDG 13 (Climate Action)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis) • TC5 (Evaluation) • TC10 (Communication and Collaboration)	
Course Objectives			
The primary objective of this course is to provide students with the applied knowledge and field-computation skills required to measure and interpret surface and subsurface water data. Students will learn to calculate watershed rainfall averages, process hydrograph data, perform basic flood estimation, and evaluate the practical layout and operation of groundwater extraction systems (such as tube wells) to support civil engineering infrastructure.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Analyze various hydrological parameters for surface and sub-surface water flow.	C4 (Cognitive) Analyze	PLO-4 / SA4 (Investigation)
CLO-2	Apply the principles of hydrologic cycle processes, flood estimation, and groundwater flow.	C3 (Cognitive) Apply	PLO-3 / SA3 (Design/development of solutions)
CLO-3	Solve the measured hydrological parameters.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-4	Demonstrate experimental investigations related to various hydrological parameters.	P3 (Psychomotor) Guided Response	PLO-9 / SA9 (Communication)

CLO-5	Contribute actively to experimental work.	A2 (Affective) Responding	PLO-8 / SA8 (Individual and Collaborative Team work)
Course Outline for Theory			
• Introduction: Hydrology, the world's freshwater resources, Hydrologic cycle, Hydrologic equation, Importance and Scope of hydrology, Practical uses of Hydrology. • Hydrologic Processes and their Computation: Wind, Temperature, Relative humidity, Solar radiation, Precipitation, Evaporation, Transpiration, Evapotranspiration, Runoff, and their measurement/estimation. Data networks, Telemetry systems, and Remote sensing. Analysis and application of the Hydrograph and Unit Hydrograph. • Precipitation: Types of Precipitation, Factors Necessary for the Formation of Precipitation, Measurement of Precipitation, Interpretation of Precipitation Data, Computation of Average Rainfall over a Basin. • Runoff & Hydrograph: Factors Affecting Runoff, Estimating the Volume of Storm Runoff, Characteristic of a Hydrograph, Components of a Hydrograph, Hydrograph Separation, Estimating the Volume of Direct Runoff, Introduction to Unit Hydrograph Concept, S-Curve Preparation. • Stream Flow: Water Stage and its Measurement, Selection of Site for Stage Recorder, Selection of Control and Metering Section, Methods of Measurement of Stream Flow, Interpretation of Stream Flow Data. • Floods- Estimation, Routing and Control: Size of floods, Estimation of peak flood, Flood frequency studies, Introduction to Reservoir routing and Channel routing, Methods of flood control, Flood forecasting and warning. • Groundwater and Well Hydraulics: Basic terminology, Types of aquifers, Yield of a well, Well losses, Specific capacity of a well, Interference among wells. • Tube Wells: Types and Parts of tube well, Tube well construction, Comparison of Tube well irrigation and Canal irrigation.			
Lab Work Outline for Practical			
As part of the overall learning requirements, the course will include: 1. To measure daily evaporation using an evaporation pan. 2. To measure daily minimum and maximum temperatures. 3. To measure wind speed and direction using an anemometer and wind vanes. 4. To measure relative humidity. 5. To measure the rainfall depth of a storm event using a non-automatic rain gauge. 6. To obtain a rainfall hyetograph of a storm event using an automatic rain gauge. 7. To study the rainfall-runoff characteristics of a long-duration single-storm rainfall, along with multiple storm rainfalls. 8. To study the effects of reservoir storage on the runoff hydrograph. 9. To study the rainfall-runoff characteristics of an urban catchment. 10. To draw a drawdown curve for a single well in an unconfined aquifer pumping at a constant discharge. 11. To draw a drawdown curve for a single well in a confined aquifer, pumping at a constant discharge.			

12. To observe the drawdown at the observation wells using a water level indicator while investigating the pumping test of a tube well.
13. To measure the cone of depression for a single well in a hydrology and rainfall apparatus.
14. To study the water abstraction from a well in a confined aquifer.
15. To estimate transmissivity and storativity of a confined aquifer.
16. To perform an Open-ended lab.

Recommended Books

1. Bedient, P. B., Huber, W. C., & Vieux, B. E. (2018). *Hydrology and floodplain analysis* (6th ed.). Pearson.
2. Chin, D. A. (2012). *Water-resources engineering* (3rd ed.). Pearson.
3. Chow, V. T., Maidment, D. R., & Mays, L. W. (2013). *Applied hydrology* (2nd ed.). McGraw-Hill.
4. Eslamian, S. (Ed.). (2014). *Handbook of engineering hydrology: Fundamentals and applications*. CRC Press.
5. Linsley, R. K., Kohler, M. A., & Paulhus, J. L. (1982). *Hydrology for engineers* (3rd ed.). McGraw-Hill.
6. Raghunath, H. M. (2006). *Hydrology: Principles, analysis, and design* (2nd ed.). New Age International Publishers.
7. Reddy, P. J. R. (2016). *A textbook of hydrology* (3rd ed.). University Science Press.
8. Subramanya, K. (2020). *Engineering hydrology* (5th ed.). McGraw-Hill.
9. Viessman, W., Jr., & Lewis, G. L. (2002). *Introduction to hydrology* (5th ed.). Pearson.
10. Ward, A. D., Trimble, S. W., Burckhard, S. R., & Lyon, J. G. (2016). *Environmental hydrology* (3rd ed.). CRC Press.

8.31 Computer-Aided Drawing and Building Information Modeling

Course Code and Title: CET-313 Computer-Aided Drawing and Building Information Modeling		Credits Hours: 1+2	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK4 (Engineering specialist knowledge) • SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 9 (Industry, Innovation and Infrastructure) • SDG 11 (Sustainable Cities and Communities) • SDG 12 (Responsible Consumption and Production)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis) • TC6 (Protection of society) • TC10 (Communication and Collaboration)	
Course Objectives			
Upon successful completion of this course, students will be able to develop architectural and structural BIM models using Revit and apply BIM concepts for visualization, documentation, quantity estimation, and project coordination. They will gain practical skills in integrating 3D models with scheduling, costing, and 5D BIM tools to support efficient planning, execution, and management of construction projects.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the underlying principles, frameworks, and process flows of developing basic architectural and structural 3D models.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Apply multidimensional BIM models (up to 5D) to integrate structural designs with project schedules and quantity estimations.	C3 (Cognitive) Apply	PLO-5 / SA5 (Tool Usage)
CLO-3	Replicate standard CAD commands and drafting templates to construct basic building components and geometrical profiles under guided supervision.	P3 (Psychomotor) Guided Response	PLO-5 / SA5 (Tool Usage)
CLO-4	Practice fully detailed architectural and structural drawing sheets—including plans, elevations,	P4 (Psychomotor) Mechanism	PLO-3 / SA3 (Design/development of solutions)

	sections, and reinforcing layouts—using professional digital drafting tools.		
CLO-5	Prioritize professional standards, rigorous clarity, and structural safety awareness when compiling and presenting engineering drawing sheets.	A3 (Affective) Valuing	PLO-9 / SA9 (Communication)

Course Outline for Theory

- **Computer-Aided Drawing using Revit:** Overview of Revit, Core Concepts, Understanding the Process of Developing 3D Architectural and Structural Models in Revit, Different Perspectives of 3D Models.
- **BIM Fundamentals:** BIM Overview; BIM vs. Traditional CAD; Common BIM Terminology; Value of BIM; BIM as a Communication and Collaboration Tool; BIM Benefits; Typical BIM Process; BIM Implementation Needs and Challenges; Discussion on BIM Benefits.
- **BIM Technology:** Phased Structure of a BIM project; Common BIM Applications; Develop understanding of how BIM models are integrated with schedules; Developing Templates for Estimating (5D), Walkthroughs/ Flythroughs/ Animation, Presentation Issues/Rendering.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Orientation to Revit Environment (Architectural Perspective), Starting a Project, and Modeling Basics.
2. Developing a 3D Architectural Model of a unit (80-120 Sq-Yd), including plan, section, and elevation.
3. The following components of Revit are to be covered while developing the 3D Model:
Links: Imports and Groups, Sketch-Based Modeling Components, Stairs and Complex Walls, Visibility and Graphics Controls, Rooms, Schedules and Tags, Annotation and Details, Basics of Families, Sheets, Plotting and Publishing.
4. Developing a 3D Structural Model of a single unit (80-120 sq. yd.), including foundation layout and details, plinth beam layout and details, framing plan, and reinforcement details of slabs and beams.
5. Estimating Quantities of architectural and structural 3D models of a single unit (80-120 Sq-Yd).
6. Development of Schedule and Cost of 80 Sq-Yd House on MS Excel/ MS Project/ Primavera.
7. Integration of Schedule with the Architectural Model of an 80 Sq-Yd House on Navisworks.
8. Developing a 5D Model of an 80 Sq-Yd House.
9. Developing Simulation of 5D BIM Model and Quantization, Pulse Amplitude Modulation, Pulse Position and Pulse width Modulation, Quantization Noise, Signal to Quantization Noise Ratio, Pulse code Modulation, Delta Modulation, Frequency Shift Keying, Phase Shift Keying.
10. Open-Ended Problem.

Recommended Books

1. Autodesk. (n.d.). *Autodesk manual*.
2. Baldwin, M. (n.d.). *Autodesk Revit Structure fundamentals* (Latest ed.). ASCENT—Center for Technical Knowledge.
3. Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (n.d.). *BIM handbook: A guide to building information modeling for owners, designers, engineers, contractors, and facility managers* (Latest ed.). Wiley.
4. Hardin, B., & McCool, D. (n.d.). *BIM and construction management: Proven tools, methods, and workflows* (Latest ed.). Wiley.
5. Watt, S. (n.d.). *Autodesk Revit Architecture Essentials* (Latest ed.). Sybex.

8.32 Irrigation Engineering

Course Code and Title: CET-314 Irrigation Engineering		Credits Hours: 2+1	Prerequisite: CET-217 Fluid Mechanics
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK4 (Engineering specialist knowledge) • SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 6 (Clean Water and Sanitation) • SDG 9 (Industry, Innovation and Infrastructure) • SDG 13 (Climate Action) • SDG 15 (Life on Land)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis) • TC6 (Protection of society) • TC10 (Communication and Collaboration)	
Course Objectives			
After completion of this course students will be able to understand irrigation engineering principles, soil–water–crop relationships, irrigation water requirements, irrigation conveyance systems, canal structures, and sustainable irrigation practices applicable to agricultural and water resources engineering, and develop practical skills in irrigation engineering, including field layout and leveling, irrigation water measurement, construction of outlets and farm gates, installation and operation of sprinkler and drip irrigation systems, and implementation of water conservation technologies in irrigation conveyance systems.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain irrigation concepts, soil-water-crop relationships, and irrigation methods.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze irrigation water requirements, evapotranspiration, and irrigation efficiencies using engineering methods.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Analyze irrigation conveyance systems, canal sections, outlets, and water-distribution arrangements to determine appropriate solutions considering operational, environmental, and sustainability requirements.	C4 (Cognitive) Analyze	PLO-3 / SA3 (Design/development of solutions)

CLO-4	Perform field layout and leveling, irrigation discharge and efficiency measurements, and installation and operation of sprinkler and drip irrigation systems using standard engineering instruments and techniques.	P4 (Psychomotor) Perform	PLO-5 / SA5 (Tool Usage)
CLO-5	Demonstrate commitment to professional and responsible communication in reporting and presenting irrigation engineering information.	A3 (Affective) Valuing	PLO-9 / SA9 (Communication)

Course Outline for Theory

- **Introduction to Irrigation Engineering:** Definition, necessity, scope, benefits, and ill effects of irrigation engineering.
- **Water Requirement of Crops:** Functions of irrigation water, Standards for irrigation water, Duty and delta, relationship between duty and delta, factors affecting and improving duty, classes of soil water, equilibrium points-soil moisture tension, depth of effective root zone, depth and frequency of irrigation, evapotranspiration, estimation of evapotranspiration, irrigation efficiencies, gross irrigation requirements
- **Soil-Water-Crop Relationship:** Soil properties, root zone soil water, crop rotation, irrigation scheduling.
- **Methods of Irrigation:** Surface irrigation, sprinkler irrigation, drip irrigation, pressurized and non-pressurized systems, factors affecting selection of irrigation methods.
- **Diversion Head Works: Weirs and barrages:** Types, components and functions; layout and selection of diversion head works; heFad and cross regulators; canal regulation; silt-control measures; silt excluders and silt ejectors.
- **Canal Irrigation and Lined Channels:** Alluvial and non-alluvial canals; canal alignment and distribution systems; determination of canal capacity; canal losses and seepage control; channel sections for minimum seepage loss; design of irrigation channels using Kennedy's and Lacey's theories; canal lining and types.
- **Canal Structures and Outlets:** Farm outlets, farm gates, outlet characteristics and functions.
- **Water Logging and Salinity:** Causes, effects, reclamation methods, drainage systems
- **Farm Water Management Techniques:** Irrigation scheduling, Land preparation, Water Users Associations, Role of RS & GIS and Smart Automation in irrigation systems.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Field visit and identification of irrigation system components and hydraulic structures.
2. Field layout and leveling exercises using leveling instruments for irrigation fields.
3. Measurement of irrigation water using weirs, flumes, and volumetric methods.
4. Measurement of seepage losses by the ponding method.
5. Measurement of sediment transport in the canals and water courses.
6. Practical layout, alignment, and construction practice demonstration of watercourses
7. Construction practices for farm gates and irrigation outlets.
8. Installation and operation of sprinkler irrigation systems.



Curriculum for Bachelor of Science in Civil Engineering Technology



9. Installation and operation of drip irrigation systems.
10. Measurement of irrigation efficiencies in irrigation channels.
11. Demonstration of water conservation technologies in irrigation conveyance systems.
12. Field exercises related to salinity management and drainage practices.
13. Preparation of field reports, sketches, and technical documentation related to irrigation works.

Recommended Books

1. Ali, I. (2007). *Irrigation and hydraulic structures: Theory, design and practice* (3rd ed.). Allied Book Company.
2. Siddiqui, I. H. (2014). *Irrigation and drainage engineering*. Oxford University Press.
3. Garg, S. K. (2023). *Irrigation Engineering and Hydraulic Structures* (38th rev. ed.). Khanna Publishers.
4. Rao, Y. P., & Bhakar, S. R. (2008). *Irrigation technology*. Agrotech Publishing Academy.
5. Punmia, B. C., Pande, B. B. Lal, Jain, A. K., & Jain, A. K. (2016). *Irrigation and water power engineering* (16th ed.). Laxmi Publications.
6. Ukarande, S. K. (2023). *Irrigation Engineering and Hydraulic Structures*. Springer.

8.33 Water Supply Systems

Course Code and Title: CET-315 Water Supply Systems		Credits Hours: 1+1	Prerequisite: CET-217 Fluid Mechanics
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 3 (Good Health and Well-being) - SDG 6 (Clean Water and Sanitation) - SDG 9 (Industry, Innovation and Infrastructure) - SDG 11 (Sustainable Cities and Communities) - SDG 13 (Climate Action)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC3 (Problem analysis) - TC6 (Modern Tool Usage) - TC10 (Communication and Collaboration)	
Course Objectives			
Upon completion of this course, students will be able to understand water supply engineering principles, estimate water demand, analyze water quality requirements, and apply modern water treatment and distribution techniques to support sustainable water management systems.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain principles of water supply systems, water quality standards, water sources, and sustainable water management practices.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Apply engineering principles for population forecasting, water demand estimation, hydraulic analysis, and water distribution system design.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Analyze water treatment processes, contamination control methods, and modern digital tools used in smart water management systems.	C4 (Cognitive) Analyze	PLO-3 / SA3 (Design/development of solutions)
CLO-4	Perform laboratory experiments for water quality analysis, water treatment evaluation, and hydraulic analysis using standard methods, instruments, and software tools, such as EPANET and GIS.	P4 (Psychomotor) Mechanism	PLO-4 / SA4 (Investigation)
CLO-5	Interpret experimental results and prepare technical reports related to water treatment and water distribution systems.	A2 (Affective) Responding	PLO-9 / SA9 (Communication)

Course Outline for Theory

- **Introduction to Water Supply Engineering:** Importance of safe and reliable water supply systems for public health and community development; Waterborne diseases and their impacts on human health; WHO and Pakistan drinking water quality standards and guidelines; Principles of sustainable water management and conservation practices.
- **Sources of Water:** Surface water sources, including rivers, lakes, reservoirs, canals, seas, and oceans; Groundwater sources, including wells and tube wells; Rainwater harvesting techniques and applications; Selection criteria of water sources based on quality, quantity, reliability, and sustainability.
- **Water Demand and Population Forecasting:** Per capita water demand and consumption patterns; estimation of fire demand and emergency requirements; Variations in water demand and peak demand factors; Population forecasting methods for future water supply planning; Non-Revenue Water (NRW), water losses, and reduction techniques.
- **Water Treatment:** Principles of coagulation and flocculation processes; Sedimentation and clarification methods (Including traditional sedimentation tanks, Lovo tanks, Plate/tube settlers), Filtration techniques for water purification; Disinfection methods and safe drinking water standards; Emerging contaminants and modern treatment approaches.
- **Water Distribution Systems:** Components and layouts of pipe network systems; Basic hydraulic principles of water distribution; Reservoirs, pumping stations, and storage systems; Functions of valves, hydrants, and appurtenances; Leak detection methods and NRW reduction strategies; Smart metering systems and efficient water management.
- **Digital and Smart Water Systems:** Introduction to EPANET software for hydraulic analysis; overview of SCADA systems in water supply management; GIS applications in water distribution mapping and monitoring; Smart water management systems and digital monitoring technologies.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Determination of pH of water sample using a digital pH meter.
2. Determination of residual chlorine and chlorine dosage calculation.
3. Determination of optimum coagulant dosage using a Jar Test apparatus.
4. Determination of total hardness of water using the EDTA titration method.
5. Determination of alkalinity and chloride concentration of the water sample.
6. Determination of iron concentration in water.
7. Determination of nitrate concentration in water.
8. Study of valves, hydrants, meters, and other appurtenances used in water distribution systems.
9. Study of pipe materials, joints, fittings, and service connections used in water supply networks.
10. Hydraulic analysis and simulation of a water distribution network using EPANET software.
11. GIS-based mapping and analysis of a water distribution system.
12. Design and perform an open-ended laboratory investigation addressing a broadly-defined water supply engineering problem using appropriate engineering tools and techniques.
13. Study visit to a water treatment plant and water supply distribution facility with submission of a technical report.



Curriculum for
Bachelor of Science in Civil Engineering Technology



Recommended Books

1. Davis, M. L. (2021). *Water and wastewater engineering: Design principles and practice*. McGraw-Hill Education.
2. Hammer, M. J., & Hammer, M. J., Jr. (2012). *Water and wastewater technology* (7th ed.). Pearson Education.
3. Mays, L. W. (2000). *Water distribution systems handbook*. McGraw-Hill.
4. Nathanson, J. A. (2021). *Basic environmental technology: Water supply, waste management, and pollution control* (7th ed.). Pearson Education.
5. Rangwala, S. C. (2022). *Water supply and sanitary engineering* (35th ed.). Charotar Publishing House.
6. Steel, E. W., & McGhee, T. J. (1991). *Water supply and sewerage*. McGraw-Hill.

8.34 Occupational Health and Safety Management

Course Code and Title: CET-316 Occupational Health and Safety Management		Credits Hours: 1+0	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 6 (Clean Water and Sanitation) • SDG 9 (Industry, Innovation and Infrastructure) • SDG 11 (Sustainable Cities and Communities) • SDG 13 (Climate Action)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
This course provides Civil Engineering Technology students with knowledge of construction safety laws, hazards, and risk management in accordance with OSHA 1926, ISO 45001, and PEC Guidelines. It focuses on developing site safety plans, conducting HIRA/JSA, inspections, and ensuring safe operation of equipment and PPE. Students will learn accident investigation, emergency response, and techniques to promote a safety-first culture on projects. By the end, graduates will be able to manage OHS compliance and lead safety initiatives on construction sites.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Identify construction hazards and apply safety rules, risk assessment, and control measures in accordance with OSHA, ISO 45001, and PEC standards.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Develop safety plans, conduct site inspections, and lead accident investigations to ensure a safe and compliant construction site.	C4 (Cognitive) Investigate	PLO-4 / SA 4 (Investigation)
CLO-3	Promote a safety culture by training workers, monitoring safety KPIs, and ensuring continuous improvement to achieve zero accidents on-site.	C3 (Affective) Promote	PLO-11 / SA-11 (Lifelong Learning)
Course Outline for Theory			
• Construction Safety: Safety and Health in the local and International Construction Industries, OSHA in the USA, Construction industry hazards and statistics in Pakistan, Legal framework: Factories Act, PEC			

Guidelines, OSHA 1926, ISO 45001. Types of construction hazards. Roles of Construction Personnel in Safety, Overview of Cost of Accidents, Overview of Accident Causation Theories, Ethics and Safety, Insurance and Safety, Compliance with Safety Standards.

- **Safety Application on the Job:** Construction Safety & Health Program, Plans and Policies, Components of the Plan, Roles, Safety Rules and Regulations, Example of Safe Work Procedures, Job site Inspections and check list, Safe operation and inspection of Cranes, Excavators, Dampers, Safety signs and color coding, Safety KPIs for Projects, Internal audit and compliance audit, Risk Assessment, HIRA, JSA for civil activities, Accident Prevention, Medical and First Aid Facilities and Services, Protection of the General Public, Fire Protection, Substance Abuse, Personal Protective Equipment, Site Safety and Hazard Analysis, Safety Communications, Accident Reporting and Investigation, Recording Injuries and Illnesses, Training, Emergency Response.
- **Strategic Safety Improvement:** Promoting Safety by Example, Employee Participation in Promoting Safety, Safety Training, Safety Committees, Employee and Management Participation, Incentives, Teamwork Approach to Promoting Safety, Establishing a Safety-First Corporate Culture, Total Safety and its Components, a Brief Discussion of Zero Accident Strategies, Continuous Safety Improvement.
- **Safety Management Techniques:** Accident prevention, health and safety policy, safe systems of work, first aid provisions, health and safety training, spill response protocols, accident investigation, recording and analysis, communicating safety measures, techniques of inspection, Health and safety regulations at the workplace.

Recommended Books

1. Construction Industry Research and Information Association. (n.d.). *A guide to the control of substances hazardous to health in design and construction* (CIRIA Report 125, Latest ed.). Thomas Telford Publications.
2. Friend, M. A. (n.d.). *Fundamentals of occupational safety and health*.
3. Reese, C. D., & Eidson, J. V. (n.d.). *Handbook of OSHA construction safety and health*

8.35 Quantity Surveying and Estimation

Course Code and Title: CET-321 Quantity Surveying and Estimation		Credits Hours: 1+1	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 9 (Industry, Innovation and Infrastructure) • SDG 11 (Sustainable Cities and Communities) • SDG 12 (Responsible Consumption and Production)		Professional Competence Profile: • TC3 (Problem analysis) • TC4 (Design and development of solutions) • TC6 (Modern Tool Usage)	
Course Objectives			
Upon successful completion of this course, students will be able to perform quantity take-off, rate analysis, and cost estimation for civil engineering projects. They will develop practical skills in preparing bills of quantities and estimates using standard methods and computer-based tools.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the principles of quantity surveying, rate analysis, and cost estimation for civil engineering works.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Apply standard methods to compute material quantities and prepare bills of quantities and cost estimates for civil engineering projects.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Prepare and develop detailed estimates and bills of quantities for buildings, roads, water supply, drainage, and other civil engineering works using spreadsheets.	P4 (Psychomotor) Perform	PLO-5 / SA5 (Tool Usage)
CLO-4	Demonstrate accuracy, teamwork, and professional responsibility in preparing engineering estimates and technical documentation.	A3 (Affective) Value	PLO-10 / SA10 (Project Management and Finance)
Course Outline for Theory			
• Material Quantities Take-off: Working out earthwork quantities for various civil engineering			

constructions. Calculating quantities for road embankments in plain and hilly areas and for irrigation channels. Quantities for roads, buildings, reservoirs, water supply, drainage projects, steel works, and bridge construction. Estimates using computer spreadsheets.

- **Rate Analysis:** Scheduled and non-scheduled rates. Analysis of rates, abstract of costs. Significance of rate analysis and its application to market rates of material and labor. Rate analysis for various items of civil engineering works.
- **Cost Estimates:** Systematic and logical approach to the estimating and costing of civil engineering works, rough cost & detailed estimates, bill of quantities, and part bills for construction, costs, and profit margins to be considered in the cost estimates. Estimates for roads, buildings, reservoirs, water supply, drainage projects, steel works, and bridge construction. Estimates using computer spreadsheets

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Work out quantities for earthwork for site-grading and leveling using the geometric cross-sectional/grid method.
2. Workout quantities for mass excavation for a raft footing,
3. Prepare a measurement sheet (MS) for 1:2:4 concrete for the substructure of a building (Foundations, columns below plinth, and plinth beams)
4. Prepare Measurement Sheet (MS) for 1:2:4 concrete for columns above plinth roof beams, roof slabs, and projections.
5. Prepare Bar Bending Schedule (BBS) for single-span and multi-span beam reinforcement from the given drawing.
6. Work out the quantities of slab reinforcement from the given drawing.
7. Work out the quantities of overhead water tank, concrete, and its reinforcement.
8. Work out the quantities of RCC retaining wall concrete and its reinforcement.
9. Prepare a material estimate for a single room, complete in all respects.
10. Prepare the material list of a steel truss.
11. Prepare a material list for a metal frame structure (low-rise).
12. Prepare a detailed estimate of an RCC water overhead reservoir of 20,000-gallon capacity.
13. Prepare a detailed estimate of a manhole.
14. Prepare a detailed estimate of a septic tank and soakage pit.
15. Prepare a bill of quantities and an abstract of cost for a manhole and septic tank.
16. Estimate the quantities of all necessary items of work required for a 1500 ft long bituminous road.
17. Estimate the cost of construction of a concrete road 24'-6" wide and one mile long for a given section. The concrete will have a 1:3:6 proportion, and 0.5% reinforcement is to be used.
18. Calculate the volume of earthwork from the contour map.
19. Calculate the volume of earth work for an irrigation channel (i) fully in cutting (ii) partially in cutting and filling.

Recommended Books

1. Hughes, A., & Drury, B. (n.d.). *Electric motors and drives* (Latest ed.).
2. Sarkar, B. N. (n.d.). *Fundamentals of industrial drives* (Latest ed.).
3. Siemens & Mitsubishi Electric. (n.d.). *PLC manuals* (Latest ed.).

8.36 Maintenance and Repair of Civil Works

Course Code and Title: CET-322 Maintenance and Repair of Civil Works		Credits Hours: 1+0	Prerequisite: None
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 6 (Clean Water and Sanitation) - SDG 9 (Industry, Innovation and Infrastructure) - SDG 11 (Sustainable Cities and Communities) - SDG 13 (Climate Action)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC2 (Comprehend and apply local knowledge) - TC3 (Problem analysis) - TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
This course is designed to equip students with the knowledge and skills required to repair, rehabilitate, and maintain buildings, roads, bridges, and hydraulic structures. It covers causes of deterioration, distress assessment, and application of repair and rehabilitation techniques. The course also focuses on planning preventive and corrective maintenance in accordance with standard codes to ensure structural safety and service life.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Understand maintenance principles and causes of deterioration in structures.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Investigate and assess structural defects using visual inspection and NDT.	C4 (Cognitive) Investigate	PLO-4 / SA 4 (Investigation)
CLO-3	Apply appropriate repair, rehabilitation, and maintenance strategies for structures in accordance with applicable codes and standards.	C3 (Cognitive) Apply	PLO-6 / SA-6 (The Engineering Technologist and the World)
Course Outline for Theory			
Introduction and Principles of Maintenance: Importance, objectives, and economic significance of			

regular upkeep. Types of Maintenance: Preventive, corrective, routine, and emergency maintenance strategies. factors influencing the repair and maintenance.

- **Factors Causing Deterioration (Sources, Causes, Effects):** Definition of deterioration/decay, Factors causing deterioration, their classification, Effects of various agencies of deterioration (Effects of moisture, thermal movements, weathering, chemical attack, and biological growth) on various construction materials, i.e., bricks, timber, concrete, paints, metals, plastics, stones.
- **Investigation and Distress Assessment:** Systematic approach/procedure of investigation, Visual inspection, and identification of structural defects (cracks, spalling, dampness, corrosion). Non-Destructive Testing (NDT), rebound hammer, ultrasonic pulse velocity, half-cell potential, and core sampling. Diagnose other parameters, such as tracing root causes like faulty workmanship, substandard materials, or structural overloading.
- **Material and Crack Repair Techniques:** Repair Materials, Polymers, epoxy resins, polymer-modified mortars, grouts, and acrylic sealants. Crack Repair Methods: Epoxy injection, routing and sealing, stitching, grouting, and guniting/shotcreting. Corrosion Protection: cleaning corroded rebar, applying passivating coatings.
- **Building Repair:** Day-to-day repairs, Special Repairs. Additions, Alterations, and Preventive Maintenance.
- **Structural Rehabilitation and Retrofitting:** Strengthening Methods, Concrete jacketing of beams and columns, supplementary members, and section enlargement. Foundation Remediation, underpinning, shoring, propping, and stabilization of sinking or settling structures. Waterproofing, Roof leak treatments, damp-proofing membrane installations, Concrete Stitching, Resin Injections. Dry packing. and joint sealant replacement.
- **Roads and Bridges maintenance:** Types of roads and bridges. Flexible and Rigid Pavement Defects. The Need for Regular Maintenance. Preventive, corrective, routine, and periodic maintenance. Identification of road damage. functional concrete pavement repair (CPR), structural CPR, remove and replace. Common failures in bridges include deck cracking, bearing failure, scour, and rebar corrosion. Identification by rebound hammer, ultrasonic, and corrosion testing. Concrete repair: epoxy injection, jacketing, fiber wrapping. Steel bridge repair, welding, bolting, painting systems, bearing replacement, and expansion joint repair. Underpinning and strengthening techniques according to AASHTO and NHA.
- **Hydraulic Structures maintenance:** Types of hydraulic structures and common failures. Active and passive cracks, sagging of members, swelling of concrete, discoloration, white/brown patches, spalling of concrete, exposure of bars, and erosion of the surface. Causes of Deterioration for Hydraulic Structures: Scour, cavitation, corrosion, seepage, siltation, and earthquakes. Selection of repair technique based on factors such as type and extent of damage, environmental conditions, load intensity, accessibility, time constraints, availability of experienced agency, etc. Repair techniques: patching, Grouting, shotcrete, epoxy injection, underpinning, providing waterproof barriers, and surface protection. Strengthening of dams, canal lining repair, gate repair, and emergency repairs during floods.

Recommended Books

1. American Association of State Highway and Transportation Officials. (n.d.). *AASHTO guide for design of pavement structures*.



Curriculum for
Bachelor of Science in Civil Engineering Technology



2. Gahlot, P. S., & Sharma, S. (n.d.). *Building defects and maintenance management*. CBS Publishers.
3. Karbhari, V. M., & Ansari, F. (Eds.). (n.d.). *Structural health monitoring of civil infrastructure systems*. Woodhead Publishing.
4. National Highway Authority. (n.d.). *NHA maintenance manual*.
5. Nayak, B. S. (n.d.). *Maintenance engineering for civil engineers*. Khanna Publishers.
6. Varghese, P. C. (n.d.). *Maintenance, repair & rehabilitation and minor works of buildings*.
7. Lee, H. S., & George, C. S. (1993). *Building maintenance technology*.

8.37 Geotechnical Investigation and Foundations

Course Code and Title: CET-323 Geotechnical Investigation and Foundations		Credits Hours: 1+1	Prerequisite: Soil Mechanics
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK8 (Engagement with the current technological literature)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 9 (Industry, Innovation and Infrastructure) - SDG 11 (Sustainable Cities and Communities) - SDG 13 (Climate Action)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC2 (Comprehend and apply local knowledge) - TC3 (Problem analysis) - TC5 (Evaluation) - TC10 (Communication and Collaboration)	
Course Objectives			
This course provides technologists with practical knowledge of geotechnical site investigation, subsurface exploration, soil compaction, and foundation engineering. It develops skills in field and laboratory testing and interpretation of geotechnical data for civil engineering projects.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Interpret various problems related to soil compaction and foundation.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Apply geotechnical site investigation and subsurface exploration techniques.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform various experiments to determine the geotechnical properties of soil.	P4 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-4	Demonstrate responsibility and teamwork during soil mechanics laboratory activities.	A3 (Affective) Adopt	PLO-8 / SA8 (Individual and Collaborative Team work)

Course Outline for Theory	
• Site Investigation: Purpose and scope of site investigation, importance in civil engineering projects, stages of site investigation, desk studies, and reconnaissance surveys. • Subsurface Soil Exploration: Importance of soil exploration and planning of soil exploration program, Soil exploration methods: probing, test pits, auger boring, wash percussion, and rotary drilling, and geophysical methods, Soil samplers, Disturbed and undisturbed sampling, In situ tests: standard penetration test, cone penetration test, and field vane shear test, Coring of rocks, Core recovery and RQD. Borehole logs. • Compaction: Definition, Moisture-Density relationship, Laboratory compaction methods: standard and modified Proctor tests, Factors affecting compaction, Compaction in the field, field compaction equipment and machinery, field control and measurements of in-situ density. • Introduction to Foundations: Purpose and functions of foundations, types of foundations, Types of bearing capacities of foundations, Gross and net pressures on footing, Plate load test, Pile load test.	
Lab Work Outline for Practical	
As part of the overall learning requirements, the course will include: 1. To determine the moisture-density relationship by the Standard Proctor Test. 2. To determine the moisture-density relationship by the Modified Proctor Test. 3. To determine the CBR value for an unsoaked soil sample. 4. To determine the CBR value for the soaked soil sample. 5. To determine the field density by the Core Cutter Method. 6. To determine the field density by the Sand Replacement (Sand Cone) Method and/or by the Water Replacement/Oil Replacement Method. 7. To determine the field density using Ground Penetrating Radar (GPR). 8. To determine load settlement behavior by Plate Load Test. 9. To perform the Standard Penetration Test (SPT). 10. To collect UDS from clayey Strata. 11. To prepare a lab test specimen from UDS. 12. To observe percussion drilling Procedures in the field. 13. To observe rotary drilling in the field. 14. To observe the pile load test and analyze the result. 15. To perform the open-ended lab.	
Recommended Books	
1. Das, B. M. (n.d.). <i>Foundation engineering</i> (Latest ed.). 2. Das, B. M. (n.d.). <i>Principles of geotechnical engineering</i> (Latest ed.). 3. Fratta, D., Aguetant, J., & Roussel-Smith, L. (n.d.). <i>Introduction to soil mechanics laboratory testing</i> (Latest ed.). 4. Holtz, R. D., Kovacs, W. D., & Sheahan, T. C. (n.d.). <i>An introduction to geotechnical engineering</i> (Latest ed.). 5. Kalinski, M. E. (n.d.). <i>Soil mechanics lab manual</i> (Latest ed.). 6. Qureshi, M. S., & Akbar, A. (n.d.). <i>Fundamentals of soil mechanics</i> (Latest ed.). 7. Smith, J. (n.d.). <i>Elements of soil mechanics</i> (Latest ed.).	

8.38 GIS and Remote Sensing

Course Code and Title: IDS-324 GIS and Remote Sensing		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 9 (Industry, Innovation and Infrastructure) - SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: - TC6 (Protection of society) - TC11 (Continuing Professional Development and Lifelong learning)	
Course Objectives			
To introduce students to the fundamentals of Geographic Information Systems (GIS) and Remote Sensing, including spatial data acquisition, analysis, mapping, and GPS, enabling them to apply geospatial technologies to engineering and infrastructure-related problems.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the basics of geographic information systems (GIS) for acquiring data to be used in different fields.	C2 (Cognitive) Understand	PLO-1 / SA 1 (Engineering Knowledge)
CLO-2	Analyze coordinate systems and referencing positioning systems using GIS and Remote Sensing, respectively.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Practice the use of Conventional and Advanced Surveying tools for acquiring data.	P4 (Psychomotor) (Mechanism)	PLO-5 / SA5 (Tool Usage)
Course Outline for Theory			
Site Investigation: Purpose and scope of site investigation, importance in civil engineering projects, stages of site investigation, desk studies, and reconnaissance surveys. Introduction to Geo Informatics and Resources of information: Photogrammetry, Satellite System, Aerial and Satellite Photogrammetry, Google Earth, Geographic Information System (GIS). Fundamentals of GIS: Spatial Data Types and acquiring considerations, Data Models and Structures, Coordinate System and Datum, Map projection and their transformation, Attribute-based operation, Introduction to Spatial Analysis. Remote Sensing (RS): Basic Concept, Physical basis of Remote Sensing, Earth Resources Satellites/			



Curriculum for Bachelor of Science in Civil Engineering Technology



Platform, Sensors and Types of Resolution, Geo-referencing, Image Processing Techniques and Classification, Introduction to Global Positioning System.

- **Global Positioning System (GPS):** Navigational Satellites, Positioning Systems (GLONASS, GPS & Galileo, Fundamentals and Elements of GPS, System Operation & Characteristics, Errors and Atmospheric Effects, Differential GPS (DGPS).
- **Field and Laboratory Work with Software:** Training on GPS instrument-based surveys, integration of GPS data in GIS, Exercises on Image processing software and recent GIS software, demonstration of RS/GIS applications in engineering disciplines.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. To practice GIS and Image Processing Software (e.g., ERDAS Imagine, ENVI, Orfeo Toolbox, ArcGIS) using collected data.
2. To plot a geographic grid on graph paper from collected data (manual).
3. To survey a geographic area by using a handheld GPS device.
4. Practice creating shape files and spatial database files from available data.
5. Use layer stacking and image mosaicking in remote sensing software.
6. Image classification (Supervised & Unsupervised) supports vector machine and neural network.
7. Indices Development: NDVI, NDWI, NDSI, Leaf Area Index in ERDAS Imagine, ENVI, MATLAB, etc.

Recommended Books

1. Campbell, J. B. (2011). *Introduction to remote sensing* (5th ed.). Guilford Press.
2. Gibson, P. J. (2000). *Introductory remote sensing: Principles and concepts*. Routledge.
3. Law, M., & Collins, A. (2013). *Getting to know ArcGIS for desktop* (3rd ed.). Esri Press.
4. Lillesand, T. M., & Kiefer, R. W. (2010). *Remote sensing and image interpretation* (6th ed.). John Wiley & Sons.
5. Weng, Q. (2012). *An introduction to contemporary remote sensing*. McGraw-Hill.

8.39 AI in Civil Engineering Technology

Course Code and Title: IDS-325 AI in Civil Engineering Technology		Credits Hours: 1+2	Prerequisite: Basic Computer Literacy (e.g., ICT)
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 4 (Quality Education) - SDG 9 (Industry, Innovation and Infrastructure)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC2 (Comprehend and apply local knowledge) - TC3 (Problem analysis) - TC5 (Evaluation) - TC10 (Communication and Collaboration)	
Course Objectives			
After completion of this course, students will be able to explain the fundamental concepts, techniques, and applications of Artificial Intelligence in engineering and professional environments; differentiate between various AI tools and approaches and their appropriate use in engineering problem-solving and decision-making; and discuss the ethical implications, limitations, and responsible use of AI technologies in professional engineering practice.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain fundamental AI concepts and applications in engineering.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze AI outputs for reliability, accuracy, and limitations.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Operate AI tools and develop effective prompts to perform civil engineering tasks and solve engineering problems.	P4 (Psychomotor) Mechanism	PLO-3 / SA3 (Design/development of solutions)
CLO-4	Validate AI-generated engineering outputs using authentic sources, relevant engineering standards, and technical documentation practices.	P4 (Psychomotor) Mechanism	PLO-4 / SA4 (Investigation)

CLO-5	Demonstrate ethical and responsible use of AI technologies.	A3 (Affective) Valuing	PLO-7 / SA7 (Ethics)
Course Outline for Theory			
• AI Foundations and Scope: Definition and scope of AI; AI in everyday and professional life; brief history and evolution; AI vs automation vs analytics; AI vs ML vs deep learning vs generative AI; current AI landscape; examples across health, business, engineering, education, and governance. • How AI Systems Work: Data and patterns; structured vs unstructured data; training vs inference; rule-based systems vs machine learning; supervised and unsupervised learning as concepts; deep learning overview; NLP, computer vision, recommender systems, and large language models at a conceptual level; why outputs can be wrong; role of data quality and context. • Working Effectively with AI Tools: Categories of AI tools; general-purpose AI assistants; AI in office/productivity workflows; AI for brainstorming, outlining, summarizing, drafting, rewriting, translation, presentations, spreadsheets, meeting notes, and study support; prompt design fundamentals; context, constraints, examples, iteration, output formatting, and multimodal interaction. • Critical, Ethical and Responsible Use of AI: Focuses on assessing AI outputs for hallucinations, fabricated citations, bias, and gaps in accuracy or completeness. Covers verification methods such as source triangulation, fact-checking, and comparison with authoritative sources. Emphasizes ethical considerations, human-in-the-loop review, limitations of AI use, and understanding the difference between confidence and reliability. • Discipline-Specific AI Applications: AI for structural health monitoring (SHM), Load and failure prediction using ML models, Smart traffic signal control systems, Road safety analysis using accident data, Soil classification using ML, Air and water quality prediction, Flood prediction and risk assessment, Project scheduling and cost estimation using AI, Rainfall-runoff modeling, Role of engineers in validating AI outputs, Data analysis (Excel + AI tools for hydrological data), Report writing and technical documentation, Visualization (graphs, charts, maps), Transparency and accountability in AI-assisted decisions.			
Lab Work Outline for Practical			
As part of the overall learning requirements, the course will include: 1. Introduction to AI tools and interfaces for engineering applications. 2. AI use-case identification for Civil Engineering Technology specializations. 3. Prompt engineering and prompt refinement exercises. 4. AI-assisted technical report writing and summarization. 5. AI-assisted spreadsheet analysis and visualization. 6. Verification and fact-checking of AI-generated outputs. 7. AI-generated calculations and validation using engineering standards and codes. 8. AI-assisted technical presentation preparation. 9. Specialization-Based Independent Lab Tasks. 10. Use AI tools for SHM, load prediction, crack detection, and structural calculations. 11. Apply AI for soil classification, bearing capacity estimation, and settlement analysis.			

12. Use AI for traffic analysis, accident interpretation, and road safety assessment.
13. Apply AI for rainfall-runoff modeling, flood prediction, and irrigation planning.
14. Use AI for air and water quality prediction and pollution analysis.
15. Apply AI for scheduling, cost estimation, and resource management.
16. Use AI-assisted GIS tools for terrain and spatial data analysis.
17. Apply AI for concrete mix optimization and durability prediction.
18. Final Integrated Mini Project/Open-Ended Lab.
19. Students shall complete one discipline-specific AI-assisted engineering mini-project, including prompt development, data interpretation, verification of AI outputs, technical report preparation, presentation, and viva.

Recommended Books

1. Jurafsky, D., & Martin, J. H. (2025). *Speech and language processing: An introduction to natural language processing, computational linguistics, and speech recognition* (3rd ed., draft).
2. Luger, G. F. (2008). *Artificial intelligence: Structures and strategies for complex problem solving* (6th ed.). Pearson Education.
3. McKinney, W. (2022). *Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter* (3rd ed.). O'Reilly Media.
4. Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.

8.40 Construction Project Administration

Course Code and Title: CET- 326 Construction Project Administration		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 8 (Decent Work and Economic Growth) • SDG 9 (Industry, Innovation and Infrastructure) • SDG 12 (Responsible Consumption and Production)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis) • TC5 (Evaluation) • TC10 (Communication and Collaboration)	
Course Objectives			
After completing this course, students will be able to understand and analyze construction planning variables, project constraints, resource management strategies, and value engineering practices, and validate project management concepts through real-time site operations and the interpretation of comprehensive project management plans.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Understand the principles of construction project administration, project documentation systems, relevant building codes and bylaws, and the roles of stakeholders involved in construction projects.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze and propose comprehensive project administration solutions by integrating planning variables, scheduling methodologies, project constraints, and resource optimization strategies.	C4 (Cognitive) Evaluate	PLO-3 / SA3 (Design/development of solutions)
CLO-3	Develop, apply, and evaluate project administration tools, safety plans, quality-control documentation, and closeout practices using industry-standard software and in field scenarios.	P4 (Psychomotor) Mechanism	PLO-5 / SA5 (Tool Usage)

CLO-4	Demonstrate effective communication and presentation skills in reporting construction project progress, safety observations, quality issues, and project administration outcomes.	A2 (Affective) Responding	PLO-9 / SA9 Communication
Course Outline for Theory			
• Introduction to Construction Project Administration: Overview of Construction Project Administration vs Management, Project Life Cycle Phases, Roles and Responsibilities of Project Stakeholders, Project Delivery Systems, Construction Team Coordination Matrices, Fundamentals of Site Administration and Professional Ethics, and Introduction to Construction Documentation and Digital Communication Systems. • Documentation and Record Keeping at Jobsite: Importance of Construction Documentation, Types of Project Records, Daily Site Reports, Diaries and Logs, Event and Conversation Documentation, Progress Reports, Inspection Reports, Accident and Incident Reports, Correspondence Management, Requests for Information (RFIs), Change Order Logs, Material Delivery and Equipment Utilization Records, Digital Documentation Systems, Progress Photographs, Video Recording and Time-Lapse Photography, Contractual Requirements for Documentation and Record Retention. • Submittals, Samples and Execution Drawings: Types and Purposes of Submittals, Shop and Execution Drawings, Material Samples and Product Data Sheets, Procurement Schedules, Review and Approval Procedures, Coordination between Consultants and Contractors, Submittals, and Building Information Modeling (BIM) Applications in Submittal Management. • Introduction to Regulatory Frameworks: Purpose, evolution, and legal status of building codes in construction project execution. Administrative hierarchy and regional adaptation of model codes, focusing on the integration of the International Building Code (IBC) and the Building Code of Pakistan (BCP) with localized municipal bylaws. Structure and application of standard reference specifications and design guidelines (such as ASCE, ACI, and AASHTO) to verify project compliance. Administrative procedures for code-based document routing, managing structural variances, and ensuring code updates are maintained throughout the jobsite drawing office. • Jobsite Layout and Organizing: Principles of Jobsite Planning, Site Constraints and Operational Challenges, Material Handling, Laydown Areas and Storage, Equipment Allocation and Tower Crane Constraints, Temporary Facilities and Utilities Planning, Spatial Layout and Labor Productivity Considerations, Access Roads and Traffic Management, Jobsite Offices, Site Security and Perimeter Control, Barricades and Safety Signage, Waste Handling Areas, Efficient Site Layout Planning and Optimization. • Planning and Scheduling for Construction: Construction Planning Fundamentals, Work Breakdown Structure (WBS) Development, Scheduling Methods, Bar Charts, CPM and Network Diagrams, Resource Planning, Loading, and Allocation, Monitoring and Updating Schedules, Integration of Cost and Time Control, Selection and Use of Scheduling Software (Primavera P6/MS Project), Introduction to Lean Construction and BIM-Based Planning Systems. • Site Administration and Coordination: Project Meetings, Toolbox Talks, and Reporting Systems; Coordination of Construction Activities; Sequencing of Site Operations; Communication with Stakeholders; Site Supervision Practices; Field Testing and Inspection Requirements; and Handling Defective and Non-Conforming Work.			

- **Jobsite Quality and Code Basics:** Following standard site inspection checklists, checking daily field quality, implementing Quality Assurance and Quality Control (QA/QC) procedures, and using simple electronic file-naming and folder-organization rules for local municipal approvals (such as CDA, LDA, or KDA bylaws). Construction Waste Management; Environmental Protection Measures; Dust, Noise, and Mud Control; Erosion Control; Protection of Installed Work; Productivity Monitoring; and Site Ethics.
- **Construction Safety Management:** Construction Safety and Health Programs (OSHA/Regional Compliance), Safety Policies and Procedures, Jobsite Safety Planning, Hazard Identification and Risk Assessment (HIRA), Job Hazard Analysis (JHA), Personal Protective Equipment (PPE) Protocols. Handling Site Inspections: Steps for dealing with external safety or government inspectors at the site, presenting the required safety records, and correcting basic field safety mistakes. Dealing with everyday site disagreements professionally and writing basic accident or incident reports. Safety Audits and Inspections, Safe Work Practices, Accident Prevention and Investigation Reporting, Emergency Response Planning, Safety Communication and Training.
- **Jobsite Risk Management:** Understanding construction site risks (delays, weather, material damage, and subcontractor failures, etc.). Steps to identify everyday hazards, complete a standard jobsite Risk Register, and implement simple risk-tracking tools. Basic methods to minimize risk impacts, including coordinating safety buffers, following site insurance protocols, and escalating critical field issues to senior project managers.
- **Resource and Cost Administration:** Management of Labor, Materials, and Equipment Resources, Productivity and Production Rate Analysis, Cost Documentation and Reporting, Resource Loading and Leveling in Schedules, Measurement and Payment Procedures (Interim Certificates), Change Orders and Claims Administration, Introduction to Value Engineering and Cost Optimization Practices.
- **Project Closeout and Handover:** Project Completion Procedures, Punch Lists and Deficiency Management, Substantial and Final Completion Milestones, Preparation of As-Built Drawings, Testing and Commissioning Documentation, Financial Closure and Release of Liens/Retention, Final Reports and Handover Procedures, Post-Construction Evaluation and Lessons Learned.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Review and verify standard construction drawings and submittals against local (PBC) or international (IBC) building codes, including checks of general dimensioning rules and layout boundary setbacks.
2. Develop and organize daily construction reports, site diaries, and field logs using clear digital folder structures and standardized file-naming conventions.
3. Complete and maintain basic safety documents, including standard incident reports, minor accident forms, and daily hazard check logs.
4. Collect and organize project site photos, field video records, and progress-tracking files with clear digital labels.
5. Draw and plan a basic job site layout map to arrange safe material storage areas, simple site offices, and clear equipment placement.
6. Complete and record standard site quality-control checklists, field-test records, and routine inspection paperwork.
7. Prepare and practice daily job-site safety plans, Job Hazard Analysis (JHA) lists, and proper Personal



Curriculum for Bachelor of Science in Civil Engineering Technology



Protective Equipment (PPE) site checklists.

8. Identify and document basic job site risks by creating a simple project Risk Register matrix (tracking risk description, low/medium/high impact ratings, and corrective field actions) using a standard spreadsheet template.
9. Develop and update basic bar charts, simple Critical Path Method (CPM) networks, and straightforward progress curves using project scheduling software (e.g., Primavera P6 or MS Project).

Recommended Books

1. Fisk, E. R., & Reynolds, W. D. (2013). *Construction project administration* (10th ed.). Pearson.
2. Mincks, W. R., & Johnston, H. (2025). *Construction jobsite management* (5th ed.). Cengage Learning.
3. Ministry of Housing and Works, Government of Pakistan. (2011). *Building Code of Pakistan (BCP): Energy provisions* (S.R.O. 249(I)/2011).
4. Ministry of Housing and Works, Government of Pakistan. (2016). *Building Code of Pakistan (BCP): Fire safety provisions* (S.R.O. 1073(I)/2016).
5. Ministry of Water and Power & Ministry of Information Technology, Government of Pakistan. (2014). *Pakistan Electric & Telecommunication Safety Code (PETSAC)* (S.R.O. 716(I) & 717(I)/2014).
6. Mubarak, S. A. (2025). *Construction project scheduling and control* (5th ed.). Wiley.
7. Project Management Institute. (2025). *A guide to the project management body of knowledge (PMBOK guide)* (8th ed.).
8. Sears, S. K., Sears, G. A., Clough, R. H., Rounds, J. L., & Segner, R. O. (2015). *Construction project management: A practical guide to field construction management* (6th ed.). Wiley.

8.41 Digital Engineering Tools

Course Code and Title: CET-411 Digital Engineering Tools		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 8 (Decent Work and Economic Growth) - SDG 9 (Industry, Innovation, and Infrastructure) - SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: TC5 (Evaluation)	
Course Objectives			
The course aims to develop understanding and application of digital assessment tools for safe, sustainable, and efficient analysis, design, monitoring, and management of civil engineering projects.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain principles and applications of digital assessment tools used in civil engineering projects.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Apply BIM, GIS, remote sensing, and related digital tools for assessment and analysis of engineering structures and construction activities.	C3 (Cognitive) Apply	PLO-3 / SA3 (Design/development of solutions)
CLO-3	Perform practical modeling, safety analysis, and infrastructure assessment using digital engineering software tools.	P4 (Psychomotor) Mechanism	PLO-4 / SA4 (Investigation)
CLO-4	Present and interpret digital analysis results and engineering assessments effectively.	A2 (Affective) Responding	PLO-9 / SA9 Communication
Course Outline for Theory			
- Introduction to sustainable, energy-efficient, and digital construction practices. - Building Information Modeling (BIM) and digital building prototypes. - Digital tools for construction safety assessment and hazard analysis. - Decision Support Systems (DSS) for monitoring and control of construction operations. - GIS, remote sensing, image sensing, and infrastructure assessment applications in civil engineering.			
Lab Work Outline for Practical			

As part of the overall learning requirements, the course will include:

1. Introduction to BIM and digital modeling tools for civil engineering applications.
2. Development of digital building models and structural assessment simulations.
3. Construction safety and hazard analysis using BIM and virtual simulation tools.
4. Application of GIS and remote sensing tools for site and infrastructure analysis.
5. Image sensing and crack detection analysis for structural assessment.
6. Digital project presentation and interpretation of assessment results.

Recommended Books

1. Crotty, R. (2012). *The impact of building information modeling*. Routledge.
2. Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2018). *BIM handbook: A guide to building information modeling* (3rd ed.). Wiley.
3. Hardin, B., & McCool, D. (2015). *BIM and construction management: Proven tools, methods, and workflows* (2nd ed.). Wiley.
4. Nixon, M., & Aguado, A. (2019). *Feature extraction and image processing for computer vision* (4th ed.). Academic Press.
5. Seaton, H. (2021). *The construction technology handbook*. Wiley.
6. Abanda, F. H. (2026). *Digital technologies for engineering construction information productivity*. Routledge.

8.42 Building Codes and Compliance

Course Code and Title: CET-412 Building Codes and Compliance		Credits Hours: 3+0	Prerequisite: None
Knowledge and Attitude Profile: • SK4 (Engineering specialist knowledge) • SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 9 (Industry, Innovation and Infrastructure) • SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: • TC2 (Comprehend and apply local knowledge) • TC8 (Ethics)	
Course Objectives			
Upon successful completion of this course, students will be able to interpret and apply national and international building codes and standards to ensure safe and compliant civil engineering practices. They will develop the ability to review engineering drawings, support building approval processes, and promote sustainable and code-compliant construction.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the purpose, scope, and application of national and international building codes and standards used in civil engineering projects.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Interpret the requirements of building codes to evaluate engineering drawings and construction practices for code compliance.	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Demonstrate professional responsibility by applying code compliance procedures during building approval, inspection, and reporting.	A3 (Affective) valuing	PLO-7 / SA7 (Ethics)
Course Outline for Theory			
• Introduction to Building Codes: Purpose, scope, and importance of building codes; national and international building codes; role of codes in ensuring safe and sustainable construction. • Building Codes and Standards: Overview and applications of Pakistan Building Code (PBC), ACI 318, ASCE 7, International Building Code (IBC), and AASHTO specifications. • Structural and Building Requirements: Basic code provisions for reinforced concrete, steel structures, building occupancy, fire safety, accessibility, seismic, and wind loading requirements. • Engineering Drawings and Code Compliance: Interpretation of architectural and structural drawings; checking drawings for compliance with applicable codes and standards. • Building Approval and Inspection: Building permit process, construction inspections,			



Curriculum for Bachelor of Science in Civil Engineering Technology



documentation, common code violations, and corrective measures.

- **Sustainable Construction Practices:** Energy-efficient buildings, green building concepts, safety requirements, and climate-resilient construction.
- **Case Studies:** Review of residential and commercial buildings for compliance with building codes and engineering standards.

Recommended Books

1. American Concrete Institute. (2025). *Building code for structural concrete—Code requirements and commentary (ACI CODE-318-25)*. American Concrete Institute.
2. Ching, F. D. K. (2024). *Building construction illustrated* (7th ed.). Wiley.
3. International Code Council. (2024). *International building code (IBC)*. International Code Council.
4. Pakistan Engineering Council. (2021). *Building Code of Pakistan 2021* (2nd ed.). Pakistan Engineering Council.

8.43 Ground Improvement Techniques

Course Code and Title: CET-413 Ground Improvement Techniques		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: - SK3 (Engineering fundamentals) - SK4 (Engineering specialist knowledge) - SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 9 (Industry, Innovation and Infrastructure) - SDG 11 (Sustainable Cities and Communities) - SDG 12 (Responsible Consumption and Production)		Professional Competence Profile: - TC1 (Comprehend and apply universal knowledge) - TC2 (Comprehend and apply local knowledge) - TC3 (Problem analysis) - TC5 (Evaluation) - TC10 (Communication and Collaboration)	
Course Objectives			
The primary objective of this course is to equip students with the practical knowledge and field-monitoring skills necessary to select, execute, and evaluate various ground modification techniques. Students will learn the working principles of mechanical, hydraulic, chemical, and inclusion methods, perform standard laboratory quality control tests on stabilized soils, and inspect site installation procedures to ensure weak soils meet engineering project requirements.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the field applications, operational principles, and suitability criteria of various soil improvement techniques.	C2 (Cognitive) Analyze	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-2	Perform various lab experiments, e.g., shear strength, Proctor, and CBR on stabilized soil.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-3	Observe various ground improvement processes in the field.	P1 (Psychomotor) Imitation	PLO-11 / SA11 (Lifelong learning)
Course Outline for Theory			
Introduction and Mechanical Modification: Need for Ground Improvement: Weak soil			

characteristics, settlement problems, shear strength deficiencies, and liquefaction mitigation; Surface Compaction: Moisture-density relationships, shallow compaction equipment, and field density quality control testing; Deep Compaction Techniques: Vibro-flotation (Vibro-compaction, Vibro-replacement), Stone Columns / Granular Piles, Explosive/Dynamic Compaction, and Heavy Tamping.

- **Hydraulic Modification and Dewatering:** Groundwater Control: Seepage principles, filter criteria, and multi-well drainage systems; Dewatering Methods: Wellpoint systems, deep bored wells, and vacuum dewatering; Precompression Principles: Preloading mechanics, surcharge fills, sand drains, and Perforated Vertical Drains (PVDs).
- **Chemical and Physical Stabilization:** Admixture Stabilization: Lime, Cement, Bitumen, Fly Ash, and Chemical admixture mechanisms; Grouting Technology: Groutability parameters, suspension/solution grouts, compaction grouting, and injection equipment; Deep Mixing Method (DMM): Lime columns, cement columns, and in-situ soil mixing mechanics.
- **Geosynthetics and Soil Inclusion:** Geosynthetic Engineering: Classification, functions (separation, filtration, drainage, reinforcement), and testing of Geotextiles, Geogrids, and Geomembranes; Mechanically Stabilized Earth (MSE): Principles of reinforced earth, facing elements, and design concepts of MSE retaining structures.
- **In-situ Soil Elements and Anchoring:** Micro-piles and Soil Nailing: Construction sequence, load transfer mechanisms, and slope stabilization; Rock Anchoring and Bolts: Applications, components, and anchor testing methods.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Standard and Modified Proctor Compaction Tests: Establishing baseline moisture-density curves for natural vs. treated soil.
2. California Bearing Ratio (CBR) Test: Comparing untreated soil bearing index with stabilized soil specimens.
3. Unconfined Compressive Strength (UCS) / Shear Strength Tests: Quantifying strength gains over 7-day and 28-day curing cycles for lime/cement-treated soil.
4. Open-ended lab on soil stabilization.
5. Related Field Visits include the following: soil compaction, stabilization by lime/cement/chemical, use and manufacturing of geotextiles/reinforcement.

Recommended Books

1. Bo, M. W., & Choa, V. (2004). *Reclamation and ground improvement*. Thomson Learning.
2. Hausmann, M. R. (1990). *Engineering principles of ground modification*. McGraw-Hill.
3. Holtz, R. D., Christopher, B. R., & Berg, R. R. (1997). *Geosynthetic engineering*. BiTech Publishers.
4. Kirsch, K., & Bell, A. (2012). *Ground improvement* (3rd ed.). CRC Press.
5. Koerner, R. M. (2012). *Designing with geosynthetics* (6th ed.). Xlibris.
6. Patra, N. R. (2012). *Ground improvement techniques*. Vikas Publishing.

8.44 Smart Technologies for Facilities Management

Course Code and Title: CET-414 Smart Technologies for Facilities Management		Credits Hours: 3+1	Prerequisite: None
Knowledge and Attitude Profile: • SK5 (Engineering design and operations) • SK7 (Knowledge of the role of technology in society)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 7 (Affordable and Clean Energy) • SDG 11 (Sustainable Cities and Communities) • SDG 13 (Climate Action)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC3 (Problem analysis) • TC5 (Evaluation) • TC10 (Communication and Collaboration)	
Course Objectives			
After completing this course, students will be able to understand and analyze advanced facilities management frameworks, spatial asset relationships, and automation infrastructures, and validate smart technological concepts through the implementation of information modeling systems, GIS applications, and building sustainability evaluations.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Understand the core frameworks of facilities management (FM), the lifecycle roles of an FM professional, and the evolution of smart technological infrastructures.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze and integrate spatial and asset lifecycle data using Geographic Information Systems (GIS) and Building Information Modeling (BIM) workflows to support operational decision-making.	C4 (Cognitive) Evaluate	PLO-2 / SA2 (Problem Analysis)
CLO-3	Evaluate asset sustainability profiles, building performance criteria, carbon emission variables, and life-cycle costing models to optimize facility operation strategies.	C4 (Cognitive) Evaluate	PLO-6 / SA6 (The Engineer and the World)
CLO-4	Demonstrate and execute operations-level tasks using Computer-Aided Facility Management	P4 (Psychomotor) Mechanism	PLO-5 / SA5 (Tool Usage)

	(CAFM) environments and mobile field-synchronization technologies.		
Course Outline for Theory			
• Introduction to Facilities Management: Objectives of FM, Key terminologies and concepts in the domain of FM, importance of good facilities management, Trends in Facility Management. Role and Responsibilities of the Facility Manager, Core traits and skills of a successful facilities manager. • Overview of Computer-Aided Facility Management (CAFM): Current Facility Management Technology, operations-level work-order tracking systems, Technology of the (Near) Future, and Trends in Asset Technology. • Building Information Modeling for Facilities Management: Overview of Application of BIM for FM, COBie (Construction Operations Building Information Exchange) data standards and Data Exchange protocol, Challenges of BIM for FM, and FM BIM in Practice. • Role of Geographic Information Systems in Facility Management: Enhancing FM Capabilities with GIS, GIS Data structures, Location mapping, Vector and Raster Data models, Attribute Data relationships, Mapping for FM, Location Mapping, Thematic Mapping, Mapping Density, Mapping Change, Spatial Analysis for FM, Attribute Selection, Nearest Selection, Inside Selection, Buffering Selection, Geocoding, Access to GIS through the Internet, GIS Analysis within the Building, and Mobile Technologies. • Sustainability and FM: Sustainability frameworks for Buildings, Certification for Sustainability, ENERGY STAR Building Certification, Assessment and Planning, Software for Sustainable Facilities Management, The Importance of Visualization, Life-Cycle Cost Analysis (LCCA), Carbon/Greenhouse Gas Calculations, Energy Analysis Tools and Applications, Building Performance and Monitoring, and Applied Case Studies. • Technology Management: Building Management Systems (BMS) and Building Automation Systems (BAS), Access and Security Management Systems, Emerging Technologies, Smart Infrastructures, Internet of Things (IoT) sensor integration, and Cloud Computing frameworks.			
Lab Work Outline for Practical			
As part of the overall learning requirements, the course will include: 1. Develop small-scale CAFM environment models to simulate asset tracking and maintenance ticketing workflows. 2. Generate asset-rich BIM data models optimized for facility maintenance parameters from architectural and structural layouts. 3. Construct localized GIS models for institutional or commercial facility parcels to manage asset networks, grounds, and spatial mapping features. 4. Deploy specialized software environments to capture and track baseline parameters for Sustainable Facilities Management. 5. Execute dynamic energy usage analysis and thermal baseline checks on engineered structural models. 6. Perform Life-Cycle Cost Analysis (LCCA) simulations to justify material replacement cycles and equipment investments. 7. Calculate carbon footprints and greenhouse gas emission profiles based on building operations data. 8. Simulate building performance, HVAC variations, and spatial efficiency metrics on sample structures.			



Curriculum for
Bachelor of Science in Civil Engineering Technology



9. Integrate mobile technology platforms and field data-capture routines with centralized facility management models.

Recommended Books

1. Atkin, B., & Brooks, A. (n.d.). *Total facility management*. John Wiley & Sons.
2. International Facility Management Association, & Teicholz, E. (n.d.). *BIM for facility managers*. John Wiley & Sons.
3. Roper, K. O., & Payant, C. F. (n.d.). *The facility management handbook*. AMACOM.
4. Shah, S. (n.d.). *Sustainable practice for the facilities manager*. Wiley-Blackwell.
5. Teicholz, E. (n.d.). *Facility management technology: Lessons learned and best practices*. John Wiley & Sons.

8.45 Land Reclamation and Drainage Technology

Course Code and Title: CET- 415 Land Reclamation and Drainage Technology		Credits Hours: 2+1	Prerequisite: CET-314 Irrigation Engineering
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK4 (Engineering specialist knowledge) • SK5 (Engineering design and operations) • SK7 (Knowledge of the role of technology in society)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 6 (Clean Water and Sanitation) • SDG 9 (Industry, Innovation and Infrastructure) • SDG 13 (Climate Action) • SDG 15 (Life on Land)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis) • TC4 (Design and development of solutions) • TC6 (Protection of society) • TC10 (Communication and Collaboration)	
Course Objectives			
After completion of this course, students will be able to understand and analyze the causes of waterlogging, salinity, and land degradation, and evaluate their impacts on agricultural productivity and sustainable land management; apply drainage engineering principles and field investigation techniques to plan, assess, operate, and maintain surface and subsurface drainage systems for land reclamation and agricultural development, and develop sustainable engineering solutions for drainage and reclamation problems by utilizing field and laboratory data while demonstrating professional responsibility, environmental stewardship, teamwork, and safe engineering practices.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Categorize the situations that necessitate drainage of agricultural lands and analyze the causes of waterlogging and salinity.	C2 (Cognitive) Understand	PLO-2 / SA1 (Problem Analysis)
CLO-2	Apply drainage engineering principles to design, operate, and maintain surface and subsurface drainage systems for sustainable agricultural production.	C4 (Cognitive) Analyze	PLO-3 / SA3 (Design/development of solutions)

CLO-3	Evaluate the environmental and sustainability impacts of drainage and land reclamation projects.	C4 (Cognitive) Analyze	PLO-6 / SA6 (The Engineer and the World)
CLO-4	Perform groundwater monitoring and drainage assessment procedures.	P4 (Psychomotor) Perform	PLO-4 / SA4 (Investigation)
CLO-5	Demonstrate environmental responsibility, teamwork, and safety in drainage investigations.	A3 (Affective) Value	PLO-6 / SA6 (The Engineer and the World)
Course Outline for Theory			
• Introduction: Causes of waterlogging, Need for drainage, Objectives of land drainage, Reclamation of waterlogged soils. • Observation wells and Piezometers: Difference between shallow monitoring wells and piezometers, Construction, location, and installation of observation wells and piezometers, reading water levels. • Drainage systems: Drainage as part of an agricultural development project, Field drainage systems, Surface and subsurface drainage systems, Combined drainage systems, Components of a drainage system, Layout of field drainage systems, Outlet of a field drainage system, discharge calculations for a drain, Slopes of field drains. • Surface drainage: Land forming- Bedding, Land grading and land planning, Field drains- Design of surface drains and construction of surface drains. • Subsurface drainage: Types of subsurface drainage systems, principles of subsurface drainage systems, Depth and spacing of field drains, Drainage coefficient, Pipes, Envelopes, Construction of pipe drainage systems, Construction methods, Alignment and levels, Machinery, Supervision and inspection, Interceptor drains.			
Lab Work Outline for Practical			
As part of the overall learning requirements, the course will include: 1. Installation and identification of observation wells and piezometers. 2. Measurement and recording of groundwater table fluctuations using observation wells. 3. Determination of hydraulic gradient using piezometric observations. 4. Field survey of waterlogged areas and identification of drainage problems. 5. Preparation of drainage contour maps using leveling data. 6. Assessment of existing surface drainage networks in agricultural fields. 7. Determination of soil texture and its influence on drainage requirements. 8. Measurement of soil infiltration rate using a double-ring infiltrometer. 9. Determination of soil permeability coefficient. 10. Layout and alignment of field surface drains. 11. Calculation of drainage coefficient using field and climatic data. 12. Design exercise for a surface drainage channel. 13. Identification of subsurface drainage components (pipes, envelopes, junctions, collectors). 14. Determination of drain spacing and depth using standard drainage design methods. 15. Inspection and performance evaluation of a subsurface drainage system.			



Curriculum for
Bachelor of Science in Civil Engineering Technology



16. Assessment of soil salinity and sodicity in reclaimed and waterlogged lands.
17. Evaluation of drainage effectiveness for salinity control.
18. Field case study and technical report on land reclamation practices and sustainable drainage management.

Recommended Books

1. Choudhry, M. R. (n.d.). *Irrigation and drainage practices for agriculture*. University of Agriculture Faisalabad.
2. Smedema, L. K., & Rycroft, D. W. (1983). *Land drainage: Planning and design of agricultural drainage systems*. Cornell University Press.
3. U.S. Bureau of Reclamation. (n.d.). *Drainage manual*. U.S. Department of the Interior, Bureau of Reclamation.

8.46 Applied Hydraulics

Course Code and Title: CET-416 Applied Hydraulics		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK4 (Engineering specialist knowledge) • SK5 (Engineering design and operations)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 9 (Industry, Innovation and Infrastructure) • SDG 13 (Climate Action)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis) • TC6 (Modern Tool Usage) • TC10 (Communication and Collaboration)	
Course Objectives			
To equip students with the applied knowledge of open channel flow, hydraulic structures, dams, hydropower systems, and fluid machinery required for the analysis, operation, monitoring, and selection of hydraulic systems in irrigation, drainage, and power generation projects, with emphasis on the practical application of hydraulic principles in real field and design situations.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain the principles of open-channel flow, hydraulic structures, dams, reservoirs, pumps, and turbines, and their applications in water resources engineering systems.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze flow conditions in open channels, hydraulic jumps, water surface profiles, and the performance of hydraulic structures using engineering principles and field observations.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Evaluate the operation, maintenance, and performance of canals, barrages, dams, reservoirs, pumping stations, and hydropower systems to recommend practical engineering solutions.	C5 (Cognitive) Evaluate	PLO-3 / SA3 (Design/development of solutions)

CLO-4	Perform hydraulic measurements, field investigations, laboratory experiments, and hydraulic system assessments using standard engineering instruments, software, and modern tools.	P4 (Psychomotor) Perform	PLO-5 / SA5 (Tool Usage)
CLO-5	Demonstrate professional responsibility by preparing technical reports, presenting hydraulic investigations, and communicating field and laboratory findings effectively.	A3 (Affective) Valuing	PLO-9 / SA9 (Communication)

Course Outline for Theory

- **Open Channel Flow and Field Applications:** Introduction to open channel flow and its engineering applications, Types of open channels (natural and artificial), Flow characteristics and energy concepts, Uniform and non-uniform flow, Critical flow and hydraulic jump, Practical applications in canals, drains, spillways, and irrigation systems, Flow measurement in open channels using weirs and flumes.
- **Canal Systems: Operation and Maintenance:** Components of irrigation canal systems, Canal lining and seepage control, Canal operation and regulation, Water distribution and delivery systems, Common canal problems (silting, erosion, weed growth, leakage), Inspection, maintenance, and rehabilitation practices, Case studies from irrigation systems.
- **Water Surface Profiles and Hydraulic Analysis:** Introduction to gradually varied flow, Water surface profile concepts, Backwater and drawdown curves, Practical applications in canals, rivers, bridges, and culverts, Introduction to HEC-RAS for hydraulic profile analysis.
- **Hydraulic Structures and Their Operation:** Introduction to hydraulic structures, Headworks and barrages, Weirs and spillways, Canal falls and outlets, Cross-drainage structures, Gates and flow control structures, Inspection, operation, and maintenance of hydraulic structures, Common structural and hydraulic failures
- **Dams and Hydropower Systems:** Introduction to dams and reservoirs, Types and functions of dams, Components of hydropower schemes, Reservoir operation and water management, Sedimentation issues and mitigation measures, Water hammer phenomenon and practical implications, Dam safety monitoring and inspection, Introduction to small and micro hydropower systems.
- **Pumps, Turbines and Hydraulic Machinery:** Classification and applications of pumps, Pump performance characteristics, Pump selection for water supply and irrigation systems, Installation, operation, and maintenance of pumps, Troubleshooting common pump problems, Types of hydraulic turbines, Turbine operation and efficiency, Introduction to pump stations and hydropower plants, Safety procedures in hydraulic machinery operation.
- **Modern Hydraulic Engineering Tools:** Introduction to HEC-RAS for river and canal hydraulics, GIS applications in hydraulic engineering, Digital flow monitoring and data acquisition systems, Use of sensors and smart water management technologies.
- **Hydraulic Engineering Case Studies:** Flood control projects; Hydropower project; Analysis of common hydraulic engineering failures and lessons learned.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Determination of discharge using volumetric, weir, and flume methods.
2. Measurement of flow velocity and development of velocity profiles.
3. Study of critical flow conditions in an open channel flume.
4. Observation of hydraulic jump characteristics and estimation of energy loss.
5. Determination and plotting of water surface profiles in laboratory channels.
6. Evaluation of channel roughness effects on flow behavior.
7. Measurement of discharge over weirs and through gated structures.
8. Identification and functional assessment of weirs, barrages, canal falls, outlets, and cross-drainage work.
9. Determination of pump head, discharge, efficiency, and power requirements.
10. Development of pump performance curves and study of cavitation effects.
11. Determination of turbine efficiency and operating characteristics.
12. Simulation of open channel flow and interpretation of water surface profiles (Hydraulic System Analysis Using HEC-RAS).

Recommended Books

1. Akan, A. O., & Iyer, S. S. (2021). *Open channel hydraulics* (2nd ed.). Butterworth-Heinemann.
2. Chadwick, A., Morfett, J., & Borthwick, M. (2013). *Hydraulics in civil and environmental engineering* (5th ed.). CRC Press.
3. Chaudhry, M. H. (2014). *Applied hydraulic transients* (3rd ed.). Springer.
4. Chaudhry, M. H. (2022). *Open-channel flow* (3rd ed.). Springer Nature.
5. Chow, V. T. (1988). *Open-channel hydraulics* (McGraw-Hill classic reissue ed.). McGraw-Hill.
6. Jain, A. K. (2010). *Fluid mechanics including hydraulic machines* (12th ed.). Khanna Publishers.
7. Novak, P., Moffat, A. I. B., Nalluri, C., & Narayanan, R. (2017). *Hydraulic structures* (5th ed.). CRC Press.
8. U.S. Army Corps of Engineers. (n.d.). *HEC-RAS hydraulic reference manual* (Latest version). Hydrologic Engineering Center.
9. U.S. Army Corps of Engineers. (n.d.). *HEC-RAS user's manual* (Latest version). Hydrologic Engineering Center.
10. United States Bureau of Reclamation. (n.d.). *Design of small dams* (3rd ed.). U.S. Department of the Interior.

8.47 Construction Equipment and Jobsite Practices

Course Code and Title: CET-417 Construction Equipment and Jobsite Practices		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK5 (Engineering design and operations) • SK9 (Ethics, inclusive behavior and conduct)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 8 (Decent Work and Economic Growth) • SDG 9 (Industry, Innovation and Infrastructure) • SDG 11 (Sustainable Cities and Communities) • SDG 12 (Responsible Consumption and Production) • SDG 13 (Climate Action)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis) • TC5 (Evaluation) • TC10 (Communication and Collaboration)	
Course Objectives			
After completion of this course, students will be able to identify common construction equipment, analyze basic equipment productivity, apply simple jobsite planning principles, observe equipment and site practices, and prepare basic jobsite records related to equipment use, material handling, safety, housekeeping, and daily reporting.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Analyze basic productivity of common construction equipment used in excavation, earthmoving, lifting, concreting, paving, and material-handling operations using field, video, or simulated data.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-2	Perform structured observation of jobsite practices related to equipment use, material handling, site safety, housekeeping, and environmental controls.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-3	Prepare a simple jobsite record/report using standard site-documentation format, including daily work, manpower, equipment, material, delay/problem, and safety observation.	A2 (Affective) Responding	PLO-9 / SA9 (Communication)

CLO-4	Apply basic jobsite planning principles for equipment selection, equipment movement, site access, material storage, housekeeping, and safety.	C3 (Cognitive) Analyze	PLO-10 / SA10 (Project Management and Finance)
Course Outline for Theory			
• Introduction to Construction Equipment and Jobsite Practices; Role of construction equipment in project productivity, time, cost, safety, and site organization; introduction to equipment categories; jobsite as an integrated system of equipment, labor, materials, access, safety, and documentation. • Earthmoving and Excavation Equipment; Use and productivity considerations for tractors, dozers, scrapers, motor graders, power shovels, off-road haulers, front-end loaders, backhoes, draglines, trenchers, rock drilling equipment, crushers, and conveyors. • Lifting, Concreting and Vertical Transportation Equipment; Use and productivity considerations for cranes and buckets, concrete pumps, concrete conveyors, and vertical concrete equipment; basic lifting/concreting coordination and safety awareness. • Road, Paving and Foundation Equipment; Concrete paving, asphalt paving, pavement rehabilitation, and pile-driving operations; basic equipment selection and productivity considerations for road and foundation works. • Jobsite Layout and Site Control; Crew assignments, material and equipment handling, material storage, temporary facilities, jobsite security, fencing, access roads, jobsite tagging, congested sites, labor organization, and site records. • Site Documentation, Safety and Environmental Practices; Procurement schedule, submittals, shop drawings and samples, subcontractor submittals, diaries/logs, accident reports, progress photographs, video recordings, time-lapse records, material logs, equipment logs, implementation of jobsite safety plan, cleaning, construction waste management, onsite material testing and inspection, and environmental plan. • Introductory Digital / AI-Assisted Site Support; Basic use of Excel and AI-assisted tools for productivity calculation, checklist preparation, photo-log organization, and report drafting, subject to manual verification, ethical use, and confidentiality.			
Lab Work Outline for Practical			
As part of the overall learning requirements, the course will include: 1. Analyze Equipment Use Matrix; Identify common construction equipment and match each type with suitable construction activity. 2. Prepare Equipment Productivity Sheet; Conduct video, field or simulated productivity study of one common equipment item such as excavator, loader, dozer, concrete pump or paver. 3. Analyze and Prepare Equipment Selection Sheet; Prepare equipment selection for a given construction activity such as excavation, concreting, lifting, paving or material handling. 4. Prepare Site Layout Sheet; Prepare a simple job-site layout showing access, material storage, equipment movement, temporary facilities and safety/housekeeping zones. 5. Analyze and Prepare Observation checklist; Observe jobsite practices through actual site visit, video or photographs.			

- 6. Prepare daily site report/ jobsite log;** Prepare a simple daily site record using a given, observed or simulated construction scenario.
- 7. Use of Digital/AI-assisted output;** Use Excel or AI-assisted drafting/checking to improve one productivity sheet, checklist, or daily report, followed by manual verification.

Recommended Books

1. Baldwin, A., & Bordoli, D. (n.d.). *A handbook for planning and scheduling*. John Wiley & Sons.
2. Hardin, B., & McCool, D. (n.d.). *BIM and construction management: Proven tools, methods, and workflows*. John Wiley & Sons.
3. Hinze, J. W. (n.d.). *Construction safety*. Prentice Hall.
4. International Federation of Consulting Engineers. (2017). *FIDIC conditions of contract for construction (Red Book)*. FIDIC.
5. Lundesjo, G. (n.d.). *Construction logistics and process management*. Kogan Page.
6. Mincks, W. R., & Johnston, H. (n.d.). *Construction jobsite management*. Cengage Learning.
7. Nichols, H. L., & Day, D. A. (n.d.). *Moving the earth: The workbook of excavation*. McGraw-Hill Education.
8. Peurifoy, R. L., Schexnayder, C. J., Shapira, A., & Schmitt, R. (n.d.). *Construction planning, equipment, and methods*. McGraw-Hill Education.
9. Project Management Institute. (n.d.). *A guide to the project management body of knowledge (PMBOK guide)*. Project Management Institute.
10. Purdue University Press. (n.d.). *Construction site planning and logistical operations: Site-focused management for builders*. Purdue University Press.
11. Sears, S. K., Sears, G. A., Clough, R. H., Rounds, J. L., & Segner, R. O. (n.d.). *Construction project management: A practical guide to field construction management*. John Wiley & Sons.

8.48 Construction of Steel Structures

Course Code and Title: CET-418 Construction of Steel Structures		Credits Hours: 2+1	Prerequisite: CET-226 Mechanics of Solids
Knowledge and Attitude Profile: SK4 (Engineering specialist knowledge)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): - SDG 9 (Industry, Innovation and Infrastructure) - SDG 11 (Sustainable Cities and Communities)		Professional Competence Profile: - TC3 (Problem analysis) - TC10 (Communication and Collaboration)	
Course Objectives			
The course aims to develop an understanding of steel structural systems, the behavior of steel members and connections, structural design principles, fabrication practices, and safe applications of steel structures in civil engineering projects.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Explain theories, principles, and design philosophy of steel structures and structural members.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze and design steel structural members and connections under various loading conditions according to relevant design codes.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Design steel structural components and prepare detailed drawings according to relevant design codes.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-4	Present structural detailing and experimental findings effectively.	A2 (Affective) Responding	PLO-9 / SA9 Communication
Course Outline for Theory			
- Introduction to steel structures/systems, loads, LRFD/ASD design philosophy, and steel construction practices. - Properties, manufacturing, fabrication, detailing, erection, and productivity of steel structures. - Analysis and design of tension and compression members. - Design of flexural members and built-up sections. - Riveted, bolted, and welded connections.			

- Introduction to steel bridges, bridge components, and specifications.
- Introduction to Plate Girders, weight, and economic depth.
- Design of Steel roof trusses.

Lab Work Outline for Practical

As part of the overall learning requirements, the course will include:

1. Study and prepare detailing of riveted, bolted, and welded steel connections
2. Prepare drawings of staggered joints, grillage foundations, and slab bases.
3. Prepare detailing of laced and battened steel columns using channel and angle sections.

Recommended Books

1. American Institute of Steel Construction. (2023). *Steel construction manual* (16th ed.). AISC.
2. McCormac, J. C., & Brown, R. H. (2015). *Design of steel structures* (6th ed.). Wiley.
3. Salmon, C. G., Johnson, J. E., & Malhas, F. A. (2020). *Steel structures: Design and behavior* (6th ed.). Pearson.
4. Segui, W. T. (2022). *Steel design* (7th ed.). Cengage Learning.

8.49 Pavement Construction and Rehabilitation

Course Code and Title: CET-419 Pavement Construction and Rehabilitation		Credits Hours: 2+1	Prerequisite: None
Knowledge and Attitude Profile: • SK3 (Engineering fundamentals) • SK6 (Engineering Technologies)		Range of Problem Identification and Solving: A Broadly-Defined Engineering Problem must include SP1 paired with any number of required attributes from SP2 through SP7 as per IEA guidelines.	Range of Engineering Activities: Broadly-Defined Engineering Activities must include any number of required attributes from TA1 through TA5 as per IEA guidelines.
Sustainable Development Goals (SDGs): • SDG 9 (Industry, Innovation and Infrastructure) • SDG 11 (Sustainable Cities and Communities) • SDG 12 (Responsible Consumption and Production)		Professional Competence Profile: • TC1 (Comprehend and apply universal knowledge) • TC2 (Comprehend and apply local knowledge) • TC3 (Problem analysis) • TC10 (Communication and Collaboration)	
Course Objectives			
This course provides knowledge about the construction of roads, including pavement materials, specifications, and step-wise standard procedures involved in pavement construction and rehabilitation, manufacturing of hot mix asphalt, and paving of asphalt. Also, students will be able to learn about the pavement rehabilitation techniques, distress identification, and remedial measures taken for the rehabilitation of the pavements.			
Course Learning Outcomes (Theory)			
CLO No.	Statement	Taxonomy Level	Program Learning Outcomes (PLOs)
CLO-1	Describe different types of pavements, construction, and rehabilitation, using different types of materials and systems, including their applications.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze various pavement rehabilitation strategies and determine the most effective solution based on specific pavement conditions.	C3 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Demonstrate the ability to select suitable materials for pavement construction and rehabilitation and perform relevant tests to evaluate their properties.	C3 (Psychomotor) Analyze	PLO-1 / SA1 (Engineering Knowledge)
CLO-4	Practice laboratory and field tests for the evaluation of pavement condition and materials.	P4	PLO-4 / SA4 (Investigation)

		(Psychomotor) Guided Response	
Course Outline for Theory			
• Introduction to Pavement Design and Rehabilitation: Pavement Design methodologies, Function of Pavement Layers and materials, embankment, subgrade, granular layers, and asphalt layers. • Pavement Construction and Equipment: Construction Techniques, site preparation, Material selection, specifications related to different layers, Compaction of layers, Construction Equipment used in the field. Earthwork, Sub-base, Base course, etc. • Hot Mix Asphalt: Asphalt mix composition, Types of asphalt mixtures, Asphalt mix design in the laboratory, and laboratory equipment. Stepwise procedure for preparing an asphalt mix design using the Marshall Method of Mix Design. Laboratory testing for quality control and verification of mix design parameters. • Manufacturing of Hot Mix on Asphalt Plant: Asphalt Plant types, layout, and its components. Preliminary requirements of asphalt production at the plant. Aggregate process, bitumen process, mixing process. Production of Hot mix in an asphalt Plant. • Paving of Hot Mix Asphalt: Operation and Inspection of Hot Mix Asphalt Facilities, Hot Mix Asphalt Paving: Machines and crew requirements; Hot Mix Asphalt paving; roadway surface preparation and placing of mix; compaction and finishing of Hot Mix Asphalt; rolling procedure; Hot Mix Asphalt Quality Control. • Pavement Maintenance and Rehabilitation: Planning for Improvement/Pavement Management, Pavement Distress identification, milling and recycling, asphalt surface treatment, other surface treatment types, Maintenance of asphalt pavement rehabilitation, different strategies of pavement rehabilitation, repair techniques, pavement serviceability measurements.			
Lab Work Outline for Practical			
As part of the overall learning requirements, the course will include: 1. To perform sieve analysis of different fractions used in the mix design 2. To determine aggregate gradation used for job mix formula using the 0.45 Power curve and semi-log technique. 3. To determine the combined bulk specific gravity and absorption of aggregate in a gradation. 4. To determine the maximum theoretical specific gravity of a loose mix of hot Mix Asphalt. 5. To determine the bulk specific gravity of the compacted mix of hot Mix Asphalt. 6. To determine the effective specific gravity of the asphalt mix. 7. To determine stability and flow of Hot Mix Asphalt using the Marshall method of Mix Design. 8. To determine the optimum asphalt content of asphalt mixes using stability and volumetric. 9. To determine the loss of stability of the asphalt mix. 10. To verify the asphalt mix properties at optimum asphalt content. 11. To perform a centrifuge extraction test on the bituminous mix. 12. To determine the rate of spray of bituminous prime coat in the field. 13. To conduct condition surveys to identify types of distress in in-service flexible pavement. 14. To conduct condition surveys to identify types of distress in in-service Rigid pavement. 15. To perform an Open-Ended Lab.			



Curriculum for
Bachelor of Science in Civil Engineering Technology



Recommended Books

1. Asphalt Institute. (n.d.). *Construction of hot mix asphalt pavements* (Manual Series No. 22 [MS-22]).
2. Asphalt Institute. (n.d.). *Mix design methods for asphalt concrete and other hot-mix types* (Manual Series No. 2 [MS-2]).
3. Mannering, F. L. (n.d.). *Principles of highway engineering and traffic analysis*.
4. McGhee, C. R. (n.d.). *Principles of pavement engineering*.
5. Papagiannakis, A. T., & Masad, E. A. (n.d.). *Pavement engineering: Principles and practice*.
6. Van Kooten, D. J., & Smadi, M. E. (n.d.). *Pavement design and management*.



9. Supervised Industrial Training

9.1 Background

Supervised Industrial Training (SIT) refers to students' supervised hands-on experience in an environment where engineering technology is practiced, familiarizing them with professional engineering work before graduation. The training curriculum consists of a minimum of 16 weeks of continuous industrial training, comprising 8 hours per day, 5 working days per week. A Bachelor of Engineering Technology student shall undergo mandatory SIT during the 8th semester (16 weeks), or the 7th and 8th semesters (16 weeks mandatory and 16 weeks in the 7th semester optional), after he/ she has passed all subjects up to the 6th semester.

SIT covers a range of activities, such as design implementation, production processes, laboratory experiments, on-site fieldwork, and maintenance. It also serves as a mechanism to integrate engineering practices and the curriculum to achieve Program Learning Outcomes that align with the Engineering Technologists Graduate Attributes in line with the Sydney Accord. While SIT provides practical exposure to engineering processes and helps develop the professional skills required of an Engineering Technologist, it also offers prospective employers an opportunity to assess a future employee's potential.

9.2 Objectives

Through the SIT, students will:

- a) Learn to apply engineering technology knowledge learned in the classroom environment in real industrial situations.
- b) Be provided with exposure to professional practices in the industries.
- c) Understand the role, responsibilities, and code of ethics that Engineering Technologists should uphold.
- d) Develop awareness about general workplace behavior and build interpersonal skills.
- e) Maintain professional work records and reports.
- f) Learn to write reports and network with probable future employers to increase employability.

9.3 Responsibility of HEI: Placement in SIT Program

During the 7th (Optional) and 8th semesters, Bachelor of Civil Engineering Technology students will undergo continuous SIT for 16 (or 32) weeks. HEIs shall arrange this training in leading industries and, preferably, should be accompanied by an MoU for the SIT. A designated Administrator/Coordinator of the HEI shall complete all necessary documentation, preferably 12 weeks before the commencement of the training, and issue a Training Schedule for 16 (or 32) weeks so that all stakeholders and the students are aware and assured of undergoing SIT training in the 7th (optional) and 8th semester according to a scheduled timeline.

9.4 Responsibilities of Students

- a) Bachelor of Civil Engineering Technology students shall get enrolled for SIT during the 6th semester and before commencement of the 7th semester.
- b) Students shall have to undergo continuous training of 16 (or 32) credit hours. One week of training, 8 hours daily for 5 days (40 contact hours), will be counted as 1 credit hour. Accordingly, 16 weeks (One semester) will help students earn 16 credit hours.
- c) Total contact hours per semester are: 16 weeks per semester x 5 working days per week x 8 hours per day = 640. If an HEI opts for SIT in 2 semesters (7th and 8th), these credit hours and contact hours will be doubled.
- d) Students will maintain a daily Logbook, signed by the SIT supervisor at the site, the Training Administrator appointed by the HEI, and the student.
- e) Students must observe the safety & security rules of the Organization where they receive Training.
- f) Students must wear the specified working dress during training.
- g) Students must obey all rules and regulations of the organization.
- h) Students must observe the working timings of the training Organization. Students may be allowed 10 days' leave during the Training period of 16 (or 32) days for genuine reasons. The leave shall only be used to cater for emergencies, with prior sanction from the training Administrator/Coordinator.
- i) Leave will be deducted from training hours and will be required to be made up later.
- j) Unsanctioned leaves shall be treated as "absent" and are liable to disciplinary action.
- k) Public holidays and leave should not be counted as working hours.

9.5 Training Progress Assessment and Review by HEI

Every HEI should appoint a focal person as the SIT Administrator/Coordinator for each program, who will monitor progress periodically through site visits, phone calls, or emails to the industrial organization's counterpart focal person. Progress reports will be maintained in coordination with the training supervisor(s) and the students.

The purpose of monitoring SIT by the Training Administrator/Coordinator is:

- a) To ensure the training organization is providing suitable and appropriate training to students.
- b) To obtain feedback on students' performance and training progress through discussion with training supervisor(s).
- c) To make courtesy visits and establish industrial relations between the HEI and the industries where students will receive their SIT.
- d) To discuss the possibility of students' job placement with the training organization.
- e) To survey new industries as potential training placement locations in the future.

9.6 Changing Student Placement During SIT

- a) Students are discouraged from changing placement during the training period from one organization to another.
- b) However, the Training Administrator/Coordinator may grant written permission if a new placement of the student is available and confirmed in another organization, provided the student does not suffer loss of training hours due to this changeover.
- c) After getting written permission from the Training Administrator/Coordinator, a fresh approval should be applied for the new placement.

9.7 Daily Training Logbook

All training activities must be recorded daily in the Training Logbook [See Appendix F]. Students must get it signed daily by the on-the-job Trainer.

The Training Logbook must reflect:

- a) The student's learning experience during the industrial training.
- b) Training records and evidence of supervised training, with evidence of participation of the student, on- the-job Trainer and HEI's training Administrator/Coordinator.
- c) Part of professional practice in the engineering profession, where incidents and evidence are properly documented.
- d) Information that becomes a source of reference in preparing the Industrial Training Report [See Section 8.8].
- e) The Logbook must be submitted along with the Industrial Training Report.

9.8 Industrial Training Report

An Industrial Training Report will be submitted upon completion of SIT. The Report must describe a student's learning and development in technical knowledge, engineering practices, and professional skills acquired through practical experience. The Industrial Training Report should also reflect a student's ability in communication skills and understanding of engineering practices. Students should seek advice from their on-the-job trainer on-site to ensure that no confidential materials are included in the report. The report shall be submitted to the Training Administrator.

The student may present a copy of the report to the prospective employer. Any references made in preparation of the report should be recognized using standard referencing formats. Students should refer to the provided Industrial Training Report Template and the guidelines below when preparing the Report. The Daily Training Logbook should be submitted together with the Report.

9.9 Guideline for Preparation of Industrial Training Report

Under the guidance of supervisors, students need to properly document their experience and learning during the SIT as an Industrial Training Report. A properly prepared Report can portray

their practical experience precisely in an orderly manner. The Report must be prepared according to the format and the guidelines below:

9.9.1 Contents of Industrial Training Report

a) Table of Contents

This section of the report should consist of:

- i. Headings
- ii. Sub-headings
- iii. Page numbers

Every appendix requires a title, and each page needs to be numbered accordingly.

b) Background & Profile of the Training Organization

A brief and concise description of the organization in which the student is undertaking the SIT. The main items are:

- i. Backgrounds/profile of the organization
- ii. Vision and Mission
- iii. Organogram.
- iv. Title and position of the supervisor in charge
- v. Other necessary information only (not more than three pages)

c) Schedule of duties performed as a Trainee

This section briefly describes the time, duration, and types of duties performed during the training. The description must follow the training schedule, i.e., in chronological order (for 16- or 32-week periods). The days when the student was not on duty must be properly recorded with cogent reasons.

d) Experience During SIT

In this section, the student must fully describe the industrial training experience gained. Some suggested areas include:

- i. Project (s) carried out, if any.
- ii. Supervisory works
- iii. Problems encountered
- iv. Problem-solving process or approach
- v. Hands-on skills acquired.
- vi. How productivity can be further enhanced.
- vii. Quality Management system in place.
- viii. Safety at work.

e) Conclusion

Students provide an overall assessment in this section and conclude regarding the SIT undertaken. Content may include:

- i. Types of major work performed during SIT
- ii. Different modules of SIT
- iii. Comments on whether SIT met the training objectives
- iv. Suggestions and recommendations for improvement of the SIT

f) References

A complete list of references used in the report must be included in accordance with the standard referencing format.

g) Appendix

Appendices are additional information that supports the main text of the Report. A copy of the permission letter from the Training Organization must be attached as an appendix. Other suggested appendices are:

- i. Investigation and project report during SIT
- ii. Technical drawings, so far, these are not secret documents or proprietary, etc.
- iii. Any other document that adds to the Report

h) Figures and Tables

All figures, tables, and similar content must be captioned, labeled, and mentioned in the main text of the Report.

i) Notations, Symbols & Acronyms

If the report contains notations, symbols, and acronyms, these must be defined before they first appear in the main text. It is good practice to put a list of notations, symbols, and acronyms on a separate page, appropriately titled, and placed after the 'Table of Contents' page. Every appendix must have a title and be mentioned in the main text of the Report. All page numbers for appendices must continue the page numbering of the main Report. Do not include irrelevant materials, e.g., brochures from the organizations, or any publicity materials in the report.

9.9.2 Format of the Report

Note on Good Practice

Students are advised to start writing the industrial training report as soon as possible after the start of the training period to ensure timely completion and submission.



Curriculum for Bachelor of Science in Civil Engineering Technology



a) General

- i. Students are advised to start writing the SIT Report as soon as training commences to ensure timely completion and submission.
- ii. Do not include irrelevant materials, e.g., brochures from the organizations, or any publicity materials in the report.
- iii. The Report must be typewritten on plain white A4-size paper, with 12-point Times New Roman font type and line spacing of 1.5.

b) Abstract or Preface

The Report should start with an abstract of a maximum of 2 pages, and should briefly describe:

- i. Description of Organization providing SIT
- ii. Summary of the Report
- iii. Acknowledgment

9.10 SIT Assessment

Assessment of the SIT should be based on the following parameters:

- | | |
|---|-------------|
| i. On-the-Job Trainer Report | (20% marks) |
| ii. HEI'S Training/ Advisor Report through visits or survey | (10% marks) |
| iii. Industrial Training Report | (50% marks) |
| iv. Viva voce | (20% marks) |

It should also be noted that:

- i. A minimum of 50% marks is required to pass the SIT.
- ii. Students are advised to be diligent in writing their Report.
- iii. The Report must be of good quality and portray in full the industrial experience and knowledge gained.
- iv. The Report should not be in the form of short notes and figurative form.
- v. If the Report is not satisfactory, students shall rewrite the Report until it is deemed satisfactory.

9.11 Completion of Industrial Training

- i. Upon completion of a 16- or 32-week continuous SIT, a Confirmation Letter to this effect must be obtained from the training organization and/or probable employer.
- ii. The Confirmation Letter must be submitted to the Industrial Training Administrator/Coordinator, together with the (1) On-the-Job Trainer's Report, (2) Student Feedback Form, and (3) Industrial Training Report for grading.

10. Guidelines for Community Service: BS Civil Engineering Technology Programs

The Higher Education Commission (HEC) of Pakistan emphasizes civic responsibility and community engagement in undergraduate education, including through the Civics and Community Engagement component of the undergraduate curriculum. In this context, these guidelines propose a structured community-service requirement for Bachelor of Civil Engineering Technology programs to promote social awareness, responsible citizenship, and meaningful engagement with communities.

Under these proposed guidelines, every student enrolled in a Bachelor of Civil Engineering Technology program shall complete a minimum of 48 verified hours of unpaid community service during the degree program, subject to approval by the relevant statutory bodies. The service shall directly or indirectly contribute to public or community welfare. Activities should foster empathy, leadership, teamwork, ethical conduct, and an understanding of local and national social challenges.

To ensure structured and meaningful participation, students should complete the required community-service hours during their degree program, preferably between the third and seventh semesters. This schedule allows students to develop sufficient disciplinary understanding while retaining flexibility to participate effectively in service-oriented activities. The requirement should normally be completed before the Supervised Industrial Training semester, where applicable.

The inclusion of community service in the curriculum aligns with national educational priorities and supports the development of well-rounded graduates prepared to contribute positively to society beyond their academic and professional responsibilities.

These guidelines provide a formal structure for planning, implementing, supervising, documenting, and assessing community-service initiatives in Bachelor of Civil Engineering Technology programs across Pakistan. Each higher education institution (HEI) shall adopt the requirement through its competent statutory bodies and implement it in accordance with the latest requirements of the HEC, the National Technology Council (NTC), and the institution.

10.1 Objectives

- a)** To promote civic engagement and social responsibility.
- b)** To foster empathy, compassion, and a service-oriented mindset.
- c)** To develop leadership, teamwork, and communication skills.
- d)** To connect academic learning with practical applications that benefit communities.
- e)** To support national development priorities and strengthen university–community linkages.
- f)** To fulfill the community-service requirement approved for Bachelor of Civil Engineering Technology programs by the relevant curriculum and statutory bodies.
- g)** To promote professional ethics, inclusivity, and responsible citizenship among students.



Curriculum for Bachelor of Science in Civil Engineering Technology



10.2 Guidelines for Activities

10.2.1. Environmental Activities

- i. Plant trees in suitable public spaces, along roads, or in school grounds, subject to permission and an appropriate after-care plan.
- ii. Organize campaigns to reduce single-use plastics and improve waste management on campus or in local communities.

10.2.2. Awareness Campaigns

- i. Conduct supervised awareness sessions in schools or community centers on the following topics:
 - The importance of safe, resilient, and accessible buildings.
 - Flood safety, earthquake preparedness, fire safety, and disaster-risk reduction.
 - Clean water, sanitation, hygiene, water conservation, and responsible waste management.
- ii. Assist authorized organizations in arranging blood-donation awareness campaigns or camps.
- iii. Organize community seminars and outreach activities approved by the HEI.
- iv. Alignment of Final Year Projects with Community-Service Initiatives.

10.3 Assessment Mechanism

10.3.1. Pre-implementation

In collaboration with the Career Development Center (CDC) or another designated office, suitable community-service opportunities shall be identified and coordinated. The designated office may connect student groups with relevant external organizations, such as Rescue 1122, development authorities, water and sanitation agencies, local schools, hospitals, and registered non-governmental organizations. Such partnerships should ensure structured engagement and alignment with academic objectives and community needs. On-campus initiatives, including reducing plastic use, promoting water conservation, and improving environmental practices, may be planned and managed by the relevant Civil Engineering Technology department or program.

10.3.2. Formation of Student Groups

Groups of 5–15 students may be formed for each community-service activity, depending on the nature and scale of the work. The Batch Advisor may assist in forming suitable groups. The Community Service Coordinator shall assign groups to approved activities and oversee coordination. One student from each group shall be designated as the Group Leader and shall coordinate with the group members, Batch Advisor, Community Service Coordinator, faculty supervisor, and partner organization, as applicable.

10.3.3. Orientation Session

An orientation session shall be conducted before each community-service activity. The Community Service Coordinator or faculty supervisor shall brief students on the objectives, scope, expected conduct, prohibited actions, schedule, and assigned responsibilities. Students shall receive appropriate guidance on safety, ethics, safeguarding, privacy, and behavior to ensure respectful and responsible participation. They shall also be instructed to maintain an individual logbook and submit appropriate evidence, such as attendance records, photographs obtained with consent, activity outputs, supervisor verification, and a short reflective note.

10.3.4. Assessment Criteria

Component	Description	Weight
Participation and Attendance	Completion of approved hours, punctuality, reliability, and commitment to assigned tasks.	20%
Quality of Contribution	Meaningful involvement, initiative, and the technical or social value of the contribution.	20%
Teamwork and Collaboration	Ability to work effectively in a group and engage respectfully with community members, partner organizations, and relevant authorities.	15%
Communication Skills	Clarity and appropriateness of communication during awareness sessions, campaigns, presentations, and reporting.	10%
Reflection and Learning	Understanding of community needs, empathy, professional responsibility, and relevance to civil engineering technology.	15%
Documentation and Reporting	Submission of an individual logbook, appropriate evidence, reflective note/report, and supervisor or partner verification.	20%

10.4 Proposed Semester-wise Community-Service Activity Plan

Academic Year	Semester	Recommended Hours	Target Activity	Relevant SDGs
Year 2	3	8	Awareness campaign or supervised volunteering in schools or local communities	SDG 4 – Quality Education; SDG 11 – Sustainable Cities and Communities
	4	8	Health, safety, blood-donation awareness, accessibility, or technical outreach	SDG 3 – Good Health and Well-being; SDG 9 – Industry, Innovation and Infrastructure

Year 3	5	12	Support for NGOs or public bodies; WASH, flood-risk, road-safety, or environmental awareness	SDG 6 – Clean Water and Sanitation; SDG 13 – Climate Action; SDG 17 – Partnerships for the Goals
	6	12	Supervised community project related to infrastructure, disaster resilience, plantation, or waste management	SDG 11 – Sustainable Cities and Communities; SDG 13 – Climate Action; SDG 15 – Life on Land
Year 4	7	8	Community-relevant activity, reflection, final documentation, and evaluation	Depending on the activity, including SDGs 6, 9, 11, 12, 13, or 17
	8	0	No routine allocation; Semester 8 may be reserved for Supervised Industrial Training, where applicable	Not applicable

10.5 HEC Guidelines and Benchmarks

In Pakistan, the Higher Education Commission (HEC) has established guidelines mandating Community Service for undergraduate students enrolled in HEC-recognized universities. While specific requirements may vary slightly between institutions, the general benchmark recommended by HEC is 48 hours of community service, to be completed over the duration of a typical 4-year undergraduate program. Below are some examples of benchmarks set by HEC-recognized universities across Pakistan.

S. No.	University	Typical Hours
1.	NUST (National University of Sciences & Technology)	48
2.	LUMS (Lahore University of Management Sciences)	40-60
3.	COMSATS University	48
4.	FAST-NUCES (National University of Computer and Emerging Sciences)	48
5.	UET Lahore (University of Engineering and Technology, Lahore)	48
6.	GIKI (Ghulam Ishaq Khan Institute of Engineering Sciences and Technology)	40-60



Curriculum for Bachelor of Science in Civil Engineering Technology



10.6 Recognition upon Completion of Community-Service Hours

Upon successful completion of the required 48 hours of community service, each student shall receive formal recognition through a certificate of completion or an approved academic/co-curricular record. The certificate or record shall be issued by the authorized office of the HEI upon verification by the Community Service Coordinator and approval by the Head of the relevant Department or Program. The certificate or approved record shall serve as official evidence that the student has fulfilled the community-service requirement adopted for the Bachelor of Civil Engineering Technology program.

11. Framework for Integration of International Certifications and Massive Open Online Courses (MOOCs) into Undergraduate Engineering Technology Programs

11.1. Background

To address emerging workforce and industry needs, the Higher Education Commission (HEC) (Ref. No. HEC/CURR/GEN/2026/9155) has proposed integrating internationally recognized certifications into undergraduate programs. The objective is to enhance graduate employability, strengthen practical competencies, and align education with evolving global industry standards.

Massive Open Online Courses (MOOCs) offered by internationally recognized universities, professional organizations, and technology companies provide high-quality, flexible, and industry-oriented learning opportunities. Integrating relevant certifications and MOOCs into Engineering Technology programs can promote lifelong learning, support Outcome-Based Education (OBE), and contribute to the National Technology Council (NTC) accreditation framework. Under this framework, a professional certification or MOOCs may be recognized as a 3-credit-hour (45-48 hours) learning component where it meets the prescribed workload and approval requirements. Such learning may also contribute to internship-related and indirect assessment evidence, particularly in relation to PLO-5 and PLO-11 (any other relevant PLO), across the four-year degree program.

11.2. Objectives

The proposed framework aims to:

- Enhance graduate employability through internationally recognized certifications.
- Develop practical and industry-relevant technical competencies.
- Bridge the gap between academia and industry.
- Develop digital, professional, and emerging technology skills.
- Align undergraduate Engineering Technology education with international best practices.

11.3. Scope

This framework shall apply to all undergraduate Engineering Technology programs accredited by the National Technology Council (NTC).

Universities may implement this framework in accordance with the recommendations of the Board of Studies (BoS), the Board of Faculties (BoF), the Academic Council, and other statutory bodies.

11.4. Approved MOOC Platforms

Students may complete approved MOOCs or professional certifications offered by internationally recognized platforms, including:



Curriculum for Bachelor of Science in Civil Engineering Technology



- DLSEI (Digital Learning & Skills Enrichment Initiative)
- Coursera
- Udemy
- edX
- Future Learn
- Open Learning
- SWAYAM/NPTEL
- LinkedIn Learning
- Microsoft Learn
- AWS Skill Builder
- Google Cloud Skills Boost
- Other platforms approved by the University

11.5. International Practices

Several leading universities have successfully integrated MOOCs into their academic programs.

Examples include:

- **University of Malaya (Malaysia):** Recognizes selected MOOCs for academic credit, subject to institutional regulations.
- **Universiti Teknologi Malaysia (UTM):** Integrates MOOCs into undergraduate engineering curricula.
- **University Grants Commission (India):** SWAYAM courses are recognized for academic credit transfer.
- **University of Melbourne:** Micro-credentials are considered a non-accredited form of study, but you may be able to stack your credentials to gain credit towards a further certificate, diploma, or degree offered by the University. Each micro-credential is worth 3.125 points, the equivalent of a quarter of a typical 12.5-point university subject.
- **Universities participating in the European MOOC Consortium** recognize micro-credentials and online certifications for lifelong learning.

11.6. National Practices

Within Pakistan, universities are increasingly promoting digital learning.

- Pakistan Engineering Council (PEC), under its initiative "Enriching Quality Engineering Education in Pakistan" (Ref. PEC/EAD/EQEEP/2025/04, dated July 14, 2025), emphasized the inclusion of professional certification in engineering programs.
- Aga Khan University has adopted policies supporting online and blended learning while emphasizing quality assurance (<https://www.aku.edu/admissions/Documents/policy-online-and-blended-learning-048.pdf>).

- **NUST** offers non-credit-bearing certificates through NUST Connected while retaining the discretion to introduce credit-bearing certificates in the future, aligned with academic and industry standards (<https://connected.nust.edu.pk/mod/page/view.php?id=3569>).
- **GIKI** integrates MOOCs strictly as supplemental resume-building tools for students to learn new skills and stand out to employers. These are non-credit.
- **COMSATS University** also encourages students for MOOCs certification (https://library.comsats.edu.pk/useful_links.aspx).
- **Ziauddin University** has established a structured mechanism for recognizing credible national and international professional certifications within undergraduate programs. Relevant certifications are mapped with program learning outcomes and may qualify for academic credit recognition of up to three credit hours, subject to the prescribed approval process.

11.7. Credit Hour Equivalence

An internationally recognized MOOC or professional certification selected for academic equivalence shall demonstrate a verified learning workload appropriate to the proposed credit-hour equivalence. For a 3-credit-hour equivalence, the target workload is 45–48 hours, including video lectures, reading materials, quizzes, assignments, projects, and final assessments.

Upon successful completion and departmental verification, MOOCs or professional certifications may be considered equivalent to a 3-credit-hour course, subject to approval by the Board of Studies, Board of Faculties, Academic Council, and applicable NTC regulations.

Students may select any approved course or combination of approved courses within the prescribed learning-hour requirements across the four-year degree program. The duration of MOOCs/professional certifications may vary depending on the provider, course content, assessment structure, and approved credit-hour equivalence.

Table - Guidelines for Credit Equivalence

Curriculum Component	Conventional Course	MOOC Equivalent
1 Credit Hour	15 contact hours	15-17 hours of verified learning + assessment
2 Credit Hours	30 contact hours	30-32 hours of learning + graded assignments + proctored assessment
3 Credit Hours	45 contact hours	45-48 hours of learning + projects + final assessment

11.8. Implementation Framework

Each student shall complete one or more approved MOOCs or internationally recognized certifications during the degree.

The selected courses shall:

- Be offered through an approved online learning platform.
- Have a verified duration of 45-48 learning hours.
- Be approved by the departmental MOOC Coordinator before enrollment.
- Be completed with the required passing criteria established by the provider.
- Be verified by the department before academic credit is awarded.

Successful completion shall be recorded on a Pass/Fail basis unless otherwise specified by university regulations.

11.9. Roles and responsibilities

Effective implementation of this Framework requires clearly defined institutional responsibilities at each stage of the approval and verification process:

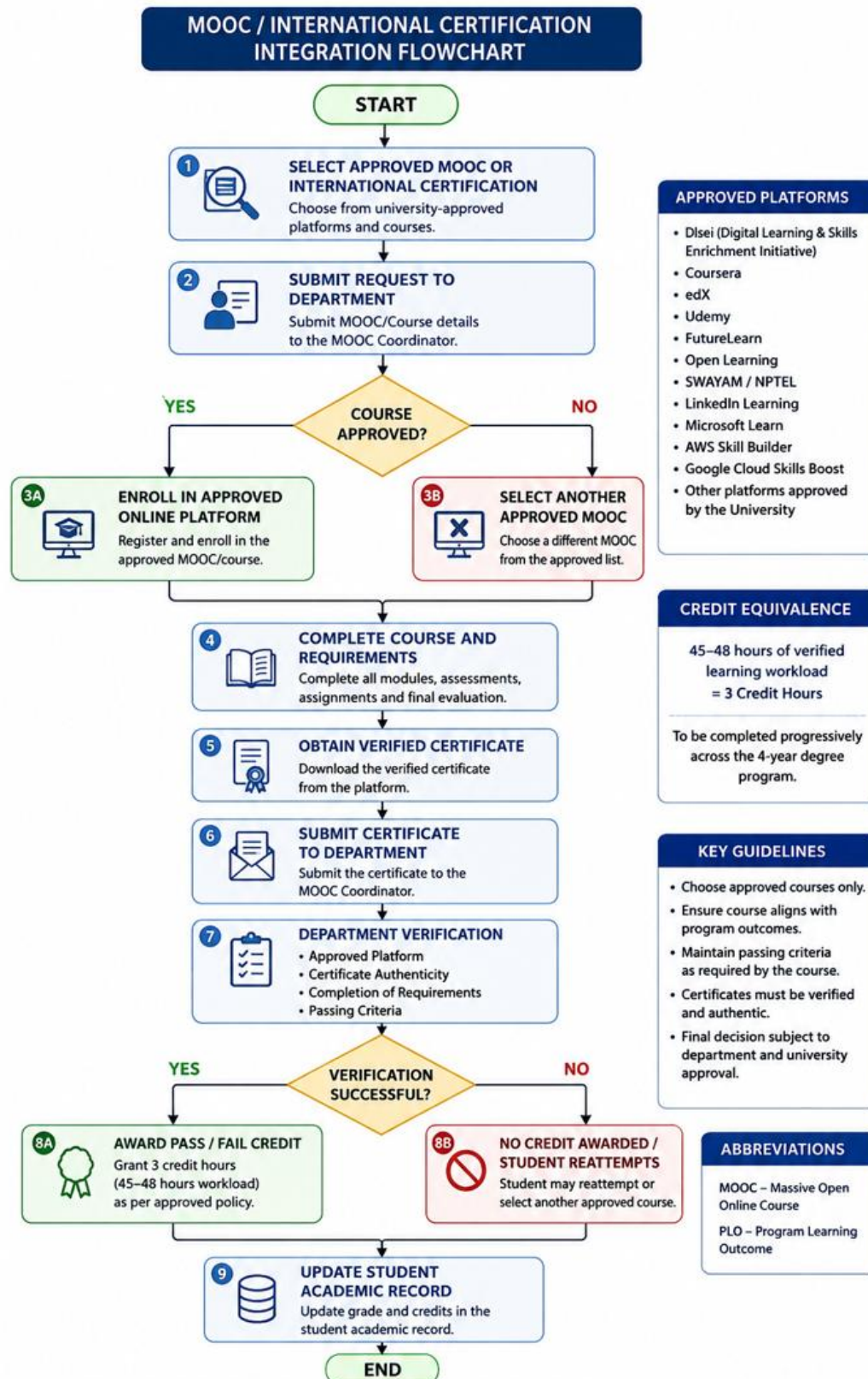
- Department / MOOC Coordinator: Reviews and pre-approves candidate MOOCs against the criteria; maintains a departmental register of approved courses.
- The Head of Department will approve the course to award the credit hours for the subject.

11.10. Quality Assurance and Monitoring

- Only courses offered by the approved platforms, or specifically approved by the university, shall be eligible for credit equivalence.
- Departments shall maintain verifiable records (certificates, transcripts, or provider verification links) for every credit awarded under this Framework.
- The MOOC Coordinator shall submit an annual compliance report to the Board of Studies, summarizing enrollments, completions, and any concerns regarding academic integrity or course quality.
- Universities shall put in place mechanisms to prevent misrepresentation of MOOC completion, including plagiarism checks and, where offered by the provider, proctored assessments.
- This Framework shall be reviewed periodically (recommended: every two academic years) by the National Curriculum Review Committee to reflect evolving industry needs and platform offerings.

11.11. Exemplary Recommended Courses

The following courses are provided as representative examples to guide departmental MOOC Coordinators and the Board of Studies in the initial approval process. This list is illustrative and not exhaustive; departments may propose additional courses meeting the criteria.



Institutional Governance and Approval Hierarchy



Curriculum for Bachelor of Science in Civil Engineering Technology



S. No.	Course name	Difficulty level	Duration	Duration (hrs.)	Proposed credit hour equivalency	International Rating	Platform
1.	BIM Fundamentals for Engineers	Beginner	2 weeks to complete at 10 hours a week	20	1.33	4.7	https://www.coursera.org/learn/bim-fundamentals
2.	Estimating Fundamentals	Mixed	9 hours	9	0.6	5	https://www.coursera.org/learn/estimating-fundamentals
3.	Natural Disaster Risk in Infrastructure Projects	Beginner	6 hours to complete	6	0.39	4.6	https://www.coursera.org/learn/natural-disaster-risk-in-infrastructure-projects
4.	The Nuts and Bolts of Machine Learning	Advance	3 weeks to complete at 10 hours a week	30	2	4.8	https://www.coursera.org/learn/the-nuts-and-bolts-of-machine-learning
5.	Satellite Imagery, Remote Sensing and Machine Learning Specialization	Intermediate	4 weeks to complete at 10 hours a week	40	2.67	4.3	https://www.coursera.org/specializations/satellite-imagery-remote-sensing-ml
6.	Building Smarter: BIM in Practice Specialization	Intermediate	4 weeks to complete at 10 hours a week	40	2.67	4.6	https://www.coursera.org/specializations/building-smarter-bim-in-practice
7.	Health, Safety, and Environmental (HSE)	Beginner	4 weeks to complete at 10	40	2.67	4.7	https://www.coursera.org/specializations/health-safety-



Curriculum for Bachelor of Science in Civil Engineering Technology



	Engineering Specialization		hours a week				<u>environmental-hse-engineering</u>
8.	Geotechnical Foundation Design (Specialization)	Advanced	4 weeks to complete at 10 hours a week	40	2.67	4	https://www.coursera.org/specializations/geotechnical-foundation-design
9.	Construction Project Management	Beginner	3 weeks to complete at 10 hours a week	30	2	4.8	https://www.coursera.org/learn/construction-project-management
10.	Bridge Infrastructure Design Specialization	Advanced	4 weeks to complete at 10 hours a week	40	2.67	4	https://www.coursera.org/specializations/bridge-infrastructure-design
11.	AutoCAD MEP & Commercial Infrastructure Design Specialization	Beginner	4 weeks to complete at 10 hours a week	40	2.67	4.8	https://www.coursera.org/specializations/autocad-mep-commercial-infrastructure-design
12.	Highway Planning, Pavement Design and Construction Specialization	Advanced	4 weeks to complete at 10 hours a week	40	2.67	4.6	https://www.coursera.org/specializations/highway-planning-pavement-design-and-construction
13.	Google Project Management	Beginner	Approx. 13 hours to complete	13	1	4.9	https://www.coursera.org/learn/project-management-foundations?specialization=google-project-management



Curriculum for Bachelor of Science in Civil Engineering Technology



14.	PMP Certification Exam Prep	advanced	Approx. 8 weeks (4 hours per week)	35	2	4.3	https://www.pmtraining.com/pmp/live-classes-overview
15.	Generative AI: Introduction and Applications	Beginner	Approx. 10 hours	10	0.89	4.6	https://www.coursera.org/learn/generative-ai-introduction-and-applications?specialization=ibm-generative-ai-engineering
16.	Master AutoCAD Basics	Beginner	Approx. 6 hours	6	0.5	4.7	https://www.coursera.org/learn/master-autocad-basics-create-modify-annotate-2d-drawings#modules
17.	Oracle Primavera P6	Beginner	Approx. 8 hrs.	8	0.68	4.7	https://www.coursera.org/learn/packtpub-oracle-primevera-p6-project-setup-and-basic-management-pit3e
18.	Structural scheme setting and ETABS Analysis of RCC Building	intermediate	1 week (Approx. 10 hrs.)	10	0.67	4.8	https://www.coursera.org/learn/structural-scheme-setting-and-etabs-analysis-of-rcc-building#modules
19.	Take Your English Communication Skills to the Next Level	Intermediate	1 week (Approx. 10 hrs.)	10	0.67	4.7	https://www.coursera.org/learn/english-communication-capstone?specialization=improve-english#modules
20.	Protecting the World: Introducing Corrosion	Intermediate	1 week (Approx. 10 hrs.)	10	0.67	4.6	https://www.coursera.org/learn/corrosion

	Science and Engineering						
21.	Design and Construction of Hydropower Structures Specialization	Advanced	4 weeks to complete at 10 hours a week	40	2.67	3.6	https://www.coursera.org/specializations/design-and-construction-of-hydropower-structures

11.12. Conclusion

The proposed Framework for the Integration of International Certifications and Massive Open Online Courses (MOOCs) into Undergraduate Engineering Technology Programs provides a structured approach to strengthening students' practical, digital, professional, and industry-relevant competencies. The framework proposes that students complete approved international certifications or MOOCs with a verified learning workload of 45–48 hours, equivalent to 3 credit hours, distributed across the four-year degree program. This approach allows students to progressively acquire market-relevant skills alongside their formal academic studies.

11.13. References

- Higher Education Commission of Pakistan. (2026). *Letter No. HEC/CURR/GEN/2026/9155* [Official correspondence].
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Curriculum for
Bachelor of Science in Civil Engineering Technology



Appendix A: Minutes of the Preliminary Meeting of the National Curriculum Review Committee (NCRC) for BS Civil Engineering Technology

Venue: National University of Technology (NUTECH), Islamabad

Dates: May 18-20, 2026

Organized by: National Technology Council (NTC) in collaboration with Higher Education Commission (HEC), Pakistan, and GIZ Germany

Day 1 Proceedings

Opening Session

The preliminary meeting of the National Curriculum Review Committee (NCRC) for the BS Civil Engineering Technology program was held from 18-05-2026 to 20-05-2026 at NUTECH, Islamabad. The meeting started with the recitation of the Holy Quran. **Prof. Dr. Wasim Khaliq** welcomed the participants and highlighted the objectives and significance of the meeting in the context of outcome-based education and international accreditation requirements.

The Chairman NTC delivered an opening address, highlighting the objectives of the meeting, emphasizing the importance of developing a contemporary, outcome-based curriculum that aligns with both national requirements and international accreditation standards.

Following the introductory remarks, the house nominated a Convener, a Co-Convener, a Secretary, and a Co-Secretary for the NCRC.

Sr. No.	NCRC Members (Full Name & Affiliation)	Role
1	Prof. Dr. Wasim Khaliq, Principal NUSAT, National University of Technology (NUTECH), Islamabad	Convener
2	Prof. Dr. Anwar Khatab, Dean, Mirpur University of Science & Technology (MUST), AJ&K	Co-Convener
3	Prof. Dr. Manthar Ali Keerio, Dean, Benazir Bhutto Shaheed University of Technology & Skill Development (BBS-UTECH), Khairpur Mirs	Secretary
4	Dr. Malik Sarmad Riaz, Associate Professor, National University of Technology (NUTECH), Islamabad	Co-Secretary

The participants were:

1	Prof. Dr. Attaullah Shah, Vice Chancellor, Karakoram International University (KIU), Gilgit
2	Prof. Dr. Tariq Bashir, Dean, CECOS University of Information Technology & Emerging Sciences, Peshawar



Curriculum for
Bachelor of Science in Civil Engineering Technology



3	Prof. Dr. Usman Rashid, Dean, Punjab Tianjin University of Technology (PTUT), Lahore
4	Prof. Dr. Irfan Zafar, HoD, National University of Technology (NUTECH), Islamabad
5	Prof. Dr. Muhammad Khurram Shahzad, HoD, University of Southern Punjab (USP), Multan
6	Dr. Imran Hafeez, Professor, University of Engineering & Technology (UET), Taxila
7	Prof. Dr. Samia Tariq, HoD, Ziauddin University (ZU), Karachi
8	Dr. Anum Khalid, HoD, Superior University (SU), Lahore
9	Dr. Muhammad Aqib (International Expert, Online Mode), Geotechnical Specialist - Wind Energy, Korea; Ex- HoD Civil, NUTECH Islamabad
10	Dr. Muhammad Habib, HoD, National Skills University (NSU), Islamabad
11	Dr. Rashid Farooq, HoD & Director ORIC, International Islamic University (IIU), Islamabad
12	Dr. Saeed Ullah Jan, Associate Professor, Balochistan University of Information Technology, Engineering and Management Sciences (BUIEMS), Quetta
13	Dr. Muhammad Yaqoob Raza (Technologist Representative), Al Hamra University, Lahore
14	Dr. Nafeesa Shaheen, Assistant Professor, National University of Technology (NUTECH), Islamabad
15	Mr. Mirza Hammad Ghazanfar Baig (Industrial Representative), Senior Project Manager, Frontier Works Organization, Rawalpindi
16	Engr. Fatima Mehwish, Lecturer, MNS UET, Multan
17	Mr. Hidayatullah Kasi (HEC Representative), Deputy Director, Academics Division, HEC, Islamabad
18	Hafiz Ghulam Muhammad (NTC Representative), Deputy Director, NTC, Islamabad

- The participants were briefed on the agenda of the meeting, which included preliminary discussions on course contents, subject assignments, and the formation of subcommittees tasked with specific domains of the Civil Engineering Technology program.

Technical Proceedings

- Mr. Hidayatullah Kasi, Deputy Director, Academics Division, HEC Islamabad, delivered a presentation on curriculum development guidelines and the HEC curriculum template with emphasis on the General Education framework.
- Sub-committees were formally constituted and assigned specific responsibilities to ensure efficient workflow during the course review process.

Sub-Committee for the review of courses related to structures

1	Prof. Dr. Anwar Khitab, Dean, Mirpur University of Science & Technology (MUST), AJ&K	Chair
2	Dr. Muhammad Habib, HoD, National Skills University (NSU), Islamabad	Secretary/ Member
3	Prof. Dr. Wasim Khaliq, Principal NUSAT, National University of Science & Technology (NUSAT), Islamabad	Member
4	Prof. Dr. Manthar Ali Keerio, Dean, Benazir Bhutto Shaheed University of Technology & Skill Development (BBSUTSD), Khairpur Mirs	Member
5	Prof. Dr. Samia Tariq, HoD, Ziauddin University (ZU), Karachi	Member
6	Dr. Anum Khalid, HoD, Superior University (SU), Lahore	Member
7	Dr. Nafeesa Shaheen, Assistant Professor, National University of Science & Technology (NUSAT), Islamabad	Member
8	Engr. Fatima Mehwish, Lecturer, MNS UET, Multan	Member

Sub-Committee for the review of courses related to Highways, Geotech, and Transportation

1	Prof. Dr. Attaullah Shah, Vice Chancellor, Karakoram International University (KIU), Gilgit	Chair
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Curriculum for
Bachelor of Science in Civil Engineering Technology



2	Dr. Malik Sarmad Riaz, Associate Professor, National University of Technology (NUTECH), Islamabad	Secretary/ Member
3	Dr. Imran Hafeez, Professor, University of Engineering & Technology (UET), Taxila	Member
4	Dr. Muhammad Aqib (International Expert, Online Mode), Geotechnical Specialist - Wind Energy, Korea; Ex-HoD Civil, NUTECH Islamabad	Member
5	Dr. Saeed Ullah Jan, Associate Professor, Balochistan University of Information Technology, Engineering and Management Sciences (BUITEMS), Quetta	Member
6	Mr. Mirza Hammad Ghazanfar Baig (Industrial Representative), Senior Project Manager, Frontier Works Organization, Rawalpindi	Member

Sub-Committee for the review of courses related to Environment and Water

1	Prof. Dr. Tariq Bashir, Dean, CECOS University of Information Technology & Emerging Sciences, Peshawar	Chair
2	Dr. Muhammad Khurram Shahzad, HoD, University of Southern Punjab (USP), Multan	Secretary/ Member
3	Prof. Dr. Usman Rashid, Dean, Punjab Tianjin University of Technology (PTUT), Lahore	Member
4	Dr. Rashid Farooq, HoD & Director ORIC, International Islamic University (IIU), Islamabad	Member
5	Dr. Muhammad Yaqoob Raza (Technologist Representative), Al Hamra University, Lahore	Member

Sub-Committee for the review of courses related to General Education

1	Dr. Nafeesa Shaheen, Assistant Professor, National University of Technology (NUTECH), Islamabad	Chair
2	Engr. Fatima Mehwish, Lecturer, MNS UET, Multan	Member

Sub-committee to oversee the format of the scheme of studies and course content (folder)

1	Dr. Muhammad Khurram Shahzad, HoD, University of Southern Punjab (USP), Multan	Chair
2	Prof. Dr. Samia Tariq HoD, Ziauddin University (ZU), Karachi	Member
3	Dr. Muhammad Habib, HoD, National Skills University (NSU), Islamabad	Member

Sub-committee to oversee the curriculum benchmarking with international standards and the Sydney Accord.

1	Dr. Saeed Ullah Jan, Associate Professor, Balochistan University of Information Technology, Engineering and Management Sciences (BUIEMS), Quetta	Chair
2	Prof. Dr. Tariq Bashir, Dean, CECOS University of Information Technology & Emerging Sciences, Peshawar	Member
3	Prof. Dr. Samia Tariq, HoD, Ziauddin University (ZU), Karachi	Member

3. Subject courses were assigned to each subcommittee based on the expertise and specialization of the participants, ensuring that each course received detailed attention from qualified members.
4. Preliminary discussions were conducted regarding the course contents, knowledge profiles, and skills expected of graduates, as well as the mapping of course learning outcomes (CLOs) and program learning outcomes (PLOs).
5. The first day concluded with a summary of the work done, highlighting the progress achieved in course assignments and subcommittee formation, and providing a roadmap for the detailed discussions scheduled for Day 2.

Day 2 Proceedings

6. The second day focused on comprehensive discussions regarding the scheme of study, including credit hours, course sequence, and ensuring alignment with the guidelines provided by HEC and NTC.
7. Each subcommittee presented detailed course contents of all major subjects in Civil Engineering Technology, along with their respective CLOs and PLOs, ensuring proper alignment with international standards and the outcome-based education framework.

8. Emphasis was placed on mapping the skills and competencies required for graduates in the civil engineering technology sector, along with the integration of practical laboratory components, project-based learning, and industry-oriented applications.
9. Recommendations regarding elective courses, subject nomenclature, and domain-wise distribution were reviewed, refined, and finalized by the committee to ensure a balanced and rigorous curriculum.

Day 3 Proceedings

Course Contents and Expert Presentations

10. The third day involved detailed discussions on course contents related to general education and interdisciplinary subjects, with presentations provided by experts to guide the integration of industry-relevant skills and global best practices.
11. Prof. Dr. Usman Rashid presented findings on international benchmarking, including observations from the Sydney Accord and other global standards, emphasizing the incorporation of globally recognized competencies into the curriculum.
12. Committee members reviewed and discussed the skills to be included in each subject, ensuring that graduates acquire both theoretical knowledge and practical competencies necessary for professional practice.
13. Presentations and discussions were conducted on mandatory certifications for certain courses, with suggested durations ranging from six to twelve months, in line with HEC and NTC policy guidelines.
14. Participants visited laboratories, innovation facilities, and the National Incubation Center (NIC) at NUTECH.
15. Support for the courses was further strengthened through the assignment of BDEAs and Teaching Assistants (TAs), responsible for aiding in laboratory sessions, assignments, and course delivery.
16. The committee emphasized that these guidelines serve as a framework, and Higher Education Institutions (HEIs) are encouraged to adopt, adapt, or modify the curriculum according to their institutional strengths and resources.

Lastly, it was decided to hold an online meeting within 15 days to review progress before the final in-person meeting.

Remarks by Lt. Gen. Moazzam Ejaz, HI (M) (Retd.), Chairman NTC

- The Chairman emphasized the need to strengthen collaborations between industry and academia, leveraging both centralized initiatives through NTC and decentralized institutional efforts, noting that modern educational practices increasingly favor a decentralized model.
- Plans for expanded teacher training programs and professional development initiatives were highlighted as a critical next step to enhance faculty capabilities.

- HEIs were encouraged to actively develop partnerships among themselves and with industry to facilitate internships, supervised industrial training, and hands-on exposure, addressing gaps that graduates often face in employability.
- A key point addressed was the difficulty Engineering Technology graduates face in Pakistan in securing government jobs. The Chairman outlined the ongoing efforts undertaken by NTC to mitigate this issue, including creating pathways for industry engagement, advocacy with government bodies, and initiatives to enhance graduate employability
- Support from HEC for initiating MS and PhD programs in Engineering Technology disciplines was acknowledged, aiming to advance research and higher education opportunities.
- HEC's role in providing funding support for laboratory infrastructure was highlighted as a means to strengthen practical and technical training in HEIs.
- Ongoing efforts to achieve international recognition and alignment with the Sydney Accord were reaffirmed as key strategic objectives for curriculum development and graduate competency.

Conclusion

The meeting concluded with a vote of thanks by the Chairman NTC, Lt. Gen. Moazzam Ejaz, HI (M) (Retd.), who appreciated the active participation and valuable contributions of all members. Commemorative shields were distributed among the participants in recognition of their contributions.

Appendix B: Range of Problem Identification and Solving

(Retrieved from www.internationalengineeringalliance.org)

In the context of both Graduate Attributes and Professional Competences, Broadly-defined Engineering Problems have characteristic SP1 and some or all of SP2 to SP7:	
Depth of Knowledge Required	SP1: Cannot be resolved without engineering knowledge at the level of one or more of SK 4, SK5, and SK6 supported by SK3 with a strong emphasis on the application of developed technology
Range of conflicting requirements	SP2: Involve a variety of conflicting technical and non-technical issues (such as ethical, sustainability, legal, political, economic, societal) and consideration of future requirements
Depth of analysis required	SP3: Can be solved by application of well-proven analysis techniques and models
Familiarity of issues	SP4: Belong to families of familiar problems which are solved in well-accepted ways
Extent of applicable codes	SP5: Address problems that may be partially outside those encompassed by standards or codes of practice
Extent of stakeholder involvement and conflicting requirements	SP6: Involve different engineering disciplines and other fields with several groups of stakeholders with differing and occasionally conflicting needs
Interdependence	SP7: Address components of systems within complex engineering problems

Appendix C: Range of Engineering Activities

(Retrieved from www.internationalengineeringalliance.org)

Broadly-defined activities means (engineering) activities or projects that have some or all of the following characteristics:
Range of resources TA1: Involve a variety of resources including people, data and information, natural, financial and physical resources and appropriate technologies including analytical and/or design software
Level of interactions TA2: Require the best possible resolution of occasional interactions between technical, non-technical, and engineering issues, of which few are conflicting
Innovation TA3: Involve the use of new materials, techniques or processes in non-standard ways
Consequences to society and the environment TA4: Have reasonably predictable consequences that are most important locally, but may extend more widely
Familiarity TA5: Require a knowledge of normal operating procedures and processes

Appendix D: Sydney Accord Knowledge and Attitude Profile

(Retrieved from www.internationalengineeringalliance.org)

A Sydney Accord program provides:
SK1: A systematic, theory-based understanding of the natural sciences applicable to the sub-discipline and awareness of relevant social sciences
SK2: Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed consideration and use of models applicable to the sub-discipline
SK3: A systematic, theory-based formulation of engineering fundamentals required in an accepted sub-discipline
SK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline
SK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations using the technologies of a practice area
SK6: Knowledge of engineering technologies applicable in the sub-discipline
SK7: Knowledge of the role of technology in society and identified issues in applying engineering technology, such as public safety and sustainable development (represented by the 17 UN-SDGs)
SK8: Engagement with the current technological literature of the discipline and awareness of the power of critical thinking
SK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc., with mutual understanding and respect, and of inclusive attitudes

Appendix E: Engineering Technologist Graduate Attribute Profile

(Retrieved from www.internationalengineeringalliance.org)

As per the Sydney Accord, the Engineering Technologist Graduate is expected to have the following attributes:
Engineering Knowledge: SA1: Apply knowledge of mathematics, natural science, computing and engineering fundamentals and an engineering specialization as specified in SK1 to SK4 respectively to defined and applied engineering procedures, processes, systems or methodologies.
Problem Analysis: SA2: Identify, formulate, research literature and analyze broadly-defined engineering problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialization (SK1 to SK4)
Design/development of solutions: SA3: Design solutions for broadly-defined engineering technology problems and contribute to the design of systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required (SK5)
Investigation: SA4: Conduct investigations of broadly-defined engineering problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions (SK8)
Tool Usage SA5: Select and apply, and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to broadly-defined engineering problems (SK2 and SK6)
The Engineer and the World: SA6: When solving broadly-defined engineering problems, analyze and evaluate sustainable development impacts* to: society, the economy, sustainability, health and safety, legal frameworks, and the environment (SK1, SK5, and SK7)
Ethics: SA7: Understand and commit to professional ethics and norms of engineering technology practice including compliance with national and international laws. Demonstrate an understanding of the need for diversity and inclusion (SK9)
Individual and Collaborative Team work: SA8: Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (SK9)



Curriculum for Bachelor of Science in Civil Engineering Technology

**Communication:**

SA9: Communicate effectively and inclusively on broadly-defined engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, taking into account cultural, language, and learning differences.

Project Management and Finance:

SA10: Apply knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.

Lifelong learning:

SA11: Recognize the need for, and have the ability for i) independent and lifelong learning and ii) critical thinking in the face of new specialist technologies (SK8)

* Represented by the 17 UN Sustainable Development Goals (UN-SDG)

Appendix F: Engineering Technologist Professional Competence Profile

(Retrieved from www.internationalengineeringalliance.org)

As per the Sydney Accord, an Engineering Technologist Graduate is expected to demonstrate the following competencies:
Comprehend and apply universal knowledge: TC1: Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems or methodologies
Comprehend and apply local knowledge: TC2: Comprehend and apply the knowledge embodied procedures, processes, systems or methodologies that is specific to the jurisdiction of practice
Problem analysis: TC3: Identify, clarify, and analyze broadly-defined problems using the support of computing and information technologies where applicable
Design and development of solutions: TC4: Design or develop solutions to broadly-defined problems considering a variety of perspectives
Evaluation: TC5: Evaluate the outcomes and impacts of broadly-defined activities
Protection of society: TC6: Recognize the foreseeable economic, social, and environmental effects of broadly-defined activities and seek to achieve sustainable outcomes*
Legal, regulatory, and cultural: TC7: Meet all legal, regulatory, and cultural requirements and protect public health and safety in the course of all activities
Ethics: TC8: Conduct activities ethically
Manage engineering activities: TC9: Manage part or all of one or more broadly-defined activities
Communication and Collaboration: TC10: Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders in the course of all activities
Continuing Professional Development (CPD) and Lifelong learning: TC11: Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work



Curriculum for Bachelor of Science in Civil Engineering Technology

**Judgement:**

TC12: Choose appropriate technologies to deal with broadly-defined problems. Exercise sound judgement in the course of all broadly-defined activities

Responsibility for decisions:

TC13: Be responsible for making decisions on part or all of one or more broadly-defined activities

*Represented by the 17 UN Sustainable Development Goals (UN-SDG)

Appendix G: Sample Broadly-Defined Engineering Problem

1. Problem Statement

TENDER NOTICE ANYNOMOUS UNIVERSITY, ISLAMABAD	
INVITATION FOR BIDS	
Sealed tenders are invited from NTC-registered contractors in relevant category for the following project:	
Project Title: Construction of Commercial Building (G+2)	
Plot Size Condition (For Students): Base plot size is 30 ft × 50 ft. Each student must individually modify the plot size by adding or subtracting the last two digits of their roll number to either length or width.	
Scope of Work: Construction of a G+2 commercial building including civil works only.	
Eligibility Criteria: Valid registration with NTC ■ Relevant experience in similar projects ■ Sound financial position	
Tender Details: - Tender Documents: Available from 17 April 2026 - Submission Deadline: 02 May 2026 (11:00 AM) - Bid Opening: Same day at 11:30 AM	
Bid Security: 2% of estimated cost in shape of CDR/Bank Draft in favor of ANYNOMOUS UNIVERSITY.	
Completion Period: 10–12 Months	
Terms & Conditions: ■ As per applicable procurement rules ■ Incomplete or late bids will not be accepted ■ All applicable taxes will be deducted	
KEY REQUIREMENTS FOR BID PROPOSAL	
1	Comply with applicable Pakistan building codes, engineering standards, and safety regulations.
2	Prepare complete quantity takeoff (BOQ) for civil works.
3	Provide detailed cost estimate including direct, indirect costs, contingencies, and taxes.
4	Submit rate analysis for all major items.
5	Calculate bid security as 2% of estimated cost in shape of CDR/Bank Draft.
6	Prepare complete tender documents including BOQ, drawings, specifications, and conditions of contract.
7	Submit a comprehensive financial proposal with construction schedule (10–12 months).
Contact Information: Procurement Office Anynomous University Islamabad, Pakistan Ph: XXXX-XXXXXXX Email: procurement@anynomous.edu.pk	
(Procurement Officer) Anynomous University, Islamabad	

2. Mapped CLO Statements

CLOs	Statement	Taxonomy (Level)	Program Learning Outcomes (PLO)
CLO-2	Apply standard methods to compute material quantities and prepare bills of quantities and cost estimates for civil engineering projects.	C3	PLO-2/SA2
CLO-4	Demonstrate accuracy, teamwork, and professional responsibility in preparing engineering estimates and technical documentation	A3	PLO-10/SA10

3. Problem Statement Table

Broadly-Defined Engineering Problem (BDEP)	Required Activities	Knowledge Area Attributes	Range of Problem	Relevant CLO	Mapped SDGs
Prepare a complete bid proposal for the construction of a G+2 Commercial Building at the Anonymous University of, Islamabad, as per the tender notice. The base plot size is 30 ft × 50 ft. Each student shall modify either the length or the width by adding or subtracting the last two digits of their roll number. The proposal shall include quantity takeoff, cost estimation, rate analysis, bid security calculation, and the preparation of tender documents, with consideration of civil works. The solution shall comply with the Government of Pakistan/ NTC procurement procedures, applicable building codes, and engineering standards	Students shall perform the following activities: 1. Modify the plot dimensions according to the roll number. 2. Develop a conceptual architectural layout for a G+2 commercial building. 3. Calculate quantities of civil, electrical, and plumbing works. 4. Prepare BOQ and detailed cost estimate 5. Perform rate analysis using market rates 6. Calculate bid security (2% of estimated cost) 7. Prepare complete bid documents, including cover letter, company profile, technical proposal, financial proposal, and conclusion	SK3: Engineering Fundamentals SK4: Engineering Specialist Knowledge	SP1: Depth of Knowledge required SP3: Depth of analysis required SP4: Familiarity of issues	CLO-2 CLO-4	SDG-12

4. Range of Problem Identification and Solving

	Attribute	Broadly-Defined Problem Attribute
SP1	Depth of Knowledge Required	Cannot be resolved without engineering knowledge at the level of one or more of SK 4, SK5, and SK6 supported by SK3 with a strong emphasis on the application of developed technology
SP2	Range of conflicting requirements	Involve a variety of conflicting technical and non-technical issues (such as ethical, sustainability, legal, political, economic, societal) and consideration of future requirements
SP3	Depth of Analysis Required	Can be solved by application of well-proven analysis techniques
SP4	Familiarity of issues	Belong to families of familiar problems, which are solved in well accepted ways
SP5	Extent of applicable codes	Address problems that may be partially outside those encompassed by standards or codes of practice
SP6	Extent of stakeholder involvement and level of conflicting requirements	Involve different engineering disciplines and other fields with several groups of stakeholders with differing and occasionally conflicting needs
SP7	Interdependence	Address components of systems within complex engineering problems

5. Knowledge and Attitude Profiles

Knowledge Profile	Description
SK1: Natural Sciences	A systematic theory-based understanding of natural sciences applicable to the discipline
SK2: Mathematics and Computing	Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed consideration and use of models applicable to the sub-discipline
SK3: Engineering Technology Fundamentals	A systematic, theory-based formulation of engineering fundamentals required in an accepted sub-discipline
SK4: Engineering Technology Specialization	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline

SP5: Engineering Design and Operations	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations using the technologies of a practice area
SK6: Engineering Technology Practice	Knowledge of engineering technologies applicable in the sub- discipline
SK7: Engineering Technology in Society	Knowledge of the role of technology in society and identified issues in applying engineering technology, such as public safety and sustainable development (represented by the 17 UN-SDGs).
SK8: Research Literature	Engagement with the current technological literature of the discipline and awareness of the power of critical thinking.
SK9: Ethics	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

6. Assessment Rubrics of Broadly-Defined Engineering Problem (Guidelines)

Sr. No.	Assessment Criterion	Poor (1)	Satisfactory (2)	Good (3)	Very Good (4)	Excellent (5)
1	Quantity Takeoff & BOQ	Incomplete and inaccurate	Basic work with several errors	Mostly complete with minor errors	Complete and accurate	Complete, accurate, and well-organized
2	Cost Estimation & Rate Analysis	Incomplete or inaccurate	Basic estimate with several errors	Mostly accurate with minor errors	Accurate with appropriate rates	Highly accurate with well-justified rates
3	Bid Security & Tender Documentation	Incomplete documents; incorrect bid security	Major documents included with errors	Documents mostly complete; minor errors	Complete documents and correct bid security	Complete, accurate, and professional documents
4	Procurement, Codes & Standards Compliance	Does not follow requirements	Limited understanding of requirements	Generally, follows the requirements	Good application of requirements	Excellent application of codes and standards
5	Technical Integration & Report Writing	Poor integration and presentation	Basic integration and presentation	Good integration and clear presentation	Well-integrated and professional	Excellent integration and highly professional

7. Presentation Assessment of Broadly-Defined Engineering Problem (Guidelines)

Sr. No.	Assessment Criterion	Poor (1)	Satisfactory (2)	Good (3)	Very Good (4)	Excellent (5)
1	Technical Content & Accuracy	Major errors; important content missing	Basic content with several errors	Most content is correct with minor errors	Complete and accurate	Complete, highly accurate, and technically strong
2	Analysis & Justification	Unable to explain calculations or decisions	Limited explanation and justification	Explains major calculations and assumptions	Clear analysis and good justification	Excellent analysis with strong engineering reasoning
3	Compliance & Engineering Standards	Does not address relevant standards	Limited understanding of requirements	Generally follows requirements with some gaps	Good application of PEC/NTC and relevant standards	Excellent and accurate application of PEC/NTC, codes, and standards
4	Communication & Presentation Skills	Unclear and poorly organized	Understandable, but lacks clarity or confidence	Clear and organized presentation	Confident and well-structured presentation	Highly confident, clear, and professional presentation
5	Questions, Defense & Professionalism	Unable to answer key questions	Answers basic questions with difficulty	Answers most questions adequately	Answers questions confidently and accurately	Provides excellent, precise, and well-reasoned answers

Appendix H: Definitions of Terms

(Retrieved from www.internationalengineeringalliance.org)

Note: These definitions apply to terms used in this document.

Awareness: Recognizing the context and implications while using or applying what has been learned. The demonstration of awareness can be more varied than a demonstration of knowledge. Asking the right questions, including among the assumptions made, complying with or respecting when faced with a situation may be acceptable demonstrations.

Broadly-defined engineering problems: a class of problem with characteristics defined in Appendix A.

Broadly-defined engineering activities: a class of activities with characteristics defined in Appendix B.

Continuing Professional Development: the systematic, accountable maintenance, improvement and broadening of knowledge and skills, and the development of personal qualities necessary for the execution of professional and technical duties throughout an engineering practitioner's career.

Engineering sciences: include engineering fundamentals that have roots in the mathematical and physical sciences, and where applicable, in other natural sciences, but extend knowledge and develop models and methods in order to lead to applications and solve problems, providing the knowledge base for engineering specialisations.

Engineering design knowledge: Knowledge that supports engineering design in a practice area, including codes, standards, processes, empirical information, and knowledge reused from past designs.

Engineering discipline: synonymous with branch of engineering.

Engineering fundamentals: a systematic formulation of engineering concepts and principles based on mathematical and natural sciences to support applications.

Engineering management: the generic management functions of planning, organising, leading and controlling, applied together with engineering knowledge in contexts including the management of projects, construction, operations, maintenance, quality, risk, change and business.

Engineering problem: a problem that exists in any domain that can be solved by the application of engineering knowledge and skills and generic competences.

Engineering practice area: a generally accepted or legally defined area of engineering work or engineering technology.



Curriculum for Bachelor of Science in Civil Engineering Technology



Engineering speciality or specialization: a generally-recognized practice area or major subdivision within an engineering discipline, for example Structural and Geotechnical Engineering within Civil Engineering; the extension of engineering fundamentals to create theoretical frameworks and bodies of knowledge for engineering practice areas.

Engineering technology: is an established body of knowledge, with associated tools, techniques, materials, components, systems or processes that enable a family of practical applications and that relies for its development and effective application on engineering knowledge and competence.

Knowledge: Recognizing and comprehending terminology, facts, methods, trends, classifications, structures, or theories. It involves learning as well as demonstrating what has been learned. The demonstration of a specific knowledge is invariably by means of work done based on that knowledge.

Manage: means planning, organising, leading and controlling in respect of risk, project, change, financial, compliance, quality, ongoing monitoring, control and evaluation.

Mathematical sciences: mathematics, numerical analysis, statistics and aspects of computer science cast in an appropriate mathematical formalism.

Natural sciences: Provide, as applicable in each engineering discipline or practice area, an understanding of the physical world including physics, mechanics, chemistry, earth sciences and the biological sciences,

Practice area: in the educational context: synonymous with generally-recognized engineering speciality; at the professional level: a generally recognized or distinctive area of knowledge and expertise developed by an engineering practitioner by virtue of the path of education, training and experience followed.

Solution: means an effective proposal for resolving a problem, taking into account all relevant technical, legal, social, cultural, economic and environmental issues and having regard to the need for sustainability.

Subdiscipline: Synonymous with engineering speciality.



Curriculum for Bachelor of Science in Civil Engineering Technology



Appendix I: National and International Benchmarking for BS Civil Engineering Technology Curriculum 2026

National and International Benchmarking for BS Civil Engineering Technology Program					
Category	Higher Education Commission (HEC), Pakistan	National Technology Council (NTC) Curriculum 2026, Pakistan	Sydney Accord–Aligned Programs		
			Unitec Institute of Technology, New Zealand (Similarity 83%)	Melbourne Polytechnic, Australia (Similarity 81%)	University Malaysia Pahang Malaysia (Similarity 79%)
Knowledge Area	Name of Courses				
General Education	Arts and Humanities	Professional Ethics	Professional Engineering Practice	Professional Engineering	Falsafah Dan Isu Samasa/ Soft Skills
	Natural Sciences	Applied Chemistry	-	-	Basic Physics
	Social Sciences	Applied Economics	-	-	English for Professional Communication
	Functional English	Functional English	Engineering Communication	-	Fundamentals of English Language
	Expository Writing	Expository Writing	Engineering Communication	-	English for Academic/ Technical/ Professional Communication
	Quantitative Reasoning–I	Quantitative Reasoning–I	Engineering Maths Level 5	Engineering Mathematics 1	Technical Mathematics
	Quantitative Reasoning–II	Quantitative Reasoning–II	Mathematics Level 6	Engineering Mathematics 2	Applied Calculus/ Applied Statistics
	Applications of Information and Communication Technologies	Applications of Information and Communication Technologies	Engineering Computing	Computer-Aided Engineering	-



Curriculum for Bachelor of Science in Civil Engineering Technology



	Entrepreneurship	Technopreneurship	Engineering Management	Engineering Management I	Technopreneurship
	Civics and Community Engagement	Civics and Community Engagement	-	-	Technology and Society
	Pakistan Studies	Pakistan Studies	Heritage, Culture and Sustainability in Engineering	-	-
	Ideology and Constitution of Pakistan	Ideology and Constitution of Pakistan	Heritage, Culture and Sustainability in Engineering	-	-
	Islamic Studies/Ethics	Islamic Studies/Ethics	-	-	Penghayatan Etika Dan Peradaban
	Fehm-e-Quran-I	Fehm-e-Quran-I	-	-	-
	Fehm-e-Quran-II	Fehm-e-Quran-II	-	-	-
Interdisciplinary	Interdisciplinary	Geology	Engineering Geology	Principles of Geomechanics	Geomatic Technology
	Interdisciplinary	GIS and Remote Sensing	Engineering Site Investigation/ Land Surveying 1	-	Elective I
	Interdisciplinary	Electro-Mechanical Technology	-	-	-
	Interdisciplinary	AI in Civil Engineering Technology	-	-	Information System in Civil Engineering
Civil Engineering Technology (Foundation)	Disciplinary Or Major	Materials and Methods of Construction	Civil Materials/ Civil Engineering Construction	Civil Engineering Construction	Construction Material Technology
		Architecture and Town Planning	-	-	Structure Analysis
		Surveying	Land Surveying 1	Surveying	-
		Engineering Mechanics	Structures 1	Mechanics of Structures 1	Engineering Mechanics



Curriculum for Bachelor of Science in Civil Engineering Technology



		Civil Engineering Drawing, Drafting and Interpretation	Engineering Design and Drawing	Engineering Skills 1 and 2	Civil Engineering Drawing
		Soil Mechanics	Geotechnical Engineering 1	Geotechnical Engineering 1	-
		Fluid Mechanics	Fluid Mechanics (Civil)	Fluid Mechanics	Fluid Mechanics
		Concrete Technology	Civil Materials/ Structural Concrete	Construction Materials	-
		Mechanics of Solids	Mechanics	Mechanics of Structures 2	Mechanics of Materials
		Environmental Engineering	Fundamentals of Environmental Engineering/ Sustainable Engineering	Environmental and Sustainable Practice	Environmental Engineering Technology / Building Environment Technology
Civil Engineering Technology (Breadth)		Maintenance and Repair of Civil Works	Civil Engineering Construction Practices	Infrastructure Maintenance & Management	-
		Engineering Hydrology	Hydrology and Erosion Management	Urban Water Resources	Hydraulics and Hydrology
		Construction Project Administration	Engineering Management/ Sustainable Resource Utilisation	Engineering Management 1 and 2	Building Assessment and Reporting
		Digital Engineering Tools (Elective)	Civil Engineering Detailing and Modeling	Computer-Aided Engineering	-
		Building Codes and Compliance (Elective)	-	Construction Law	Building Services Technology/ Industrialized Building System



Curriculum for Bachelor of Science in Civil Engineering Technology



Civil Engineering Technology (Depth)		Reinforced and Prestressed Concrete	Structural Concrete/ Design of Structures	Design of Concrete Structures 1 and 2	Reinforced Concrete Design Technology
		Computer-Aided Drawing and Building Information Modeling	Civil Engineering Detailing and Modeling	Computer-Aided Engineering	Building Information Modeling
		Irrigation Engineering	Water and Waste Systems	Water Network Design	-
		Water Supply Systems	Water and Waste Systems/ Water and Waste Management	Water Network Design	Urban Stormwater Technology
		Quantity Surveying and Estimation	Engineering Management/ Civil Engineering Construction Practices	Cost Engineering	Construction Management and Estimation Technology
		Geotechnical Investigation and Foundations	Geotechnical Engineering 2/ Engineering Site Investigation	Geotechnical Engineering 2	Geotechnical and Site Investigation Technology
		Transportation and Highway Technology	Highway Engineering 1	Roads Design and Construction/ Planning and Subdivision	Highway and Transportation Technology
		Ground Improvement Techniques (Elective)	Geotechnical Engineering 3	Geotechnical Engineering 2	-
		Smart Technologies for Facilities Management (Elective)	Resource and Environmental Management	Integrated Management Systems	-



Curriculum for Bachelor of Science in Civil Engineering Technology



		Land Reclamation and Drainage Technology (Elective)	Urban Drainage Systems	Urban Water Resources	-
		Applied Hydraulics (Elective)	Water and Waste Systems	Water Network Design	Hydraulics and Hydrology
		Construction Equipment and Jobsite Practices (Elective)	Civil Engineering Construction Practices	Construction Operations	Construction Method Technology
		Construction of Steel Structures (Elective)	Structural Steel and Timber	Design of Steel Structures 1 and 2	Steel and Timber Design Technology
		Pavement Construction and Rehabilitation (Elective)	Highway Engineering 2/ Urban Transport Planning	Transportation Engineering	-
	Capstone Project	Project Part–I	Engineering Development Project	Major Engineering Project	Final Year Project Part–I
		Project Part–II	Engineering Development Project	Major Engineering Project	Final Year Project Part–II
Training	Field Experience	Supervised Industrial Training (Opt.)	Professional Engineering Practice	Work Integrated Learning	Industrial Training Attachment
		Supervised Industrial Training	Professional Engineering Practice	Work Integrated Learning	Industrial Training Attachment

Appendix J: Introduction to Foreign Language and Culture

This course is intended to provide students with introductory communicative competence in a selected foreign language and an understanding of its associated culture. The course should focus on practical language use and intercultural awareness rather than advanced grammatical proficiency.

By the end of the 16-week course, students are expected to demonstrate the ability to communicate at a basic level in familiar situations, understand simple spoken and written language, produce basic written expressions, and demonstrate an informed understanding of relevant cultural practices and contexts.

The course objectives may include the following:

1. Recognize and use basic sounds, pronunciation features, and the writing system of the selected foreign language.
2. Read and write basic words, expressions, and sentences using the appropriate writing system of the foreign language.
3. Apply basic language and cultural knowledge in simple communicative situations, including everyday conversations and familiar social contexts.

Higher Education Institutions (HEIs) may select an appropriate foreign language based on the needs and interests of relevant stakeholders and the institutional context. The selected language should be supported by appropriate course learning outcomes, content, teaching and learning strategies, and assessment methods. These should be developed in accordance with the relevant course template (as per other courses in the curriculum) and the guidelines provided in the IEA Graduate Attributes and Professional Competencies document.