Curriculum

for

Bachelor of Architectural Engineering Technology Degree

(2023)

Higher Education Commission
Islamabad
Curriculum Division

Acronyms, Abbreviations & Definitions

Acronym/Abbreviation	Definition
HEC	Higher Education Commission
NTC	National Technology Council
NCRC	National Curriculum Review Committee
HEI	Higher Education Institution
ACI	American Concrete Institute
ASCE	American Society of Civil Engineers
AISC	American Institute of Steel Construction
LRFD	Load and Resistance Factored Design
ASD	Allowable Stress Design
ASTM	American Society for Testing and Materials
BCP	Building Codes of Pakistan
FIDIC	The International Federation of Consulting Engineers
IBC	International Building Codes
PMBOK	Project Management Body of Knowledge
Th	Theory
Lab	Laboratory
Cr. Hrs.	Credit Hours

Contents

1. Introduction

Curriculum is the total learning experience of a student that occurs in 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 institutions 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 in learners' life-long 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, curriculum must be singularly aligned to national development goals, and produce human resources that becomes an effective factor of production in the economy.

Curriculum is thus the foundation on which rests the edifice of academic programs designed for focused outcomes that equip graduates with desired skill sets. Engineering technology curriculum aims to produce proficient engineering technology graduates who meet demands of both national and international job markets. The curriculum conforms substantially to the Sydney Accord – the international accreditation body regulating local accrediting institutions of partnering countries -- and is in consonance with the essence of Graduates Attributes and Professional Competence defined by International Engineering Alliance (IEA). [See Appendixes A through C]

Curriculum is developed and reviewed by HEC's National Curriculum and Review Committee (NCRC).

2. Curriculum Development Methodology

2.1 Benchmarking

Curriculum for Architectural Engineering Technology is benchmarked to HEC's Undergraduate Policy and in accordance with NTC Curriculum Framework. It conforms substantially to standards laid out by the Sydney Accord (SA) and the International Engineering Alliance (IEA) pertaining to architectural engineering technology programs [See Appendixes A through C].

The course of studies clearly defines, and differentiates, the program from Bachelor of Architectural Engineering by contact hours spent in classrooms, laboratories, and industry.

Ideally, an engineering program is designed with classroom to practical-training contact hours in the ratio of 70:30, with emphasis on the design aspects. Whereas for engineering technology programs, the ratio of contact hours is reversed to 30:70, providing more opportunity for hands-on psychomotor training.

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 of leading national experts.
- From the nominations received, NCRC is finalized and notified by NTC/HEC.
- NCRC Members elect a Convenor, a co-Convenor, and a Secretary amongst themselves for the proceedings of NCRC, after mutual consultations.
- A Preliminary Meeting of the NCRC, spanning three days, is held to establish framework and benchmarking issues, and assign different facets of curriculum development to smaller teams within the NCRC.
- A draft of the curriculum is prepared by NCRC at the end of the Preliminary Meeting and sent to relevant foreign experts for review and feedback.
- After the foreign expert's review and feedback, a Final NCRC Meeting, lasting up to 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 Meetings

Historical Timeline of NCRC meetings to develop Bachelor of Architectural Engineering Technology are enlisted below:

- Preliminary Meeting of NCRC [See Appendix D]
- Final Meeting of NCRC [See Appendix E]

3. Curriculum Details

Bachelor of Architectural Engineering Technology Program			
Parameter	**HEC Framework**	**Framework - A (SIT in 7th & 8th Semesters)**	**Framework - B (SIT in 8th Semester Only)**
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	41	38	43**
Engineering Technology Domain Courses	28	23	26**
Non-Engineering Technology Domain Courses	13	15	17**
Total Credit Hours	124 – 136	130	130
Engineering Technology Domain Credit Hours	85	94	89
Percentage of Engineering Technology Domain Credit Hours	68.50%	72.30%	68.50%
Non-Engineering Technology Domain Credit Hours	39	36	41
Percentage of Non-Engineering Technology Domain Credit Hours	31.50%	27.70 %	31.50 %
No. of Credit Hours per Semester	15 – 18	15 – 18	15 – 18
** Optional Courses shall be included in 7th Semester for Framework B (SIT in Semester 8 only)			
1 credit hour is counted as: (1) For theory: 1 contact hour per week for a minimum of 16 weeks for theory. (2) For practical's: 3 contact hours per week for a minimum of 16 weeks for practical's.			

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 Scheme of Studies	**As per Framework**	**As per Scheme of Studies**	**As per Framework**
Architectural Engineering Technology (Foundation)	Basics of Design	0+2=2	0+6=6	15	20	6	10
	Technical Drawing-I	1+1=2	1+3 =4				
	Elementary Surveying-I	1+2=3	1+6 =7				
	History of Architecture	2+0=2	2+0=2				
	Building Construction Technology-I	1+2=3	1+6=7				
	Technical Drawing-II	1+2=3	1+6=7				
Architectural Engineering Technology (Breadth)	Breadth Elective	1+1=2	1+3=4	21	24	7	6
	Architectural Design	1+2=3	1+6=7				
	Building Services & Systems-I	2+1=3	2+3=5				
	Building Construction Technology-II	2+1=3	2+3 =5				
	Sustainability in Buildings	2+1=3	2+3=5				
	Concrete Technology	2+2=4	2+6=8				
	Building Services & Systems-II	2+1=3	2+3=5				
Architectural Engineering Technology (Depth)	Technological Building Analysis	2+1=3	2+3=5	14	14	5	5
	Building Information Modeling	0+3=3	0+9=9				
	Building Conservation & Rehabilitation	2+1=3	2+3=5				
	Geotechnical & Foundation Engineering	2+1=3	2+3=5				
	Steel Structures	2+0=2	2+0=2				
IDEE	Theory of Structures	3+0=3	3+0=3	6	5	2	2
	Strength of Materials	2+1=3	2+3=5				
Senior Design Project	Project Part-I	0+6=6	0+18=18	6	6	2	1
Training	Supervised Industrial Training-I	0+16=16	0+16=16	16		0	

	Supervised Industrial Training-II	0+16=16	0+16=16	16	0
Total Credit Hours and Courses **(For Engineering Technology Domain Courses)**		31+63 = 94	31+173 = 204	94 - 107	23 - 27
** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)					

Non-Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework								
Knowledge Area	**Sub Area**	**Name of Course**	**Credit Hours** (Th+Lab)	**Weekly Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
					As per Scheme of Studies	**As per Framework**	**As per Scheme of Studies**	**As per Framework**
Computing	**Computing**	Computer Fundamentals	1+1=2	1+3=4	6	6	3	3
		Computer Aided Design-I	0+2=2	0+6=6				
		Computer Aided Design-II	0+2=2	0+6=6				
Humanities and Social Sciences	English (Expository Writing)	Communication Skills	2+0=2	2+0=2	4	6	2	2
		Technical Report Writing	2+0=2	2+0=2				
	Culture	Islamic Studies / Social Ethics	2+0=2	2+0=2	6	9	2	2
		Pakistan Studies	2+0=2	2+0=2				
	Social Sciences	Professional Ethics	2+0=2	2+0=2			1	3
Management Sciences	Management Sciences	Construction contracts, codes & regulations	3+0=3	3+0=3	6	6	2	3
		Elective	3+0=3	3+0=3				
Natural Sciences	Math (Quantitative Reasoning)	Applied Mathematics-I	3+0=3	3+0=3	9	6	3	2
		Applied Mathematics-II	3+0=3	3+0=3				
		Quantity Surveying & Estimation	1+2=3	1+6=7				
	Health & Safety	Occupational Health & Safety	2+0=2	2+0=2	2	4	1	1
	Physics	Applied Mechanics	2+1=3	2+3=5	3	4	1	1
Total Credit Hours and Courses					Cr. Hrs. **36/35**		Courses **15 /13**	

<table>
<tr><th colspan="2">List of Elective Topics</th></tr>
<tr><th>Social Sciences</th><th>Management Sciences</th></tr>
<tr><td>➢ Professional Ethics
➢ Sociology for Technologist
➢ Critical Thinking
➢ Organizational Behavior
➢ Professional Psychology
➢ Elective Courses by HEI*</td><td>➢ Economics
➢ Construction Management
➢ Project procurement Management
➢ Entrepreneurship
➢ Leadership and Personal Grooming
➢ Elective Courses by HEI*</td></tr>
<tr><th>Natural Sciences*</th><th rowspan="3">Depth Electives*</th></tr>
<tr><td>➢ Building Physics
➢ Environment responsive design
➢ Numerical Analysis
➢ Chemistry
➢ Elective Courses by HEI*</td></tr>
<tr><th>Breadth Electives*</th></tr>
<tr><td>➢ Urban Planning
➢ Building Structures and aesthetics
➢ Fluid Mechanics
➢ Building Hydraulics
➢ Wood Design
➢ Energy and Environment
➢ Interior Design
➢ Elective Courses by HEI*</td><td>➢ Building lighting Design
➢ Building electrical Design
➢ Building Plumbing Design
➢ Landscape Design
➢ Site planning and Development
➢ Construction Surveying
➢ Building HVAC Design
➢ Integrated Building Design
➢ Elective Courses by HEI*</td></tr>
<tr><td colspan="2">*Any related course can be included with approval of the HEI's Statutory Bodies (maximum: 3 courses per elective knowledge area)</td></tr>
</table>

4. Admission Criteria

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

(1) At least 50% marks in DAE/FSc (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

Semester-wise scheme of studies for Bachelor of Architectural Engineering Technology program spanning 4 years, spread over 8 semesters, and totaling 130 credit hours is presented below, along with weekly contact hours for each course.

SEMESTER-I				**Weekly Contact Hrs. (Th+ Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+ Lab)**	
ART-111	Basics of Design	Architectural Engineering Technology Foundation-I	0+2	0+6
ART-112	Technical Drawing-I	Architectural Engineering Technology Foundation-II	1+1	1+3
ARH-111	Pakistan Studies	Art & Humanities -I	2+0	2+0
ARN-111	Occupational Health and Safety Management	Natural Sciences-I	2+0	2+0
ART-113	Elementary Surveying	Architectural Engineering Technology Foundation-III	1+2	1+6
ARQ-111	Applied Mathematics-I	Quantitative Reasoning-I	3+0	3+0
ART-114	History of Architecture	Architectural Engineering Technology Foundation-IV	2+0	2+0
	Subtotal		**11+5 =16**	**11+15 =26**
SEMESTER-II				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ART-121	Building Construction Technology-I	Architectural Engineering Technology Foundation-V	1+2	1+6
ARC-121	Computer Fundamentals	Computing-I	1+1	1+3
ARH-121	Islamic Studies/Social Ethics	Art & Humanities -II	2+0	2+0
ART-122	Technical Drawing-II	Architectural Engineering Technology Foundation-VI	1+2	1+6
ARQ-121	Applied Mathematics-II	Quantitative Reasoning-II	3+0	3+0
ARN-121	Applied Mechanics	Natural Sciences-II	2+1	2+3

	Subtotal		**10+6 =16**	**10+18 =28**
SEMESTER-III				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ART-211	Breadth Elective	Architectural Engineering Technology Breadth Core-I	1+1	1+3
ART-212	Architectural Design	Architectural Engineering Technology Breadth Core-II	1+2	1+6
ARC-211	Computer Aided Design-I	Computing-II	0+2	0+6
ARI-211	Strength of Materials	Inter Disciplinary Technology-II	2+1	2+3
ART-213	Building systems & services-I	Architectural Engineering Technology Breadth Core-III	2+1	2+3
ARI-212	Theory of Structures	Inter Disciplinary Technology-I	3+0	3+0
	Subtotal		**9+7 =16**	**9+21 =30**
SEMESTER-IV				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ARH-221	Professional Ethics	Social Science-I	2+0	2+0
ART-221	Building Construction Technology-II	Architectural Engineering Technology Breadth Core-IV	2+1	2+3
ART-222	Sustainability in Buildings	Architectural Engineering Technology Breadth Core-V	2+1	2+3
ART-223	Building systems & services-II	Architectural Engineering Technology Breadth Core-VI	2+1	2+3
ARC-221	Computer Aided Design-II	Computing-III	0+2	0+6
ART-224	Concrete Technology	Architectural Engineering Technology Breadth Core-VII	2+2	2+6
	Subtotal		**10+7 =17**	**10+21 =31**

SEMESTER-V				Weekly Contact Hrs. (Th+Lab)
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ARM-311	Construction contracts, codes & Regulations	Social Science-II / Management Sciences-I	3+0	3+0
ART-311	Technological Building Analysis	Architectural Engineering Technology Depth Core-I	2+1	2+3
ART-312	Building Information Modelling	Architectural Engineering Technology Depth Core-II	0+3	0+9
ARS/ARM	Elective	Social Science-III / Management Sciences-II	3+0	3+0
ARE-311	Communication Skills	Social Science-IV / Expository writing-I	2+0	2+0
ARN-311	Quantity Surveying & Estimation	Natural Sciences-III	1+2	1+6
	Subtotal		**11+6 =17**	**11+18 =29**
SEMESTER-VI				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ART-321	Building Conservation & Rehabilitation	Architectural Engineering Technology Depth Core-IV	2+1	2+3
ART-322	Geotechnical & Foundation Engineering	Architectural Engineering Technology Depth Core-V	2+1	2+3
ART-323	Steel structures	Architectural Engineering Technology Depth Core-VI	2+0	2+0
ART-324	Architectural Technologies Research Project	Architectural Engineering Technology Depth Core-VII	0+6	0+18
ARE-321	Technical Report Writing	Social Science-V / Expository writing-II	2+0	2+0
	Subtotal		**8+8 =16**	**8+24 =32**

SEMESTER-VII (Framework A)				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ART-411	**Supervised Industrial Training (Optional)**	**Architectural Engineering Technology Domain Industrial Training**	**16**	**40 (Per Week)**
	Subtotal		**0+16= 16**	**0+40= 40**
OR SEMESTER-VII (Framework B)				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ARM-411	Social Sciences / Management Sciences Elective	Social Science-II / Management Sciences-III	2+0	2+0
ART-411	Depth Elective	Architectural Engineering Technology Depth Elective-VIII	2+1	2+3
ART-412	Depth Elective	Architectural Engineering Technology Depth Elective-IX	2+1	2+3
ART-413	Depth Elective	Architectural Engineering Technology Depth Elective-X	2+1	2+3
ART-414	Depth Elective	Architectural Engineering Technology Depth Elective-XI	2+1	2+3
ARC-411	Computing	Computing-III	1+1	1+3
	Subtotal		**11+5=16**	**11+15 =26**

SEMESTER-VIII				Weekly Contact Hrs. (Th+Lab)
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ART-421	**Supervised Industrial Training (Mandatory)**	**Architectural Engineering Technology Domain Industrial Training**	**16**	**40 (Per Week)**
	Subtotal		**0+16= 16**	**0+40= 40**
Total Credit Hours & Contact Hours in Four Years (Framework A: SIT conducted in 7th and 8th Semesters)			**59+71 = 130**	**59+197=256**
Theory vs Practical with respect to Contact Hours			Theory Practical	59 (23%) 197 (77%)
Total Credit Hours & Contact Hours in Four Years (Framework B: SIT conducted in 8th Semester**)**			**70+60 = 130**	**70+172 =242**
Theory vs Practical with respect to Contact Hours			Theory Practical	70 (29%) 172 (71%)

6. Course Codes

Course Code details are given below:

- The program spans over 4 years, with 2 Semesters per year, Spring and Fall (with a Summer Semester, if required).
- Each course has a unique three letter prefix, followed by a three-digit code
- Letters are acronyms describing courses, and numbers define the chronological position in the academic year, and sequence number in the program.

Letters in Course Code prefixes are defined below:

- First two letters pertain to the program (e.g., AR for Architectural)
- Third letter pertains to specifics of the course (e.g., T for technology, E for expository writing etc.)

Digits in Course Codes are defined in table below:

1st Digit	2nd Digit	3rd Digit
Denotes Year (1,2,3,4)	Denotes Semester (1,2,3…)	Denotes Sequence in Program (1, 2, 3…)

Course Code Examples		
Sr.	**Course Code Prefix**	**Description**
1	AR**T**	Architectural Engineering Technology Foundation/ Breadth/ Depth
2	AR**E**	Expository Writing
3	AR**H**	Art & Humanities
4	AR**S**	Social Sciences
5	AR**Q**	Quantitative Reasoning
6	AR**N**	Natural Sciences
7	AR**C**	Computing
8	AR**M**	Management Sciences
9	AR**I**	Inter Disciplinary Technology Elective

7. Elective Courses

Lists of Elective Courses – grouped along depth and breadth categories – are given below, showing credit hours and weekly contact hours.

Elective Breadth Courses				Weekly Contact Hrs.
Course Code	**Title**	**Knowledge Area**	**Credit Hrs.**	
ART-211	Landscape Design	Architectural Engineering Technology Breadth Elective-I	1+1	1+3
ART-211	Building Structures and aesthetics	Architectural Engineering Technology Breadth Elective-II	1+1	1+3
ART-211	Fluid Mechanics	Architectural Engineering Technology Breadth Elective-III	1+1	1+3
ART-211	Building Hydraulics	Architectural Engineering Technology Breadth Elective-IV	1+1	1+3
ART-211	Wood Design	Architectural Engineering Technology Breadth Elective-V	1+1	1+3
ART-211	Energy and Environment	Architectural Engineering Technology Breadth Elective-VI	1+1	1+3

Elective Depth Courses				Weekly Contact Hrs.
Course Code	**Title**	**Knowledge Area**	**Credit Hrs.**	
ART-411	Building lighting Design	Depth Elective-I	2+1	2+3
ART-411	Building electrical Design	Depth Elective-II	2+1	2+3
ART-412	Building Plumbing Design	Depth Elective-III	2+1	2+3
ART-413	Site planning and Development	Depth Elective-IV	2+1	2+3
ART-413	Construction Surveying	Depth Elective-V	2+1	2+3
ART-414	Building HVAC Design	Depth Elective-VI	2+1	2+3
ART-414	Interior Design	Depth Elective-VII	2+1	2+3
ART-414	Integrated Building Design	Depth Elective-VIII	2+1	2+3

8. Course Contents

The primary goal of this curriculum is to be substantially in compliance with international standards set by relevant agencies such as the International Engineering Alliance (IEA) and the Sydney Accord.

Program Learning Objectives (PLO's), Course Learning Objectives (CLO's) and Bloom's Taxonomy Levels are expected learning outcomes and are aligned to standards set by the Sydney Accord and the IEA.

Course Content

8.1 Basics of Design

CODE & TITLE (ART-111) **Basics of Design**		**CREDIT & CONTACT HOURS** (0+2) **0 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Architectural Engineering Technology Foundation-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** basic design techniques.		A-1	1
CLO-2	**Demonstrate** basic design principles in visual design projects.		A-3	3
CLO-3	**Practice** basic design principles.		P-3	9
CLO-4	**Present** images and designs using basic design concepts and principles.		P-4	10
Course Outline for Theory				
This course introduction with definition of design and principles of design, color theories and color schemes encompassing potential exercise in ground figure configuration, spatial tension, symmetry and balance, weight, column intensity and have geometrical forms, scale, proportion and different layouts will be achieving. It also introduces the 3d forms, and abstract modeling by using different materials.				
Lab Outlines				
1. Key Topics included in this course are as follows: 2. Introduction to Basic Design, elements and principles of design. 3. Introduction to color and color schemes and theories. 4. Introduction to Drafting Sheets, Colors & Geometrical Forms 5. Scale, Proportion & Different Layouts 6. Figure Ground Relationships, Spatial Tension & Likeness 7. Symmetry & Balance 8. Colors and Color Variations 9. Color Wheel 10. Color scheme through different design theme. 11. Anthropometry 12. Sculpture with scrap material. 13. Abstract modeling				

Recommended Books
1. Francis Ching, Space, Form and Order. 2. Robert Krier, Architectural Composition. 3. Simon Unwin, Analyzing Architecture 4. Amos Rappoport, House Form and Culture. 5. Kevin Lynch, the Image of the City. 6. Calendar, Time Saver Standard Vol. 1-4.

Course Content

8.2 Technical Drawing-I

CODE & TITLE (ART-112) **Technical Drawing-I**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Architectural Engineering Technology Foundation-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** technical drawings and make them proficiently.		C-1	1
CLO-**2**	**Demonstrate** technical skills in architectural engineering technology drawings.		P-2	1
CLO-3	**Trace**, draw, and compile drawings using MEP techniques.		P-3	2

Course Outline for Theory

Introduction to Technical drawing and its significance in industry, Description of Instruments used in technical drawing and their use, Drawing of basic geometric shapes, Line types and their application. Lettering and numbering. Dimensions and scaling, Orthographic projection method; Definition, significance and drawing applications, Isometric projection method; Definition, significance and drawing applications, Comprehension of architectural, electrical, civil and mechanical drawings to produce architectural engineering drawings. Preliminary preparations for MEP design drawings.

Lab Outlines

This module will be covered through the technical drawing lab practices of basic geometric drawing applications, Isometric projection drawing applications, Perspective projection drawing application, Comprehension of architectural, electrical, civil and mechanical drawings to produce architectural engineering drawings. Preliminary preparations for MEP design drawings.

Recommended Books

1. Technical Drawing, Frederick Ernest Giesecke , Macmillan Publishing Company, 8th edition
2. Technical Drawing, Prof..Dr.Atun A. NEU Press, 2nd edition.

Course Content
8.3 Pakistan Studies

CODE & TITLE (ARH-111) **Pakistan Studies**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Art & Humanities-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the difference between ideological and non-ideological states.	A-1	6
CLO-2	**Discuss** Pakistan Movement, and Pakistan's political and constitutional.	A-3	11
CLO-3	**Understand** current issues of Pakistan, their causes and suggest solutions.	A-4	11

Course Outline for Theory

Pakistan ideology: Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah, Aims and objective of the creation of Pakistan. Indus Civilization, Location and Geo-Physical features, Reformist Movement in Subcontinent. Muslim League 1906, Lahore Resolution 1940, 3rd June plan and Independence 1947, Constitution and Law, Constitutional Assembly, Nature and Structure of Constitution, Features of 1956, 1973 Constitutions. Amendments in the Constitution (17th, 18th, 19th and 20th), Foreign Policy, Objectives, Contemporary Pakistan, Economic institutions and issues, Society and social structure, Ethnicity, Determinants of Pakistan Foreign Policy and challenges, Futuristic stance of Pakistan

Recommended Books

1. Amin, Tahir. Ethno – National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad
2. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research
3. Struggle for Pakistan by Mr. Ishtiaq Hussain Qureshi

Course Content

8.4 Occupational Health & Safety Management

CODE & TITLE (ARN-111) **Occupational Health & Safety Management**	CREDIT & CONTACT HOURS (2+0) **32 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Natural Sciences-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** fundamental concepts of safety management and basic standards for health and safety in national and international construction industry.	A-1	1
CLO-2	**Demonstrate** competency in various safety management systems, accident analysis, safety reporting, and hazard investigation.	A-3	3
CLO-3	**Follow** safety rules and regulations in the construction industry.	C-3	5

Course Outline

Introduction to Health and Safety: Background and history of safety management, definition of health and safety, the scope and nature of occupational health safety, nature and consequences of accidents, types of hazards and injuries, causes of accidents, barriers to health and safety.

Health and Safety Management System: key elements of health and safety management system, purpose and importance of setting a policy for health and safety, key features and appropriate content of an effective and safety policy, concept of health and safety culture and climate, and safety behavior.

Safety Theory, Ethics and Standards: different safety theories, national and international safety standards, health and safety programs, safety rules and regulations in Pakistan.

OSHA's Construction Industry Standards: personal protective equipment (PPE), signs, signals, and barricades, materials handling, storage, use and disposal, tools, fire protection and prevention, fall protection, electrical, excavation, heavy machine operations, demolition, toxic and hazardous substances. Work Equipment Hazards general requirement for work equipment, hazards and control for hand-held tools, mechanical and non-mechanical hazards of equipment, control measures to minimize risk from hazards of equipment. Musculoskeletal Hazards and Risk Control: musculoskeletal disorders and work-related disorders, manual handling hazards and control measure, lifting and moving equipment. Chemical Health Hazards forms and classification and the health risk from exposure to hazardous substances, workplace exposure limits, control measure, safe handling and storage of waste.

Health and Safety Monitoring, Investigation and Recording: investigating incidents, worksite hazard analysis, direct and indirect causes of accidents, accident investigation report, recording and reporting incidents and review of health and safety performance.

Construction Site Issues – Hazards and Risk Control: initial site assessment, health and work environment, safe movement of people and equipment.

Safety Prevention: safe work procedures, site inspection, accident prevention, first aid facilities, safety communication, and emergency response.

Hazard Identification: struck-against, stuck by, contact-by and contact with, caught in caught on, caught-between, and fall-same level and fall-to-below.

Modern Technologies in Safety Management: Introduction to safety management tools such as drones, virtual reality, wearable sensing devices and exoskeletons, building information modelling (BIM), etc.

Recommended Books

1. Occupational health and safety management: a practical approach. CRC press, Reese, C.D., 2018.
2. International health and safety at work: For the NEBOSH international general certificate in occupational health and safety. 3rd edition, Routledge, Hughes, P. and Ferrett, E., 2021.
3. The Benefits of Occupational Health and Safety Standards. In Handbook of Standards and Guidelines in Human Factors and Ergonomics (pp. 541-568). CRC Press, Coelho, D.A., Matias, J.C. and Filipe, J.N., 2021.
4. Introduction to health and safety in construction: For the NEBOSH National Certificate in Construction Health and Safety. Routledge. Hughes, P. and Ferrett, E., 2015.
5. Safety and health for engineers. John Wiley & Sons, Brauer, R.L., 2022.

Course Content

8.5 Elementary Surveying

CODE & TITLE (ART-113) **Elementary Surveying**		**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Architectural Engineering Technology Foundation-III**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO–1	**Explain** basic techniques used in surveying and leveling.	C-2	1
CLO–2	**Apply** different techniques to calculate parameters required for plotting surveying maps, plans, profiles, and cross sections.	C-3	2
CLO–3	**Discuss** GIS, RS, GPS, and their applications.	C-2	1
CLO–4	**Conduct** surveying tasks using modern surveying tools.	P-4	5
CLO-5	**Design** surveying experiments.	A-3	10

Course Outline for Theory

Introduction to Surveying, Chain Surveying, Compass Surveying, Leveling, Plane Table Surveying, Contouring Computation of Area, Computation of Volume, Triangulation, Theodolite Traversing ,Electronic Distance Measurement & Total Station Traversing, Construction Surveying, Curves, Geographic Information systems (GIS)/ Remote sensing (RS) ,Global Positioning System (GPS)

Lab Outlines

1. To standardize the Pace length of a Person
2. Measurement of Triangulation scheme with the help of Different Measuring Tapes/Chains
3. Base Line Measurement using Jaderin's Method
4. To determine Magnetic Bearing of a Traverse using Prismatic compass
5. To perform the Profile and Fly Leveling with the help of Auto level
6. To conduct Plane table surveying in the field
7. To perform Theodolite Traversing in the field
8. To find the Area of Traverse by Triangulation Method
9. To determine the Height of Inaccessible Point
10. To layout the Horizontal curve
11. To find Co-ordinates of a Traverse by using Total Station
12. To locate survey stations using Hand G.P.S (Global Positioning System

Recommended Books

1. "Elementary Surveying – An introduction to Geometrics" by Wolf P.R. & Ghilani C. D.
2. "Surveying and Levelling" by N.N. BASAK.
3. "Surveying Theory and Practice" by R. E. Davis, J. Anderson, F.S. Foote, McGraw-Hill.

4. “Surveying” by Jack C. McCormac.
5. “Surveying with Construction Applications” by Barry F. Kavanagh, Prentice Hall.
6. “The Global Positioning System and GIS: An introduction” by Michael Kennedy, Taylor Frances, New York.
7. “Remote Sensing and Image” by Thomas, M. Lille sand & Ralph W. Kiefer, John Wiley & Sons, Inc.

Course Content

8.6 Applied Mathematics-I

CODE & TITLE (ARQ-111) **Applied Mathematics-I**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** concepts of rate of change, derivatives, and their applications.	C-2	1
CLO-2	**Apply** techniques of calculus and analytical geometry for solving and analyzing architectural engineering technology problems.	C-3	2

Course Outline for Theory

Basic definition of derivative, differentiation of different functions, rule of differentiation, chain rule implicit differentiation, Applications: slope, equation of tangent and normal. maxima, minima and point of inflection. Indefinite integral, different technique or integration i.e., integration by parts, integration by substitution, by partial fraction, integration of different trigonometric identity. Define definite integral: Application of definite integral, i.e., Area under the curve. Area between the curve, mean value theorem, finding the volume by slicing, volume of solid revolution Disk and Washer method, moment and center of mass etc. Vector in space, vector calculus, Divergence, curl of vector field, Directional derivatives, multivariable function Partial derivatives, Spherical, polar, cylindrical coordinates. Vector in plane: Dot product and cross products, line and plane in space. Application: work, angle between two vectors, Area of triangle, Area of parallelogram etc.

Recommended Books

1. H. Anton, I. C. Bivens, S. Davis, "Calculus, Early Transcendental", 11th edition (or Latest Edition), John Wiley, New York, 2016.
2. Essential Calculus by James Stewart, 2nd Edition
3. G. B. Thomas, A. R. Finney, "Calculus", 14th edition Pearson, USA, 2017.
4. S.M Yousaf, "Calculus and Analytic Geometry"
5. Advanced Engineering Mathematics by Erwin Kreyszig, 10th Ed.

Course Content

8.7 History of Architecture

CODE & TITLE (ART-114) **History of Architecture**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Architectural Engineering Technology Foundation-IV**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Give** a detailed analysis of architecture characteristics through a historic timeline.	C-2	1
CLO-2	**Discuss** architecture of various historical civilizations.	C-2	2

Course Outline for Theory

Introduction to world history and importance of historical and geographical knowledge for Architectural Technologists. Chronological and other systems of understanding history. Political, Social, Cultural, Religious, Technological etc. context of societies and buildings. Survey of historical evolution and development of architecture and structures across all world regions. Detailed historical development of architecture in the following time periods with special reference to context, technological aspects and innovations in evolving construction methodologies.

1. Primitive Societies (Paleolithic, Neolithic etc.)
2. Mesopotamia (Fertile Crescent, Indus Valley, Egyptian, Chinese, Meso American etc.)
3. Classical (Greeks, Roman etc.)
4. Middle Ages (Early Christian, Romanesque, Byzantine, Gothic etc.)
5. Renaissance (Mannerism, Baroque etc.)
6. Non-western Civilizations (Far Eastern, African, Hindu, Buddhist etc.)
7. Islamic Civilizations

Recommended Books

1. History of Architecture by Bannister Fletcher
2. Atlas of World History by John Haywood
3. Understanding Architecture by Leland M. Roth et. al.

Course Content

8.8 Building Construction Technology-I

CODE & TITLE (ART-121) **Building Construction Technology-I**		**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Architectural Engineering Technology Foundation-V**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** basics materials, and construction technology in national and international construction industries.	C-2	1
CLO-2	**Describe** composition of different materials for specific construction applications.	C-2	1
CLO-3	**Know** relevant construction science techniques, and technology principles.	C-3	2
CLO-4	**Practice** fabrication schemes and characterization tests of basic building construction materials.	P-3	1

Course Outline for Theory

Introduction to Building Materials; types of materials used in buildings.
Sand; Definition, classification, sieve analysis, bulking of sand.
Aggregate; definition of fine and coarse aggregate, sieve analysis and sizes of aggregate, properties of aggregates.
Tests Blocks; definition, composition of blocks materials, process of manufacturing, properties, tests and quality control.
Brick; definition, composition of brick materials, process of brick manufacturing, properties of bricks, tests on bricks
Cement; definition of cement, composition of cement, properties of cement, tests on cement
Lime: definition, composition of lime, properties of mortar, tests to be performed on mortar .
Mortar: composition of mortar, uses of mortar, tests to be performed on mortar .
Kerbstones; definition, types, uses, properties, composition,
Stone as Building Material; Types of stones, properties, shades, applications.
Masonry; Procedure, masonry materials and methods, Brick and stone Masonry work, quality assurance during masonry, bonds.
Plaster Materials; Mud Plaster, Plaster of Paris, Venetian Plaster.
Terrazo; definition, composition, types, uses and applications.
Pozzolano; Definition, composition, types, uses.
Tools and Equipment; Basic knowledge of using and maintaining construction-related tools and equipment to demonstrate the operation of construction tools and equipment to include, but not limited to, hammers, saws, levels, puller, clamps, drills, grinders, sanders, etc.

Lab Outline
1. Standard consistency test of cement. 2. Casting of standard sizes of brick and blocks. 3. Determination of water absorption of brick 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 of Cement. 9. Fineness modulus of various sands. 8. Determination of crushing strength and Flakiness Index of Fine Coarse aggregate 11. Casting of standard cement mortar samples for mechanical properties evaluation
Recommended Books
1. Construction Technology, 3rd ed., NCCER, Pearson Publishing, 2009. 2. Materials of. Construction by R. C. Smith and C. K. Andres, ISBN: 0070585040, McGraw Hill. January 1987. 3. Fundamental of Building Construction: Material and Methods, by Edward B. Allen. 4. Building Construction Vol. I to Vol. IV by Mckay. 5. Building Construction by Mitchall. 6. Building Construction by Huntington. 7. Civil Engineering Materials by Neil Jackson. 8. Construction Materials by P. D. Domone, University College, London.

Course Content

8.9 Computer Fundamentals

CODE & TITLE (ARC-121) **Computer Fundamentals**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** fundamentals of computer systems.	C-1	1
CLO-2	**Explain** the working of computer components and peripherals and summarize types and applications of computer software.	C-2	1
CLO-3	**Use** different computer software and hardware efficiently.	P-3	5

Course Outline for Theory

Basic terminology: computer, user, hardware, software, chip, program, Input: data, instructions (programs, commands, user responses), Output: text, graphics, video, audio, Types of computers: personal, notebook, handheld, PDA, internet appliance, server, mainframe, supercomputer, Programming languages, Machine, assembly, High-level, Key terms: VLSI, microprocessor, microcomputer, Computer Software: Terms: file, menu, font, voice recognition, FAQ, online help, wizard, software suite, single-user license, site license, application window, dialog box, clip art, cross-platform application, Application software, Word processing, Spreadsheet: cell, function, recalculation, charting, Database: record, field, query, Other: accounting software, Computer Aided Design (CAD), desktop publishing, paint/image, multimedia, web authoring, System software, Operating System (OS), Booting (startup), Cold vs. warm, BIOS, Steps in booting, Utility programs: file viewer, file compression, backup, screen saver, disk scanner, disk defragmenter, Computer hardware, System unit Terms: motherboard, chip, memory, storage, expansion slot (plug and play), port (serial vs parallel), bus (expansion bus), power supply, Central Processing Unit (CPU), Machine cycle (fetch, decode, execute, store), Memory, Volatile vs. nonvolatile, RAM vs ROM, Cache, Hard disk, Tracks, sectors, platters, RAID (mirroring and striping), Internet hard drive, Compact disks (and drives), PC Cards, Miniature mobile storage (Compact Flash, Memory Stick, Microdrive, Smart Media), Input Devices: Keyboard, Pointing Devices, Others: trackball, touchpad, pointing stick, light pen, touch screen, stylus, Handwriting recognition software, Sound, Image: Digital camera, Scanners (flatbed, optical readers), Optical readers, Optical character recognition (OCR), bar code scanner, Optical Mark Recognition (OMR), Video: Web cam, PC Video camera, Output Devices, Display device, CRT monitor, Liquid Crystal Display (LCD) – passive versus active matrix, Gas plasma monitor, Printer and its types: Impact printers, Dotmatrix printer, Line printer, Plotter, Non-impact printers, Ink-jet, Laser, data projector, fax machine (fax modem), Internet, E-commerce, Ethics and social issues, Privacy and security.

Lab Outlines

The experiments related to above mentioned outline shall be covered in lab.

Recommended Books

1. Computer fundamentals "by P. K.Sinha
2. "Introduction to Computers" by Peter Norton
3. "Discovering Computers 2010" by Shelly Cashman Series

Course Content

8.10 Islamic Studies/Social Ethics

CODE & TITLE (ARH-121) **Islamic Studies/Social Ethics**	CREDIT & CONTACT HOURS (2+0) **32 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Art & Humanities -II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Recite** Holy Quran with correct pronunciation.	C-1	10
CLO-2	**Understand** basic concepts of teaching of Islam (faith, pillars, Dawit, preaching and Seerat).	C-3	8
CLO-3	**Discuss** the compilation of the Holy Quran and basic concepts of Hadith.	A-2	8
CLO-4	**Present** Islam as a complete code of life.	A-3	12

Course Outline

History of Islam: Compilation of the Holy Quran and Hadith, Fundamental doctrines of Islam i.e., Tawheed, oneness of Allah, Prophet hood, the day of Judgment, Revealed books, Ibadaat (worship) Philosophy of Ibadaat, Namaz, Zakat, Hajj & Sawm, Importance of preaching of Islam, its needs and effects, Difficulties in the ways of preaching of Islam, sectarianism, its causes and effects in Muslim society, definition of Right, classification of Right, importance of Rights, Khutba Hajjatul Wida (last address of the Holy Prophet, peace be upon him), Seeratun-Nabi (Peace be upon him).

Life of Holy Prophet (Peace be upon him): The life of the Holy Prophet before and after prophet hood. The Hijra (Migration to Madina), Treaty of Al Madina, Makki and Madani life of Holy Prophet Muhammad (Peace be upon him), importance of peace and causes of terrorism.

Islam and Civilization: Definition of civilization, Impacts of Islamic civilization on the Sub-continents, international impacts of Islamic civilization, Impacts of Human thoughts, social and humanistic effects, Importance of Ethics, Human rights (Hoqooq Ul Ibad) with detail.

Knowledge and Islam: Definition of Knowledge, Classification of knowledge, Importance of technology in the light of Holy Quran and Sunnah, relevant verses of the Holy Quran about Technology (Baqara 28,30,33,201, Nahal:76, Jasia: 13, Araf: 32, Noor: 55 etc), Islamic and scientific knowledge.

Recommended Books

1. A Guidebook for Muslims, by Syed. Abul Hasan Ali Nadvi.
2. An Introduction to Islam, by Dr. Muhammad Hameedullah.
3. What is Islam? by Maulana Manzoor Nomani.
4. Islamiat (A standard book for CSS), Prof. Dr. Arif Naseem.

Course Content

8.11 Technical Drawing-II

CODE & TITLE (ART-122) **Technical Drawing-II**		**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Architectural Engineering Technology Foundation-VI**
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** basic concepts, scale, and proportions in three dimensional forms, exhibiting technical skills and aesthetical sense.		C-1	1
CLO-2	**Follow** specific techniques of technical drawings to diversify and make digital presentations.		P-3	5
CLO-3	**Have** skills to create graphical solutions with precision, clarity, and objectivity.		A-3	10
Course Outline for Theory				
This course will introduce a sense of three-dimensional forms among the students, one-point perspective, two-point perspective, three-point perspective and free hand sketching. Furthermore, complete knowledge of model making, Photography and digital technical presentation.				
Lab Outlines				
Practicing the one-point perspective, two-point perspective, three-point perspective and free hand sketching and model making techniques, Photography studio practices, digital technical presentation through adobe.				
Recommended Books				
1. Jefferies, Architectural Drafting and Design 2. Greusel, Architecture Essentials of Presentation Skills. 3. Yee, Architectural Drawing; A Visual Compendium of Types and Methods				

Course Content

8.12 Applied Mathematics-II

CODE & TITLE (ARQ-121) **Applied Mathematics-II**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** differential equations and find solutions of first and higher orders homogenous and non-homogenous differential equations by appropriate methods.	C-2	2
CLO-2	**Solve** basic engineering technology problems by using the knowledge of ordinary differential equations and transforms.	C-3	2

Course Outline for Theory

Basic concept of differential equation, I.e., Definition, order, degree, and geometric meaning of Diff: equation. Solution of First order Diff Equation: Separable of equation, Exact Diff: Equation, integrating Factor, Linear ODEs. Second and higher order Differential Equation: Homogenous linear ODE with constant coefficient, Cauchy Euler Equation. Non homogenous Equation by undetermined coefficient, by variation of parameter and similar higher order Diff. equation. Finding Laplace and inverse Laplace of different functions, S- shafting theorem, solution of differential equation using Laplace transform. Basic concept of power series, Radius of convergence, convergence interval, using power series method to find the solution of Differential Equation.

Recommended Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, Willey 2014.
2. W. E. Boyce, R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems, 10th edition", John Wiley & Sons, Inc., 2012.
3. D. G. Zill, M. R. Cullen, "Differential Equations with Boundary-Value Problems", 10th edition, Brooks/Cole, 2013.

Course Content

8.13 Applied Mechanics

CODE & TITLE (ARN-121) Applied Mechanics	CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/DOMAIN Natural Sciences-II	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basics of mechanics for a two-dimensional force system.	C-2	1
CLO-2	**Apply** principles of mechanics on two-dimensional determinate force systems and solve problems related to statics and dynamics.	C-3	2
CLO-3	**Perform** experiments on force systems and systems in equilibrium.	P-3	9

Course Outline for Theory

System of Forces: Force System, Resultant, and resolution of co-planner forces using parallelogram, triangle & polygon law and funicular polygon, Simple cases of resultant and resolution of forces in space.
Equilibrium of Rigid Bodies: Conditions of equilibrium of co-planar forces, analytical and graphical formulations. Free body concept, conditions of support and attachment to other bodies, Support Reactions under different types of loading, Introduction to shear force and bending moment diagrams. Degree of restraint and static determinacy, statically determinate problems especially of civil engineering importance, Equilibrium of two-force and three-force bodies.
Properties of areas: Geometrical properties of plane areas, first moment of area, centroid, second moment of area, principal axes, polar second moment of area and radius of gyration.
Friction: Coulomb's theory of friction, Problems involving friction on flat and curved surfaces.

Lab Outline

1. To determine the reaction of the simply supported beam under various loadings.
2. To determine the center of mass of various figures, cut out the wooden plank by experiment & calculations.
3. To determine the forces by method of polygon
4. To find the tension in various parts of a Hanging rope loaded at various points.
5. To verify the principle of moment.
6. To verify law of friction between solid bodies and to find the coefficient of friction between wood and other materials.

Recommended Books

1. Hibbeler, R. C. Engineering Mechanics- Statics and Dynamics, Prentice Hall (13th Edition), 2013
2. Ferdinand P. Beer and E. Russel Johnston Jr. "Vector Mechanics for Engineers", 7th Edition, 2008
3. F. L. Singer, Engineering Mechanics, 4th ed, Harper and Row Publisher, 1987.
4. J. L. Mariam & L. G. Kraige; Engineering Mechanics Statics and Dynamics; John Wiley & Sons, 6th Edition, 2007

Course Content

8.14 Urban Planning

CODE & TITLE (ART-211) **Urban Planning**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Architectural Engineering Technology Breadth Core-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** concepts of urban planning in engineering and design.		C-1	PLO 1
CLO-2	**Explain** principles of urban planning in development of modern cities and towns based on best practices and guidelines.		C-2	PLO 1
CLO-3	**Conform** to concepts of urban planning in projects.		A-2	PLO 9

Course Outline for Theory

Introduction to cities, urban planning and allied disciplines. Terminologies and definitions used in urban planning, regional planning and urban design. Types of cities and urban planning. Survey of cities in history, their evolution and development with special emphasis on technological aspects. Issues, problems, models and trends in contemporary urban planning. Principles and models of Transportation Planning, Land use Planning, Infrastructure Planning etc. Urbanization and cities in Pakistan. Urban Site Development and Planning. Technical aspects of elements of master and physical planning. Calculations for site planning and introduction to digital methods in urban discipline.

Lab Outline

The students will learn and apply urban design tools such as sketching, site analysis and mapping, model building, scenario development, master planning, and space programming. The course will improve their visualization, presentation and documentation techniques and learn to communicate with urban authorities, actors and experts.

Recommended Books

1. Kirk, Gwyneth. *Urban planning in a capitalist society*. Routledge, 2018.
2. Rabinovitch, Jonas, and Josef Leitman. "Urban planning in Curitiba." *The City Reader*. Routledge, 2015. 548-554
3. Freestone, Robert, ed. *Urban planning in a changing world: the twentieth century experience*. Taylor & Francis, 2000.
4. Time Saver Standards for Urban Planning
5. Time Saver Standards for Urban Design

Course Content

8.15 Architectural Design

CODE & TITLE (ART-212) **Architectural Design**		**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Architectural Engineering Technology Breadth Core-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO–1	**Describe** procedures for architectural design and planning.		C-1	1
CLO–2	**Illustrate** characteristics and elements of design in architecture and planning.		C-4	3
CLO–3	**Analyze** properties of design as a creative observer.		C-4	2
CLO–4	**Use** building design techniques on sites.		P-4	12

Course Outline for Theory

This course introduces the architectural design process including design development. Elementary small-scale projects are carried out to explore the basic structural forms and shapes. Design is supplemented with human, cultural and local context. Small and simple (minimum complexity) projects are carried out to explore functional, structural and aesthetical issues. Concepts of scaled drawings are also part of the course (architectural scales and architectural drafting techniques.)

Lab Outlines

The lab projects comprised of single space single function, single space multiple functions, multiple spaces with multiple users and address issues related to immediate building and context. Use of models to explore architectural design both in terms of interior and exterior spaces. The emphasis should be given to the details of architecture in terms of anthropometry and ergonomics. Examples are bedroom design, bathroom, kitchen design, cafeteria and auditorium/cinema etc.

Recommended Books

1. Francis Ching, Space, Form and Order.
2. Robert Krier, Architectural Composition.
3. Time Saver Standards (Building Type) by John Hankook Calendar, ISBN 0-07-099076-x
4. Architectural Graphics Standards by Charles G.Ramsy & Hanrold R.Sleeper

Course Content

8.16 Computer Aided Design-I

CODE & TITLE (ARC-211) **Computer Aided Design-I**		**CREDIT & CONTACT HOURS** (0+2) **0 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO–1	**Describe** basic standards of architecture.	P-1	1
CLO–2	**Follow** the basic tools and techniques for the use of CAD software in building industry.	P-3	5
CLO-3	**Describe** concepts related to architectural projects.	A-3	9

Lab Outlines

Autodesk AutoCAD:
Master the basic commands of CAD, the setting of drawing environment, the setting method of layer and line type; familiar with system variables, master common system variables; master the use and definition of Block, familiar with design center and specific window; master module Editing and application; master the techniques associated with filling. Familiar with the concept of three-dimensional coordinates; master the simple method of information exchange between CAD and other software, master the relationship between model space and paper space, master the method of adding and using raster format printer for printing.

Google Sketch up pro:
Architectural design concept software Sketch-up: Master the basic drawing methods and editing tools of Sketch-up, master the techniques related to using Sketch-up, and use Sketch-up to output complex 3D renderings

Recommended Books

1. Ryan Duell, Tobias Hathorn, Tessa Reist Hathorn. Autodesk Revit Architecture 2015 Essentials: Autodesk Official Press.Sybex.2014
2. Scott Onstott. AutoCAD 2015 and AutoCAD LT 2015 Essentials: Autodesk Official Press.2014

Course Content

8.17 Strength of Materials

CODE & TITLE (ARI-211) Strength of Materials		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Inter Disciplinary Technology-II	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO–1	**Explain** the basic concepts, and terms related to strength of materials.		C-2	PLO 1
CLO–2	**Compute** stresses and strains in structural elements.		C-3	PLO 2
CLO–3	**Design** experiments related to mechanical properties, and physical parameters of materials, and compare with its analytical results.		P-4	PLO 4
CLO-4	**Perform** as an individual or as a team member in lab activities.		A-2	PLO9

Course Outline for Theory

Introduction of mechanics of materials, Purpose of Mechanics of Material, Types of Supports, Types of Beams, Load, units of Load, Classification of Loads, Stress, Units of stress, Types of Stresses, Introduction of Strain, Types of Strain, Stress, Strain curve, Introduction of Beams, How to find out the Reactions, Concept of SF & BM, Complete analysis of Beam, Introduction of simply supported Beam, one point load on simply supported Beam, two point load on simply supported Beam, Introduction of Fixed support Beam, one point load on fixed support Beam, two point load on fixed support Beam, Elasticity , Elastic Limit, Hooke's Law, Maximum and ultimate stress, Thermal stress and Strain, Theory of simple bending, Bending and shearing stress distribution in beams, Strain energy due to direct loads, Introduction to column, Difference between short and long column, Concept of radius of gyration.

Lab Outline

1. To determine the compressive strength of cement.
2. To familiarize the students with the functions of Universal Testing Machine.
3. To perform tensile test on a mild steel specimen and to determine yield strength, ultimate strength, rupture strength and percentage elongation.
4. Hardness test on a given metal specimen using Avery's Rockwell testing machine.
5. To perform the Izod Impact Test for the given metals.
6. To perform the Charpy's Impact Test for the given metals.
7. To determine shear strength of a half-inch dia steel bar.
8. To determine the modulus of elasticity of the material of given rectangular beam.
9. To determine modulus of rigidity of the material of given specimen with circular cross-section.
10. To perform Bending test on wooden beam.
11. To determine the Brinell hardness number of given specimen by Brinell hardness testing machine.
12. Torsion test on a given specimen by torsion Testing Machine.

Recommended Books
1. Mott, Robert L., and Joseph A. Untener. *Applied strength of materials*. CRC Press, 2021. 2. Khurmi, R. S., and N. Khurmi. *A textbook of strength of materials*. S. Chand Publishing, 2019. 3. Ilyushin, Alekseĭ Antonovich, and V. S. Lensky. *Strength of materials*. Elsevier, 2013. 4. Den Hartog, Jacob Pieter. *Strength of materials*. Courier Corporation, 2012.

Course Content

8.18 Building Systems and Services-I

CODE & TITLE (ART-213) **Building Systems and Services-I**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** different building systems and their functions.	C-2	1
CLO-2	**Apply** design guidelines and dimension related requirements in buildings.	C-3	3
CLO-3	**Suggest** technical solutions and equipment for building systems and services.	P-4	5

Course Outline for Theory

Environment and Human Comfort Systems: Temperature Control Systems; Moisture and Humidity in Buildings, Natural and artificial ventilation systems; Humidifiers and blowers/ coolers (Calculating throws and angles; Installation and maintenance procedures). Movements in Buildings: Systems for horizontal movement of people and goods (Travolators and moving pavements); Systems for vertical movement of people and goods (Capacity calculation and maintenance of elevators, escalators and cargo lifts etc.). Systems and Services: Power systems (electrification and gas supply), calculation and maintenance of conduits, ducts and pipes etc. Water Supply; UGT and OHT capacity calculation; materials and diameters' suitability of supply pipes for hot and cold-water supply. Sewerage Systems: Collection, treatment and disposal of sewerage; Systems for grey water and storm water collection and disposal. Rainwater harvesting techniques. Waste Management in Buildings: Municipal, Industrial and Hospital waste; Collection, storage, transportation and disposal systems.

Lab Outlines

Construction site visits; documentation of existing systems; reading and understanding drawings, preparing on site drawings; Preparation of POE reports based on walk-through survey method

Recommended Books

1. The Architectural Expression of Environmental Control Systems by George Baird
2. Principles of Heating, Ventilation and Air Conditioning with Work Examples by Nihal E Wijeysundera (2015)
3. Control Systems for Heating, Ventilating and Air Conditioning by Roger W. Hines, Douglas C. Hittle (2005)
4. Handbook of Heating, Ventilation and Air Conditioning by Jan F. Kreider (2000)
5. Transportation Systems in Building by Chartered Institute of Building Services
6. CIBSE Guide D: Transportation Systems in Buildings by Guide D Steering Committee

Course Content

8.19 Theory of Structures

CODE & TITLE (ARI-212) **Theory of Structures**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Inter Disciplinary Technology-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** different types and forms of structural systems.	C-1	1
CLO-2	**Explain** the fit and synergy of different structural forms and systems.	C-2	3
CLO-3	**Analyze** load pathways for transfer of active loads.	C-4	2

Course Outline

1. **Introduction & Overview of course**
- Relationship between Architectural and Structural form.
- How do Structure (and part of structure) behave
- Alternative forms of structure

2. **Truss System**
- Definition and characteristics
- Types of Trusses
- Truss configurations & Analysis
- Forces in members & method of joints
- *Studio-Sketching of different truss shapes and marking forces with magnitude and direction*

3. **Frame Structures**
- Definition and characteristics
- Types of Frames
- Supports types and idealization details
- Load transfer pathways in different loading scenarios
- Introduction to future developments (Polyhedral, high-rise & mega structures)
- Studio-Sketching of different frame shapes and marking forces with magnitude and direction

4. **Shell Structures**
- Types of shell structures
- Exploring shell forms & shaping forces
- Form finding and structural optimizations
- Connectivity of Grid shells
- Studio-Sketching of different shell forms and the load trajectories

5. **Vertical Structures**
- General background of Tall structures
- Types of Loads (Lateral & Gravity loads)
- Types of structure systems for high rise buildings (pros &Cons)
- Beams-column interactions
- Studio-Sketching of different high rise structural forms and the loading pathways

6. **Tensile Structures**

- Types of Tensile structures (pros &Cons)
- Tension members
- Cable and membrane structures
- Studio-Sketching of different tensile shapes and marking forces with magnitude and direction

Recommended Books

1. Charleson Andrew, Structure as Architecture (2015) Routledge Third Ave New York, USA.
2. Chilton jhon, Space Grid structures (2000) Architectural press jordan hill, Oxford-UK.
3. Edited by; Sigrid Adriaenssens , Philippe block, Diederik veenendaal & chris Williams, Shell Structures for Architecture (2014), Routledge Third Ave New York, USA.
4. Sandaker Normann, Arne Petter Eggen, Mark Cruvellier, The Structural Basis of Architecture, 2nd Edition (2011) Routledge Third Ave New york, USA.
5. F. Otto, Tensile Structures Vols 1 & 2 (1973) MIT Press, Cambridge, USA.
6. RC Hibbler, Structural Analysis, 8th Edition (2018), Prentice Hall, USA.

Course Content

8.20 Professional Ethics

CODE & TITLE (ARH-221) **Professional Ethics**		CREDIT & CONTACT HOURS (2+0) **32 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Social Science-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** basics of a profession, professional ethics, moral and social issues, importance of values, ethical behavior in personal and professional life, and consequences of acting unethically in organizations and society.	C-1	7
CLO-2	**Demonstrate** knowledge of roles of engineering technologist in applying ethical principles at various professional levels.	A-3	6
CLO-3	**Resolve** ethical dilemmas using common ethical values, and identify actions to be taken in response.	A-5	7

Course Outline for Theory

Introduction: Introduction to ethics, personal and professional ethics, the nature of engineering ethics; legal, professional and historical definitions; origin of professional ethics, profession and professionalism; professional accountability, professional success, professional risks, professional associations; benefits of acting ethically and consequences of acting unethically. Value of Ethics: Values in professional ethics, central responsibility of engineering professionals, ethics in different fields of work, Architecture and engineering technology codes of ethics, ethical code for engineering professionals, global issues in professional ethics, ethics in manufacturing and marketing, intellectual property rights, business ethics and corporate governance. Ethical Dilemmas: Common ethical dilemmas, resolution of ethical dilemmas, possible actions in response to dilemmas, probable consequences of these actions.

Recommended Books

1. Engineering Ethics Concepts & Cases by Charles E Harris, 5th Edition, Cengage 2014.
2. Kenneth Blanchard, Professional Ethics, 4th Edition
3. Ethics in Engineering 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005.
4. The Seven Habits of Highly effective people by Stephan r. Covey
5. Engineering Ethics: Concepts and Cases, 4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008
6. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
7. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

Course Content

8.21 Building Construction Technology-II

CODE & TITLE (ART-221) **Building Construction Technology-II**	CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Breadth Core-V**

	After completion of this course, students will be able to:	Bloom's Taxonomy Level	PLO
CLO-1	**Understand** basic properties and standards applicable to construction materials and techniques.	C-2	1
CLO-2	**Identify** appropriate materials, and technical solutions to be used.	C-3	4
CLO-3	**Present** the most suitable industrial solution for a building component.	A-3	10
CLO-4	**Practice** fabrication schemes and characterization tests of building construction materials.	P-3	4

Course Outline for Theory

Introduction to Finishing materials used in the Building, Types of structure, materials and applications, concept of structural glazing.

Timber; types of wood, defects in timber, seasoning, properties of timber, Uses of Timber for Structural Components of Building, Uses of Timber from architectural perspective, benefits of timber in architectural/structural uses. Calculation of useful timber from raw size, assessment and

Laminated sheets, ply, shutter board, veneer, UV sheets, matt finishing, gloss finishing, textured sheets, pvc-finished **sheets,** acrylic finish sheets. Properties of Sheet; thickness, strength, scratch resistance, durability and density.

Cladding Sheets &pvc sheets, properties, types, applications, advantages and disadvantages,

Aluminium: composition, properties of aluminium material, Aluminium as building material in construction industry, gauges, density, sections, coating, colours, advantages and disadvantages of aluminium.

Paints and Varnishes: types, composition, properties, applications, defects, repair and maintenance. Base materials before paint applications, surface preparation.

Ceramic Tiles: types, composition, manufacturing process, properties, textures, comparison between marble and tiles, maintenance and repair.

Stainless Steel: composition, properties, section, thickness, gauges. Stainless steel in modern technology; Pipes, sheets, frames, mesh, panels, shelfing and joinery, stainless steel for houses and multi storey buildings. Fitting and weldings.

Glass: composition, properties, manufacturing, Types of glass: flat, toughened, patterned, laminated, mirrored, coated, tinted, sand blasted. Thicknesses, durability, defects, maintenance. Uses of glass technology.

Miscellaneous Materials; Astroturf, copper, galvanized iron, upvc, bitumen, heating insulation and water proofing materials,

Scaffolding; work design and its importance in construction work for R. C. beams, columns, lintels and slab construction in buildings.

Formwork; for slabs, beams, columns & walls, etc. and its design.

Types of Walls; Load bearing walls, composite walls cavity construction, concrete framed structures panel walls, internal walls and partitions and external finishes.

Lab Outline
1. To determine the moisture contents by oven drying method of Timber. 2. Determination of specific gravity of given sample of wood. 3. To study different section of aluminium and discuss its application 4. To measure gauges of different sections of aluminium 5. To measure thickness of different section of laminated sheets 6. To identify different types of laminated sheets and discuss their applications 7. To identify different types of glasses and to discuss their applications 8. To fabricate an aluminium frame for a required size
Recommended Books
1. Fundamental Building Technology by Andrew J. Charlett, Craig Maybery-Thomas 2. Fundamentals of Residential Construction, 4th Edition by Edward Allen, Rob Thallon, Alexander C. Schreyer 3. Advances in Building Technology by M. Anson, J.M. Ko, E.S.S. Lam 4. Construction and Building Technology by E. Keith Blankenbaker 5. Roy Chudley,Roger Greeno. Building Construction Handbook. Routledge 2016 6. Andrew Watts. Modern Construction Handbook. Birkhauser 2016 7. George Albert Hool.Handbook of Building Construction: Data for Architects, Designing and Constructing Engineers, and Contractors.Arkose Press 2015 8. Roy Chudley,Roger Greeno BA,FCIOB FIPHE FRSA. Building Construction Handbook. Butterworth-Heinemann 2010

Course Content

8.22 Sustainability in Buildings

CODE & TITLE (ART-222) **Sustainability in Buildings**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-V**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the significance, concepts, and techniques for sustainable architecture.	C-2	7
CLO-2	**Describe** structures of various natures, and their compliance with standard codes of practices.	C-3	6
CLO-3	**Identify** and use sustainable materials and techniques.	P-3	5
CLO-4	**Describe** the concept and strategies for sustainable buildings.	A-3	7

Course Outlines for Theory

General introduction to sustainable buildings, concepts and strategies that can be used to design sustainable buildings and neighborhoods. Insight into climate change and as such the backdrop for the need to design sustainable buildings and cities with considerably less greenhouse gas emissions. Sustainable/energy efficient architecture as well as the most important tools and methods used in them.

Lab Outline

1. Use of industrial and agricultural waste as an alternate to building materials
2. Use of energy efficient materials and techniques

Recommended Books

1. Design of structures by R.H Nilson
2. ACI-318-14
3. ASCE-07

Note: Each specialty related structural design based on codes and standards will be taught by respective specialists, like building, highway, water retaining structures and foundation design.

Course Content

8.23 Building systems and services-II

CODE & TITLE (ART-223) **Building systems and services-II**	CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Breadth Core-VI**

	After completion of this course, students will be able to:	Bloom's Taxonomy Level	PLO
CLO-1	**Understand** different building systems and their functions.	C-2	1
CLO-2	**Apply** design guidelines and dimension related requirements in buildings.	C-3	3
CLO-3	**Suggest** technological solutions and equipment for building systems and services.	P-4	5

Course Outline for Theory

Fire Fighting Systems: Installation and maintenance of fire extinguishers and sprinklers etc., Fire resistant materials and doors etc. Building Safety and Security Systems. Building Evacuation Systems: Emergency exits and spill ways; Protection of staircases and elevator shafts; placement and maintenance fire and storm shelters. Mechanical Systems for High- and Mid-Rise Buildings. Heating, Ventilation and Air Conditioning Systems: Types and capacities of different HVAC plants; Installation and maintenance of HVAC systems. Communication in Building Systems and Services. MEP Drawings: Reading and understanding MEP drawings; Preparing shop drawings/ on-site decisions. Smart Buildings: Artificial intelligence in buildings; responsive and smart buildings systems; Networking and security installations (CCTV cameras, security points etc.). Safety and Security Instruments based on Digital Technology.

Lab Outline

Construction site visits; Detailed documentation of given/ selected building system(s); Preparation of maintenance plan for the given/ selected system(s)

Recommended Books

1. Fire Protection Engineering in Building Design by Jane I. Lataille
2. Smart Building Systems for Architects, Owners and Builders by James Sinopoli
3. Integrated Security Systems Design: A Complete Reference for Building Enterprise-Wide Digital Security Systems (2nd Edition) by Thomas L. Norman
4. Advanced Building Systems: A Technical Guide for Architects and Engineers by Klaus Daniels

Course Content

8.24 Computer Aided Design-II

CODE & TITLE (ARC-221) **Computer Aided Design-II**	**CREDIT & CONTACT HOURS** (0+2) **0 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the basic tools of 3D Modelling.	P-2	1
CLO-2	**Practice** on basics tools of 3d modelling and have digital rendering skills.	P-3	5
CLO-3	**Make** digital presentations by using digital tools.	A-2	9

Lab Outlines

3D Studio Max:
Introduces the practical steps required to use 3ds Max effectively. Delegates learn how to:

- Configure and render scenes.
- Create and edit 3D geometry.
- Understand and apply lighting and materials for realism.
- Setting up cameras and views
- Create desktop animations.

Lumion:
The Lumion Renderer is to provide an understanding of the professional workflow of rendering through practical training. This course is set out systematically to teach students from the basic foundations of Lumion to advanced rendering techniques. Introduction of Lumion, Project Setup, Screen Layout, Controlling the Camera, Modeling Environment and Modifying Terrain, Adding a Water Plane and/or Ocean Importing – Updating Models with Geometry Placing, Content from the Library Using Layers, Assigning and Modifying Materials Saving Material Sets Advanced Materials (Glass, Waterfalls, Self-Illuminated, Glows) Environment Settings, Course outline Setting Sun Direction and Height Cloud Setting, Adding / Modifying Light Fixture, Creating Rendering Images, Creating Animations, Animating Objects Camera Presets, Working with Filters, Adding Special Effects to Individual clips Using Theater Mode Export and Rendering Options Rendering the final output as a movie.

Recommended Books

1.Lumion 3D Cookbook Kindle Edition by Ciro Cardoso

2.Kelly L. Murdock's Autodesk 3ds Max 2020 Complete Reference Guide 1st Edition by Kelly L. Murdock

Course Content
8.25 Concrete Technology

CODE & TITLE (ART-224) **Concrete Technology**	CREDIT & CONTACT HOURS (2+2) **32 Theory + 96 Lab**	KNOWLEDGE AREA/ DOMAIN **Breadth Core-VII**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO–1	**Explain** properties of plain concrete and component materials.	C-2	1
CLO–2	**Design** concrete mix to comply with given criteria.	C-3	3
CLO–3	**Analyze** behavior of reinforced concrete members exposed to varying ambient conditions.	C-4	2
CLO-4	**Execute** experiments related to properties of freshly poured and hardened concrete.	P-4	3

Course Outline for Theory

Properties of aggregates, cement and concrete, Mixing, Transporting, placing, Vibrating and Curing Techniques of Concrete, properties of fresh and hardened concrete, strength, elastic behavior, shrinkage and creep, concrete in extreme weather and durability of concrete to chemical and physical attacks. Effects of impurities in water and in aggregates on the performance and durability of plain and reinforced concrete. Effect of water/cement ratio upon workability and strength of concrete.

Mix Design:

Requirements of cube cylinder strength, workability and aggregate size. Prescribed mix, design mix and the effect of varying proportions of the component parts. Procedure for design of concrete mix (ACI, British Standard Specifications and Road Note No.4). Laboratory and site testing for assessing the quality, performance, and strength of a design mix.

Reinforced Concrete:

Mechanics of reinforced concrete and its behavior under working and ultimate loads. Basics of reinforced concrete design. Analysis and design of Singly Reinforced RC beams. Behavior of one way and two-way slabs. Basic design equations, Function of reinforcement in structural concrete elements with respect to resisting tension, compression, and shear. Types of Cracks in Beam, Stresses in Un-cracked Transformed Section, Introduction about Flexural Behavior of Beam Under Service Load.

Detailing and Fabrication of Reinforcement:

Function of reinforcement in structural concrete elements with respect to resisting tension, compression, shear and shrinkage cracking. Concrete cover to reinforcing bars and its variation in different structural elements, lapping of reinforcement, details of bar bending and preparation of schedules. Preparation of working drawings of structural elements. Introduction to different types of concrete foundations.

Lab Outlines

1. Determination of standard consistency and water demand of cement paste.
2. Determination of Initial and Final setting of cement

3. Determination of soundness of cement
4. Determination of compressive strength of cement mortar cubes.
5. Perform workability tests on fresh concrete.
6. Determination of unit weight of concrete
7. Determination the compressive strength and tensile strength of concrete
8. Determination of modulus of elasticity of concrete.
9. Nondestructive testing evaluation of concrete.
10. Effect of curing/exposure conditions on strength on concrete.

Recommended Books

1. Properties of Concrete by A. M. Neville; Wiley John & Sons.
2. Concrete Design by Zahid Ahmad Siddiqi, Help Civil Engineering Publishers, Lahore, 2009.
3. Design of Concrete Structures by H. Nilson, McGraw-Hill.
4. Reinforced Concrete - Design & Behavior by C. K. Wang & Salmon.
5. Structural Concrete Theory and Design. By M.Nadim Hassoun & Akthem AlManaseer. 3rd Edition

Course Content

8.26 Construction Contracts, Codes and Regulations

CODE & TITLE (ARM-311) **Construction contracts, codes and Regulations**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Science-II /** **Management Sciences-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** legal implications of contracts, common law, and regulatory law to manage construction projects.	C-2	6
CLO-2	**Apply** standard codes of practice to structures of various natures and importance.	C-3	6

Course Outlines for Theory

Specifications codes and Practice:

a) ACI-318-14
b) ASCE-07
c) Pakistan Building Codes (PBC)
d) IBC
e) Green Building
f) FIDIC

Study of contracts and building codes required at city, provincial, and federal levels and their relation to quality control. These may include (but not limited to): Conduct and Consulting Byelaws; Construction and Operations Engineering Works Byelaws; Code of Ethics and Conduct; Building Code of Pakistan; Building Code of Pakistan-Energy Provisions; Building Code of Pakistan Fire Safety Provisions; Building Control and Town Planning Regulations; Land Regulations; Different Development.

Code Compliance Policies and Procedures: Policy description, Prioritizing Code Cases, Problem Oriented Policing Program, Performance Measures, Records Organization and Electronic File Naming, Initial Steps, Investigation, and Informal Efforts to Obtain Voluntary Compliance and Correction of Violations, Scope of Inspection and Expectation of Privacy, Consent, Documentation, Inspection Warrants, Officer Safety - Basic Officer Safety Rule, Expectations, Avoiding Conflict, and Reporting.

Authorities and their regulations; Overview of Regional Codes; Overview of International Codes; Comparative assessment of national vs. international codes and regulations.

Recommended Books

1. Design of structures by R.H Nilson
2. ACI-318-14
3. ASCE-07
4. Pakistan Building Codes

Note: Each specialty related structural design based on codes and standards will be taught by respective specialists, like building, highway, water retaining structures and foundation design.

Course Content

8.27 Technological Building Analysis

CODE & TITLE (ART-311) **Technological Building Analysis**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Core-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Recognize** basic tools of MEP engineering technology drawings.	C-1	1
CLO-2	**Understand** MEP engineering technology drawing tools and use techniques to represent models.	C-2	5
CLO-3	**Use** MEP engineering technology drawing techniques and principles.	P-3	5
CLO-4	**Participate** in technological building analysis, and experimental procedures.	A-2	9

Course Outline for Theory

Introduction to the Revit MEP**,** Basic Creation Tools, Basic Editing tools, Basic Editing tools, Starting An MEP Project, Views, Component Families, Spaces And Zones, Building Performance Analysis, Systems, HVAC, Hydronic Piping Systems, Plumbing Systems, Fire Protection Systems, Electrical Systems, Scheduling, Detailing, Documentation, Presentations

Lab Outline

Practicing Basic Creation Tools, Basic Editing tools, Basic Editing tools, Starting An MEP Project, Views, Component Families, Spaces And Zones, Building Performance Analysis, Systems, HVAC, Hydronic Piping Systems, Plumbing Systems, Fire Protection Systems, Electrical Systems, Scheduling, Detailing, Documentation, Presentations

Recommended Books

1. Mastering Autodesk Revit Architecture 2015 by Eddy Krygiel
2. Mastering Autodesk Revit MEP 2016. Autodesk Official Press by Simon Whitbread

Course Content

8.28 Building Information Modelling

CODE & TITLE (ART-312) **Building Information Modelling**		**CREDIT & CONTACT HOURS** (0+3) **0 Theory + 144 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Core-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the role and potential of BIM for the industry.	P-1	1
CLO-2	**Practice** BIM in building projects.	P-3	5
CLO-3	**Use** BIM for design and modelling.	A-2	9
Lab Outlines			
Introduction of Revit as example of BIM: BIM Concepts, Methods and Processes, Parametric Modelling, IFC, SMC and Model Auditing , Construction detailing and documentation processes, BIM for Design Collaboration and Decision-Making, understanding of applying BIM in urban context, BIM and Collaborative Virtual Environment.			
Recommended Books			
1. Integrated Building Information Modelling 2. Editor(s) : Peng Wu, Haijiang Li, Xiangyu Wang D'Azzo Control System. 3. Shaum Series. Feedback Control System.			

Course Content

8.29 Project Management

CODE & TITLE (ARM-311) **Project Management**	CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/DOMAIN **Social Science-III /** **Management Sciences-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** fundamental concepts of project management.	C-1	11
CLO-2	**Apply** project management techniques.	C-3	11
CLO-3	**Understand** project management thoroughly.	A-3	10

Course Outline

Introduction to Project Management: History of project management, definition of project management, introduction to institute (PMI) and international certification, benefits of project management, framework of project management, project management knowledge areas (PMBOK), project life cycle, project characteristics, project constraints, project organization structure, managerial skills, types of organizations, managerial control, principles of management, tasks and responsibilities of project managers in construction enterprises.

Project Planning and Scheduling: the organization and planning of construction projects, the contents and preparation methods of planning, construction project schedule planning system, target demonstration of the overall schedule, preparation and adjustment methods of the schedule, measures for schedule control, WBS and linear responsibility charting, activity sequencing, dependencies, Network diagram, bar chart and giant chart, critical path method (CPM), calculation of CPM, CPM scheduling for construction, and Program Evaluation and Review Technique (PERT), and project resource allocation and levelling.

Project Cost Management: basic principles of cost management, types of estimates, tasks and measures for construction cost management, construction cost planning, mastering the determination of project change price, settlement of construction and installation cost, construction cost control and construction cost analysis,

Valuation and concept theory: introduction to simple and compound interest, life cycle cost and calculation of simple and compound interest and value management (use of fast diagram and Miro).

Project Quality Management: defining quality, quality issues in construction, project quality planning, quality plans and manuals, work inspection procedures, responsibilities of various parties, quality control and assurance, familiar with the formation process and influencing factors of project quality, construction quality control methods; quality acceptance content, and project quality government supervision measures.

Project Stakeholder Management: Project stakeholder analysis and management, project delivery systems, project team selection, skills, and competencies of project manager, building and managing successful project teams.

Communication and Information Management: functions of communication, communication process, barriers to effective communication, group decision making, site-office communication, and communicating with stakeholders.

Project Risk Management: Defining risk and uncertainty, project risk, probability and impact of risk, risk management process.

Human Resource Management: manpower planning, management approaches, hiring and training, performance evaluation and appraisal, motivation and incentives.

Project Management Tools: Introduction and use of project management tools like MS Project, Primavera, MIRO, etc.
Recommended Books
1. Fundamentals of project management, 5th edition, American Management Association, Heagney, K., 2022 2. Project management for engineering, business and technology, 6th edition, Routledge, Nicholas, J.M. and Steyn, H., 2020. 3. Project Management: A Guide to the Project Management Body of Knowledge PMBOK 7th edition. Project Management Institute, USA, 2021. 4. Project Management: Construction Management in Practice. Blackwell Science Ltd, Frisk, E. R. and Reynolds, W.D. 2010. 5. Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons, Kerzner, H., 2017. 6. Project Management: Urban Construction Project Management (McGraw-Hill Construction Series). McGraw-Hill Education, Lambeck, R. and Eschemuller, J., 2009. 7. Project Management: Open Design: A Stakeholder-oriented Approach in Architecture, Urban Planning, and Project Management (Vol. 1). Los Press, Binnekamp, R., van Gunsteren, L.A., van Loon, P.P. and Barendse, P., 2006. 8. Project management for design professionals. Kaplan Publishing, Ramroth, W., 2006.

Course Content

8.30 Communication Skills

CODE and TITLE (ARE-311) **Communication Skills**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Science-IV /** **Expository writing-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basic concepts and importance of communications.	C-2	10
CLO-2	**Identify** common errors made by learners of English as a second language.	A-1	10
CLO-3	**Communicate** through technical writings, presentations using basic-to-intermediate level English, and understand essentials of communication skills.	A-3	10

Course Outline

Vocabulary building, common writing errors, purposeful writing, business writing, critical reading, reading for understanding, introduction to communication process, seven Cs of communication, types of listening, listening skills, verbal and non-verbal communication, basic presentation skills, Presentation Strategies and public speaking skills, use of Audio-Visual Aids, basics of group communication, communicate effectively in job interviews.

Recommended Books

1. Practical English Grammar, by A. J. Thomson and A. V. Martinet. Fourth edition. Oxford University Press. (Latest Edition)
2. Practical English Grammar Exercises 1, by A. J. Thomson and A. V. Martinet, Oxford University Press. (Latest Edition)
3. A Practical Guide to Business Writing: Writing in English for Non-Native Speakers, by Khaled Mohamed Al Maskari. Wiley. (Latest Edition)
4. Communication Skills for Engineers, by Sunita Marshal and C. Muralikrishna (Latest Edition)
5. The Essentials of Technical Communication, by Elizabeth Tebeaux and Sam Dragga, Oxford University Press. (Latest Edition)
6. College Writing Skills, by John Langan,. 9th Edition (or Latest Edition)
7. Exploring the World of English, by Saadat Ali Shah, Ilmi Kitab Khana. (Latest Edition)

Course Content

8.31 Quantity Surveying and Estimation

CODE & TITLE (ARN-311) **Quantity Surveying and Estimation**	CREDIT & CONTACT HOURS (1+2) **16 Theory + 96 Lab**	KNOWLEDGE AREA/ DOMAIN **Natural Sciences-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** basic concepts of quantity surveying and estimation, and skills to perform these tasks.	C-2	1
CLO-2	**Evaluate** rate analysis and pricing.	C-4	2
CLO-3	**Produce** programmed spreadsheet-based cost estimates and bills.	P-4	5

Lab Outlines

1. Workout quantities for earthwork for site-grading and leveling using geometric cross-sectional/grid method.
2. Workout quantities for mass excavation for raft footing.
3. Prepare Measurement sheet (MS) for 1:2:4 concrete for 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 given drawing.
6. Workout the quantities slab reinforcement from given drawing
7. Workout the quantities of overhead water tank concrete and its reinforcement.
8. Prepare material estimate for a single room complete in all respect.
9. Prepare Material List of a steel truss.
10. Prepare Material List of a metal frame structure (low-rise)
11. Prepare a detailed estimate of an RCC water overhead reservoir of 20,000-gallon capacity.
12. Prepare detailed estimate of a manhole.
13. Prepare detailed estimate of a septic tank and soakage pit.
14. Prepare bill of quantity and abstract of cost for a manhole and septic tank.
15. Estimation of construction cost of a concrete road with specific percentage of reinforcement
16. Calculate the volume of earth work from contour map

Recommended Books

1. D. D. Kohli, Estimating, Costing and Accounts, 9th Ed. S. Chand & Co. Pvt. Ltd
2. Keith Collier, Fundamentals of construction. Estimating & Cost Accounting,Prentice Hall, 1975

3. Stephen J. Peterson, Construction Estimating Using Excel, Prentice Hall
4. Standard Form of Bidding Documents by Pakistan Engineering Council
5. S. Dutta, Estimating and Costing in Civil Engineering, 24th Ed. SOS Free Stock, 1999

Course Content

8.32 Building Conservation and Rehabilitation

CODE & TITLE (ART-321) Building Conservation and Rehabilitation	CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Architectural Engineering Technology Depth Core-IV	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Comprehend** fundamental concepts of building conservation.	C-2	1
CLO-2	**Understand** the standards and legislation covering cultural heritage sites and buildings, their preservation, and ways to identify such sites and structures from historical literature.	C-2	6
CLO-3	**Perform** lab activities related to building conservation.	P-3	4
CLO-4	**Participate** as an individual or as a team member in lab or field activities.	A-2	9

Course Outline for Theory

Introduction to building heritage, culture, building monuments. Archaeology, archaeological sites have their importance. Principle of archaeology and archaeological investigation. Introduction of historic buildings and historic sites. Integrity of historic buildings. Defects in historic buildings. Causes of decay in historic buildings. Measurement techniques of cracks and settlement. Introduction to the concept of adaptive reuse of buildings. Factors affecting reuse of buildings. Importance of traditional materials. Construction materials are used in historic buildings. Finishing and decorative materials used in historic buildings. Analysis of Architectural Heritage of a Settlement with reference to Historic Periods, Building Typologies, Architectural Styles etc. Study of building conservation, Terminologies of Conservation i.e. Preservation, Restoration and Reconstruction. Conservation documentation techniques. Underpinning & other restoration techniques. Present state of conservation in Pakistan. Building Materials and Construction Techniques used in the Conservation works. Legislation for Conservation of Cultural Heritage, Existing Legislation in Pakistan and its History. The Antiquities Act 1975, The Punjab Special Premises Preservation Ordinance 1985, Analysis. Required improvements/amendments. Law implementing Agency, its structure, organization etc. under the jurisdiction of the Law/Act. Department of Archaeology and Museums, Pakistan, its history, organization and analysis of its functions International Charters for the Conservation of Cultural Heritage.

Lab Outlines

The experiments related to above mentioned outline shall be covered in the Laboratory/Design class such as material surface characterization test for building conservation, Documentation of Building conservation, Site Visits etc.

Recommended Books

1. Conservation of Historical Buildings by Sir Bernard M. Fielden
2. Archaeology in Pakistan by Dr. Ahmad Nabi Khan
3. Historic Preservation for Designers by Peter B. Dedek
4. The Antiquities Act 1975, Islamic republic of Pakistan
5. The Punjab Special Premises (Preservation) Ordinance, 1985, Government of the Punjab, Pakistan
6. Conservation Plan for the Walled city of Lahore, Lahore Development Authority (LDA), Lahore

Course Content

8.33 Geotechnical and Foundation Engineering

CODE & TITLE (ART-322) Geotechnical and Foundation Engineering	CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Core-V	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** classification of different soils.	C-2	1
CLO-2	**Estimate** the bearing capacity of soils for various type of foundations.	C-2	2
CLO-3	**Investigate** the geotechnical properties of soils through experimentation.	P-4	4

Course Outline for Theory

Introduction: Importance of mechanics of soils in Civil Engineering Technologists

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, Consistency of soils, States of consistency and Atterberg's limits, Determination of Atterberg's limits and consistency indices, Grain Size distribution of soils: particle size distribution curves, sieve analysis, Stoke's law, hydrometer analysis.

Soil Classification: Particle size classification systems, AASHTO classification system, Unified soil classification system, Identification and classification of expansive soils, Collapsible and dispersion soils.

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.

Shear Strength: Shear strength parameters of soils, shear strength of cohesive and cohesion less soil, Laboratory measurement of shear strength parameters: shear box test, unconfined compression test, vane shear test and tri-axial shear test.

Foundations: Purpose and types of foundations, Gross and net pressures on footing, Selection of foundation type, Bearing capacity of foundation, Plate load test, Pile load test.

Lab Outline

1. Introduction to the Soil Mechanics Laboratory and HSE (Health, Safety and Environment) measures.
2. To determine the water content of soil
3. To determine the particle size distribution of coarse-grained soil by Sieve Analysis.
4. To determine the particle size distribution of fine-grained soil by Hydrometer Analysis
5. To determine the liquid limit of fine-grained soil by Casagrande Apparatus and or Fall Cone (Penetrometer) Method
6. To determine the liquid limit of fine-grained soil by.
7. To determine the shrinkage limit of fine-grained soil.
8. To obtain shear strength parameters of the collected UDS sample.
9. To determine the shear strength parameters of soil.
10. To perform SPT/CPT in the field

11. To perform plate load test in the field.
Recommended Books
1. Principles of Geotechnical Engineering, Das, B.M, Brook/Cole. 10th Edition 2. Introduction to Soil Mechanics Laboratory Testing by Dante Fratta, Jennifer Aguettant and Lynne Roussel-Smith, 2nd Edition. 3. Fundamentals of Soil Mechanics, M. Siddique Qureshi and Aziz Akbar 4. Foundation Engineering by B.M, Das, Brook/Cole. 9th Edition

Course Content

8.34 Steel Structures

CODE & TITLE (ART-323) **Steel Structures**		CREDIT & CONTACT HOURS (2+0) **32 Theory + 0 Lab**	KNOWLEDGE AREA/DOMAIN **Depth Core-VI**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Know** the theories and models to analyze steel structural members.	C-1	1
CLO-2	**Understand** types of welded and bolted connections, glazing, fire safety, and corrosion protection techniques**.**	C-2	4
CLO-3	**Analyze** structural steel members and connections under axial, flexure, and shear loads.	C-4	2

Course Outline for Theory

Introduction: Use of steel as structural material, technical characteristics, Types and shapes of structural steel members, Types of Beams, Columns and Trusses. American Institute of Steel Construction (AISC) specifications and codes. Analysis methods: Allowable Stress Design and Load and Resistance Factored Design (LRFD). Tension members: Analysis of tension members against gross yielding, rupture and block shear. Compression members: Analysis of long columns against bucking. Flexural members: Analysis of beams against bending and shear. Types of connections, Glazing interface details, Fire and corrosion protection.

Recommended Books

1. McCormac, J. C., Csernak, S. F., Structural Steel Design, Pearson Education, 6th edition (2018).
2. Segui, W. T., Steel Design, Cengage Learning, 6th edition (2018)
3. Trebilcock, P., Architectural Design in Steel, CRC Press, Ist edition (2016)

Course Content

8.35 Architectural Technologies Research Project

CODE & TITLE (ART-324) **Architectural Technologies Research Project**	CREDIT & CONTACT HOURS (0+6) **0 Theory + 288 Lab**	KNOWLEDGE AREA/DOMAIN **Depth Core-VII**

	After completion of this course, students will be able to:	Bloom's Taxonomy Level	PLO
CLO-1	**Application** of engineering knowledge.	C-3	1
CLO-2	**Participation** as an individual and in team.	A-5	9
CLO-3	**Effective** written and oral communication**.**	A-2	10
CLO-4	**Recognition** of significance of projects as lifelong learning**.**	A-3	12

Course Outline

1. Lecture on Nature and types of research,
2. Demonstration of using google scholar, online searching and Turnitin.
3. Visit to industrial head office. Identification of different problems for research. Finalization of research topic.
4. Collection of literature review.
5. Demonstration of adding references.
6. Submission of literature review
7. Selection of case study
8. Discussion on case study
9. Submission of case study and finalization of research aspect.
10. Data collection of research questions
11. Submission of research aspect.
12. Analysis and presentation of data and conclusion.
13. Submission and presentation of final report.

Recommended Books

1) Lewis Mumford. The City in History: Its Origins, Its Transformations, and Its Prospects. New York: Harcourt, Inc, 1961.

2) Stephan Fussel, Rem Koolhaas. City of the world. Braun, Taschen GmbH. 2015

3) Spiro Kostof, Richard Tobias. The city shaped: urban patterns and meanings through history. Thames & Hudson Ltd. 1999

4) Greg Clark. Global cities: a short history. Brookings institution press. 2016

Course Content

8.36 Technical Report Writing

CODE & TITLE (ARE-321) **Technical Report Writing**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Science-V /** **Expository writing-II**
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** basic concepts in technical writing, and use standard word processing software, along with referencing tools, for report writing.		A-2	5
CLO-2	**Initiate** technically correct statements, do written assignments, write final year project report, project proposals, short reports, research papers, and execute business and professional correspondence.		A-3	10

Course Outline for Theory

Introduction to technical writing, technical communication process, proposal write-up and improvement strategies, introduction to research and research types, choosing research problems and research advisors, how to carry out research, different parts of technical writing, formulation – problem statement, literature review, design – methodology, analysis - data analysis and interpretation good writing style techniques, uses of correct words, presenting and publishing research, write business/professional correspondence, cover letter and CV, writing meeting minutes, introduction to informal writing, uses of informal reports.

Recommended Books

1. Technical Report Writing Today, by Daniel Riordan, 10th Edition.
2. Technical Writing and Professional Communication, Leslie Olsen and Thomas Huckin, 2nd Edition.
3. Communication for Engineering Students by J. W. Davies.
4. Science Research Writing for Non-Native Speakers of English by Hilary Glassman-Deal, Imperial College Press.

Course Content

8.37 Entrepreneurship

CODE & TITLE (ARM-) Entrepreneurship		CREDIT & CONTACT HOURS (3+0) 48 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Management Science Elective-II
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** entrepreneurship concepts, and the role of entrepreneurship in economic development.	A-3	10
CLO-2	**Discuss** the role and importance of small and medium sized enterprises in the economy.	A-4	6
CLO-3	**Identify** attractive markets, and apply business planning concepts to create new businesses with growth potential.	A-3	8

Course Outline for Theory

The concept of entrepreneurship, the economic view of entrepreneurship, the sociologist view, Behavioral approach, Entrepreneurship and Management. The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, the new venture. The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, the innovation process, Risks involved in innovation. Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, the environment, Socio cultural factors, Support systems. Teamwork, Networking organization, Motivation and compensation, Value system. Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs, Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design, Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience, Case Studies of Successful Entrepreneurs

Recommended Books

1. Technology Ventures: From Idea to Enterprise by Thomas Byers, Richard Dorf, Andrew Nelson, 4th Edition, McGraw Hill 2015, (or Latest edition)
2. Paul Burns and Jim Dew Hurst: "Small Business and Entrepreneurship", 1996, Palgrave Macmillan Publishing Company, Second Edition (or Latest edition)
3. Peter F. Drucker: "Innovation and Entrepreneurship", 2006, Harper Business, Reprint Edition (or Latest edition)
4. The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company by Steve Blank, Bob Dorf, K & S Ranch 2012, (or Latest edition)
5. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries, Penguin Books 2011, (or Latest edition)
6. John B. Miner, "Entrepreneurial Success", 1996, Berrett-Koehler Publishers, First Edition (or Latest edition)

Course Content
8.38 Site Planning and Development

CODE & TITLE (ART-411) **Site planning and Development**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Elective-VIII**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** site design conditions of various buildings.	C-2	1
CLO-2	**Analyze** the road and nodes.	C-4	4
CLO-3	**Identify** basic parking designs and standards.	C-1	4
CLO-4	**Develop** site designs using standard planning and design principles.	P-2	2

Course Outline for Theory

Introduction to basic content of site design, basic principles and site elements, Site design conditions
Natural conditions, construction conditions, Site design conditions, public constraints of the site design, basic principles and requirements for the site selection, terrain analysis methods, Mastering analysis of the site design conditions.

Vertical design
Calculation of earth work volume, vertical layout methods and expressions for the different site conditions. Mastering the methods and expressions of vertical design.

General site layout
Principles of site zoning, site building layout, traffic organization, method of green space allocation

Road and square design
Types and methods of square design, basic knowledge and technical standards of site road design

Parking design
Principles and standards of parking design, mastering the design of the parking lots

Surrounding analysis
Site analysis according to the surroundings factors.

Design strategies
Site integration as per standards and conditional study as per site

Topography
Topographical studies and classification. Neighborhood spatial characteristics
Introduction to spatial characteristics and other factors

Weather and geology
Weather condition study and geological studies through case studies

Allocation of green space
Study of green space and allocation principles and standards

Verticality on design
Verticality as per design standards and their usage.

Lab Outline

Perform related site design in conjunction with planning and design curriculum settings. Students should understand the site topography, weather, geology, traffic conditions, neighborhood spatial characteristics and other factors, as well as relevant laws, regulations, technical specifications, and urban planning requirements. Influence, have the ability to comprehensively use the basic knowledge of site design, and reasonably determine the plane and spatial relationship of each building, structure and other facilities based on the composition content,

functional requirements of the construction project, and the natural conditions and construction conditions of the construction site. Site Design.
Recommended Books
1. James A. La Gro Jr. Site Analysis: Informing Context-Sensitive and Sustainable Site Planning and Design. Wiley; 2013 2. David Kent Ballast. Site Planning & Design: ARE Sample Problems and Practice Exam. Professional Pubns Inc; 2008 3. Russ, Thomas H. *Site planning and design handbook*. McGraw-Hill Education, 2002.

Course Content
8.39 Building Electrical Design

CODE & TITLE (ART-412) **Building Electrical Design**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Elective-IX**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** electrical systems for buildings and related parameters.	C-2	1
CLO-2	**Perform** relevant tasks for electrical systems in buildings.	P-3	9

Course Outline for Theory

Overview of Electrical system: Electrical system and basic components of Electrical System, Basic Electrical formulas and calculations, Single phase and three phase electrical system.

Major electrical components for buildings: Wire and types of wires, Cable and types of cables, cable trays/ raceways and their types, Boxes & Panels, Switches, Receptacles, Bus ways, Electrical protection equipment including fuses, Circuits breakers and relays.

Interior wiring system: Electrical Load Calculations for buildings, Preliminary Work: Planning Your Project, Highlights of the National Electrical Code, Wiring project, Circuit Maps: Common Household Circuits.

Communication and security systems: Communication spaces and pathways, Design considerations for communications, types of communications cable pathways, Design considerations for communication spaces, Grounding system, Communication cabling system: Types of communication cabling, Design considerations for communications, Material and installation standards, Cable hierarchy, Voice and data communication system: Types of voice communications, Types of data communications system: Terminal-host systems, Local area network (LANs): other data communication systems, video communications systems.

Electronic security systems: Levels of security, Types of security technologies, Access control/ card entry, Design considerations for card entry systems: Biometric Access control technologies. Intrusion detection, Design considerations for intrusion detection, Closed circuit television.

Lab Outline

- Characteristics of Single Phase A.C. Series and Parallel Circuits
- Measurement of Power Consumed by a Fluorescent Lamp
- Balanced Three-phase Circuit
- Study of Constant Current Source
- Measurement of Low Resistance by Kelvin Double Bridge
- Study of a Simple on-off Control System
- Measurement of strain of a beam by strain gauge.

Recommended Books

1. Belu, Radian. Building Electrical Systems and Distribution Networks: An Introduction. CRC Press, 2020.
2. Cobb, Matthew, et al. "Higher education Building efficient electrical design." Southeast Con 2016. IEEE, 2016.
3. Sclater, Neil. Handbook of electrical design details. McGraw-Hill Education, 2003.

Course Content

8.40 Building Lighting Design

CODE & TITLE (ART-413) Building Lighting Design	CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective-X	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** illumination systems in buildings (electric and natural lighting).	C-2	1
CLO-2	**Apply** analytical lighting calculation techniques in building design.	C-3	5
CLO-3	**Perform** lighting and daylighting computational models to design illumination systems, predict electricity consumption, and recommend energy savings techniques.	P-3	5

Course Outline for Theory

Lighting metrics, calculations and measurements - Nature of light and sight; Basic photometric quantities; Lighting terms and metrics**;** Inverse square law**;** Luminance equations**;** Lambertian surfaces and diffusion**;** Sky luminance**;** Measuring luminous flux**;** General square law in 3D**;** Zonal lumens for light sources

Illuminance from non-point sources - Strip, tube and rectangular sources**;** General flux transfer theory

Vision and color, radiant energy and light - Spectral sensitivity**;** Luminous efficacy**;** Vision factors**;** Contrast and brightness, spectral power density**;** Emissivity and selective radiators**;** Luminescence and incandescence**;** Relating lumens and watts**;** Color temperature

Lamps – Incandescent, tungsten-halogen, fluorescent and CF lamps: properties, construction, types, characteristics, life and losses, efficiency; Ballasts**;** Circuits and starting methods**;** Mercury, metal halide and high-pressure sodium lamps

Luminaires and controls for interior lighting - Criteria**;** Luminaire characteristics and classifications, luminance and optics –glare criteria**;** Photometric reports**;** Visual comfort and glare indices; Lighting control functions and types; Control circuit types**;**

Interior lighting design: average and detailed illuminance calculations- Illuminance selection**;** Basic lumen method; non-rectangular spaces; Detailed Flux transfer; Luminous existence and relationships**;** Configuration factors**;** Form/view factors and properties**;** One-bounce flux transfer analysis**;** Multiple- bounce analysis, radiosity method and detailed illuminance calculations

Daylighting prediction models- Basic daylighting models (CIE and ASHRAE sky models)**;** Solar geometry and model similarities; The Perez all weather sky model**;** Weather data and detailed model formulation

Windows and optics - Optical properties as fundamental variables**;** Angle dependency**;** Basic ray tracing for optical properties**;** Selective glazings and coatings for daylighting

Daylighting metrics and shading - Daylight factors**;** Illuminance histograms**;** Useful illuminances**;** Daylight autonomy**;** Energy savings from daylighting; Shading devices: types, properties and controls

Lighting and daylighting research projects and applications

Lab Outline

1. Introduction to lighting software
2. Ecotect software
3. Comfen software
4. Daysim, Radiance and other software other software
5. Programming and building computational models for lighting calculations

6. Experimental measurements in Bowen
Recommended Books
1. Karlen, Mark, Christina Spangler, and James R. Benya. *Lighting design basics*. John Wiley & Sons, 2017. 2. Tregenza, Peter, and Michael Wilson. *Daylighting: architecture and lighting design*. Routledge, 2013. 3. Tregenza, Peter, and David Loe. *The design of lighting*. Routledge, 2013.

Course Content
8.41 Landscape Design

CODE & TITLE (ART-414) **Landscape Design**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Elective-XI**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** basic methods and principles of landscape design.	C-2	1
CLO-2	**Identify** and describe types of urban gardens and green spaces according to local conditions, and define conditions to form an organic urban garden, green space system.	C-3	4
CLO-3	**Perform** basic skill exercises of landscape Design.	P-3	3

Course Outline for Theory

Spatial basis of landscape design: related basic knowledge of space; basic theory of spatial design; spatial limitation and scale.
Human behavior in landscape design: the human behavior in gardens and the outer rules of design.
Landscape design: knowledge about landscape topography, types, characteristics and expressions of water bodies, knowledge about piled rocks in gardens, design requirements for water systems, and knowledge about the separation and connection of water surfaces.
Garden architecture and sketch design: The layout requirements of garden architecture and sketches in the garden design.
Garden road design: layout and design of garden roads.
Garden Planting Design: Significance and Basic Principles of Garden Planting Design

Lab Outline

planning and design of green areas in residential areas
Make students understand the basic process and method of green space planning and design in residential areas. Able to carry out investigation and analysis, site survey, and data collection according to design requirements, and draft sketches, functional zoning, and space design in accordance with the environment, grasp the relationship between the landscape and other elements in the environment, design a reasonable campus landscape, and express landscape elements according to local conditions Accurate and adequate.
comprehensive park planning and design.
To enable students to understand the basic process and methods of city-level comprehensive park green space design Conduct surveys, collect relevant materials for analysis, establish design concepts, functional zoning, and organize spatial transportation relationships. After comparing the schemes, the schemes will be perfected, and the drawings will be accurate.

Recommended Books

1. Darke, Rick, and Douglas W. Tallamy. *The living landscape: Designing for beauty and biodiversity in the home garden*. Timber Press, 2014.
2. Beck, Travis. *Principles of ecological landscape design*. Island Press, 2013.
3. Reid, Grant. *Landscape graphics: plan, section, and perspective drawing of landscape spaces*. Watson-Guptill, 2012.

Course Content

8.42 Energy and Environment

CODE & TITLE (ART-41X) Energy and Environment	CREDIT & CONTACT HOURS (1+1) 16 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Breadth Elective	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Have** basic knowledge of fundamentals of energy and environmental technology.	C-1	6
CLO-2	**Analyze** energy sources and their environmental impact.	C-4	6
CLO-3	**Suggest** remedies and solutions to energy supply and associated environmental issues.	C-5	6
CLO-4	**Explain** ecological impact through Environmental Impact Assessment (EIA) reports.	P-1	6

Course Outline for Theory

Introduction to environmental engineering, Identification of the factors affecting the environment, The causes and effects of environmental pollution (water, air and land), Introduction to renewable energy technology, energy crisis and environmental hazards, Types of renewable energy systems, opportunities of renewable energy utilization, renewable energy storage and transmission design and sizing of renewable energy systems, Environmental pollution and control, Types of pollution, primary and secondary pollutants, Air pollution, Composition of air, Types of atmosphere, Design of cyclone and its calculations, Electrostatic precipitator and calculations, pollution from energy systems, clean coal technologies coal and environments, soil and water pollution from energy systems Eutrophication process, Controlling eutrophication, Environmental Impact assessment (EIA) and initial Environmental Examination (IEE), Global environmental issues (acid rain, global warming, ozone depletion and greenhouse gases), Overview of safety and environmental risk assessment.

Lab Outline

Learn the use of basic study of renewable energy resources. Design and implement environmentally friendly energy system. Steps involved in Environmental Impact Assessment (EIA).

Recommended Books

4. Renewable energy sources: John Twidell and Tony Weir, Taylor and Francis (Latest edition)
5. Renewable energy conversion, transmission, and storage: Bent Sorensen, Academic Press (Latest edition)
6. Energy, environment, and sustainable development: Mohammad Aslam Uqaili, Khanji Harijan. (Latest edition)
7. Introduction to Environmental Impact Assessment: John Glasson, Riki Therivel (Latest edition)

Course Content
8.43 Economics

CODE & TITLE (ARM-41X) **Economics**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Management Science Elective-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Estimate** depreciation of an asset using standard depreciation techniques and assess its impact on present or future values.	C-2	10
CLO-2	**Predict** cost effectiveness of individual projects using methods learnt, and the effects of inflation on economic analysis of engineering projects.	C-3	6
CLO-3	**Use** appropriate engineering economics analysis and methods for problem solving, i.e., present worth, annual cost, rate of return, payback period, break-even analysis, and cost-benefit ratio.	C-4	10

Course Outline for Theory

Basic concepts, technological economy defined Types of Business organizations, financial statements and financial ratios, Time value of money, cash flow series and its types, basic cost concepts. Profit and interest, discrete and continuous compounding, nominal, and effective interest rate. Economic analysis of alternatives, Alternatives having identical lives, Alternatives having different lives, PW, AW, FW, Cost-benefit analysis and rate of return analysis, Break-even and payback analysis. Use of spreadsheets for economic analysis, economic effects of inflation. Replacement and retention decisions Depreciation, amortization, and depletion of economic resources. Price, Supply and Demand Relationship. Project financing. Factors of production, Capital budgeting, economic analysis in the service sector.

Recommended Books

1. Technological Economics by Shoubo Xu (Springer)
2. Engineering Economy, Latest Edition, Leland T. Blank and Anthony J. Tarquin, McGraw Hill
3. Contemporary Engineering Economics, Latest edition, Chan S Part Pearson Prentice Hall
4. Engineering Economic Analysis by Donald G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, 12th edition, Oxford University Press

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 prior to graduation. The training curriculum consists of minimum 16 weeks of continuous industrial training, comprised of 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 7th and 8th semesters (16 weeks mandatory and 16 weeks in 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 field works and maintenance. It also serves as a mechanism to integrate engineering practices and the curriculum to achieve Program Learning Outcomes that cover Engineering Technologists Graduate Attributes in line with the Sydney Accord. While SIT provides practical exposure to engineering processes and helps developing professional skills required for an Engineering Technologist, it also offers an opportunity to the prospective employers to assess potential skills of a future employee.

9.2 Objectives:

Through the SIT, students will:

a. Learn to apply engineering technology knowledge learned in classroom environment in real industrial situations.
b. Be provided exposure to professional practices in the industries.
c. Understand the role and 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 7th (Optional) and 8th semester, Bachelor of Architectural Engineering Technology students will be undergoing continuous SIT of 16 (or 32) weeks. This training shall be arranged by HEIs in leading industry, and preferably should sign an MoU for the SIT. A designated Administrator/Coordinator of HEI shall complete all necessary documentation, preferably 12 weeks prior to the commencement of the training, and issue Training Schedule for 16 (or 32) weeks so that all stakeholders and the students are aware and assured of undergoing SIT training in 7th (optional) and 8th semester according to a scheduled timeline.

9.4 Responsibilities of Students

a. Bachelor of Architectural Engineering Technology students shall get enrolled for SIT during the 6th semester and before commencement of 7th semester.
b. Students shall have to undergo continuous training of 16 (or 32) weeks. One week's training of 8 hours daily for 5 days (40 contact hours) will be counted as 1 credit hour. Accordingly, 16 weeks (One semester) will help earn students 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 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 site, Training Administrator appointed by HEI and the student.
e. Students must observe safety & security rules of the Organization where they receive Training.
f. Students must wear specified working dress during training.
g. Students must obey all rules and regulations of the organization.
h. Students must observe working timings of the training Organization. Students may be allowed 10 days leave during Training period of 16 (or 32) 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 required to be made up later.
j. Unsanctioned leaves shall be treated as "absent", and 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 SIT Administrator/Coordinator for each program who will monitor progress randomly through site visits, phone calls or emails to the industrial organization's counterpart focal person. Progress reports will be maintained after coordination with training supervisor(s) as well as the students.

The purpose of monitoring of SIT by Training Administrator/Coordinator are:

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

9.6 Changing Student Placement During SIT

a. Students are discouraged to change placement during the training period from one organization to another.
b. However, written permission may be granted by the training Administrator/Coordinator, if 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 on daily basis in the Training Logbook [See Appendix F]. Students must get it signed, on daily basis, by on-the-job Trainer.

The Training logbook must reflect:

a. The student's learning experience during the industrial training

Training records and evidence of supervised training, with evidence of participation of student, on- the-job Trainer and HEI's training Administrator/Coordinator.

b. Part of professional practice in engineering profession where incidence and evidence are properly documented.
c. Information that becomes a source of reference in preparing the Industrial Training Report [See Section 9.8].
d. 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 student's learning and development in technical knowledge, engineering practices and professional skills acquired through practical experience. The Industrial Training Report should also reflect 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 Industrial Training Report Template as provided [See Appendix G] and guidelines given below in preparing the Report. The Daily Training Logbook should be submitted together with the Report.

9.9 Guidelines for Preparation of Industrial Training Report

Under the guidance of supervisors, students need to properly document their experience and learning during the SIT in form of 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 shall consist of:

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

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

(b) Background & Profile of the Training Organization

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 Trainee

This section briefly describes the time, duration and types of duties performed during the training. The description must follow the schedule of the training, i.e., in chronological order (for 16/32 weeks). 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. Problems 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 arrive at a conclusion with regards to the SIT undergone. Content may include:

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

(f) References

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

(g) Appendixes

Appendixes are additional information appended to support the main text of the Report. A copy of the letter of permission from the Training Organization must be attached as an appendix. Other suggested appendixes 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 cited 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 list of notations, symbols, and acronyms on a separate page, appropriately titled, and placed after 'Tables of Contents' page.

Every appendix must have a title and be mentioned in the main text of the Report. All page numbers for appendixes must be in continuation of page numbers of the main Report.

9.9.2 Format of the Report

(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 maximum 2 pages, and should briefly describe:

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

9.10 SIT Assessment

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

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 is also be noted that:

i. Minimum 50% marks are 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.

APPENDIX A: Sydney Accord Knowledge and Attitude Profile

(Retrieved from www.ieagreements.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 B: Engineering Technologist Graduate Attribute Profile

(Retrieved from www.ieagreements.org)

As per Sydney Accord, Engineering Technologist Graduate is expected to have the following attributes:
Engineering Technology Knowledge: **SA1:** An ability to apply knowledge of mathematics, natural science, Engineering Technology fundamentals and Engineering Technology specialization to defined and applied Engineering Technology procedures, processes, systems, or methodologies.
Problem Analysis **SA2:** An ability to Identify, formulate, research literature and analyze Broadly Defined Engineering Technology problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialization.
Design/Development of Solutions **SA3:** An ability to design solutions for broadly- defined Engineering Technology problems and contribute to the design of systems, components, or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
Investigation **SA4:** An ability to conduct investigations of broadly defined problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions.
Modern Tool Usage **SA5:** An ability to Select and apply appropriate techniques, resources, and modern technology and IT tools, including prediction and modelling, to Broadly Defined Engineering Technology problems, with an understanding of the limitations.
The Engineering Technologist and Society **SA6:** An ability to demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to Engineering Technology practice and solutions to broadly defined Engineering Technology problems.
Environment and Sustainability **SA7:** An ability to understand and evaluate the sustainability and impact of Engineering Technology work in the solution of broadly defined Engineering Technology problems in societal and environmental contexts.
Ethics: **SA8:** Understand and commit to professional ethics and responsibilities and norms of Engineering Technology practice.
Individual and Teamwork **SA9:** An ability to Function effectively as an individual, and as a member or leader in diverse teams.

Communication **SA10:** An ability to communicate effectively on broadly defined Engineering Technology activities with the Engineering Technologist community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project Management **SA11:** An ability to demonstrate knowledge and understanding of Engineering Technology 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: **SA12:** An ability to recognize the need for and have the ability to engage in independent and life-long learning in specialist Engineering Technologies.

APPENDIX C: Engineering Technologist Professional Competence Profile

(Retrieved from www.ieagreements.org)

As per Sydney Accord, 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 (represented by the 17 UN-SDGs).
Legal, regulatory, and cultural: **TC7:** Meet all legal, regulatory, and cultural requirements and protect public health and safety during 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 during 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.

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.

APPENDIX D: Minutes of Preliminary Meeting of NCRC

1. The preliminary Meeting of the National Curriculum Review Committee (NCRC) was held on 21-09-2022 to 23-09-2022 at the University of Lahore (UoL), Lahore.
2. The welcome session was started with recitation of Holy Quran, and it was chaired by Honorable Engr. Imtiaz Hussain Gilani, Chairman NTC. In a welcome speech, objectives, and arrangements for NCRC were presented by the host respected Prof. Dr. Muhammad Ashraf, Rector University of Lahore (UoL), Lahore. Then, the Chairman NTC elaborated upon the importance of curriculum development for Bachelors of Engineering Technology programs by focusing more on practical work, keeping in mind the sharp global pivot towards hands-on skills, market demand, and societal needs. The curriculum must follow NTC guidelines and be aligned with the Sydney Accord.
3. Mr. Hafiz Ghulam Muhammad of NTC highlighted the agenda of this meeting and emphasized adoption of general rules of curriculum development.
4. In the second session, Members were asked to nominate the Convener, Co-Convener, Secretary and Co-Secretary. After discussions, Engr. Prof. Dr. Anwar Khitab was nominated as Convenor, and Engr. Prof. Dr. Ayub Elahi, Engr. Sadaf Noshin and Engr. Nijah Akram were nominated as Co-Convener, Secretary and Co-Secretary for the Committee, respectively.
5. The following nominated members from HEIs participated in developing Bachelor of Architectural Engineering Technology curriculum:

Sr#	NCRC Members	Role
1.	Engr. Prof. Dr. Anwar Khitab Professor and Dean, Mirpur University of Science & Technology, AJ&K	Convener
2.	Engr. Prof. Dr. Ayub Elahi Professor, University of Engineering & Technology (UET) Taxila	Co-Convener
3.	Engr. Sadaf Noshin, Assistant Professor University of Lahore (UoL), Lahore	Secretary
4.	Engr. Nijah Akram, Lecturer and HoD Punjab Tianjin University of Technology (PTUT), Lahore	Co-Secretary
5.	Engr. Prof. Dr. Imran Hafeez Professor, University of Engineering & Technology (UET) Taxila	Member
6.	Ar. Fariha Amjad Ubaid Associate Professor NED University of Engineering & Technology, Karachi	Member
7.	Engr. Dr. Saeed Ullah Jan Mandokhail Associate Professor, Baluchistan University of Information Technology Engineering and Management Sciences (BUITEMS), Quetta	Member
8.	Engr. Dr. Muhammad Kaleem Ullah Associate Professor and HoD University of Lahore (UoL), Lahore	Member
9.	Engr. Dr. Rao Arsalan Khushnood Associate Professor and HoD National University of Science & Technology (NUST), Islamabad	Member

Sr#	NCRC Members	Role
10.	Ar. Shahid Mansoor Khan Assistant Professor and HoD, University of Engineering & Technology (UET) Peshawar	Member
11.	Engr. Dr. Rashid Farooq Assistant Professor and HoD, International Islamic University, Islamabad (IIUI	Member
12.	Engr. Dr. Rahat Mahmood Assistant Professor and HoD, AlHamd Islamic University, Quetts	Member
13.	Engr. Dr. Khursheed Ahmed Assistant Professor, Karakurram International University	Member
14.	Dr. Fariha Amjad Ubaid Associate Professor, NED University of Engineering & Technology, Karachi	Member
15.	Ar. Muti Ul Haq Lecturer, Punjab Tianjin University of Technology (PTUT), Lahore	Member
16.	Architect Sohail Anwer Saeed Consultant Architect, Pakistan Town Council of Architects & Twon planers (PCATP)	Member
17.	Mr. Hidayatullah Kasi Deputy Director, Academics Division, HEC, Pakistan	HEC Representative
18.	Mr. Hafiz Ghulam Muhammad NTC, Pakistan	NTC Representative

6. After taking charge as Convenor, Engr. Prof. Dr. Anwar Khitab chaired the meeting and emphasized reflection of the Sydney Accord in the curriculum, and that the curriculum and course titles etc. must provide a uniform framework under the title “Bachelor of Architectural Engineering Technology”.
7. In continuation of above guidelines, Prof. Dr. Ayub Elahi, Co-Convener, Engr. Sadaf Noshin, Secretary and Engr. Nijah Akram, Co-Secretary highlighted the objectives of curriculum development.
8. Once objectives were agreed upon, these were categorized and assigned to Subcommittees for detailed deliberations.
9. The honorable Subcommittee Members resolved as follows:
    - To develop an undergraduate curriculum of Bachelor of Architectural Engineering Technology that is at par with international standards, and in substantial conformity with the Sydney Accord.
    - To clearly define program education objectives (PEOs), course learning outcomes (CLOs) with taxonomy levels, and course contents aligned with program learning outcomes (PLOs).
    - To incorporate latest relevant reading materials and references.
    - To ensure that course content is uniform across other disciplines (e.g., HEC’s Gen Ed requirements) and is not duplicated.
    - To develop a curriculum that is futuristic and produces manpower that answers need of our society.
10. In the next session, the Members discussed the nomenclature of the discipline, preface, objectives of the programs, PLOs, methods of instruction, learning environment, assessment protocols, and operational framework.

11. After long deliberations, the Committee proposed the curriculum framework, the duration of the program, number of semesters, number of weeks per semester, total number of credit hours, weightage of technology domain and non-technology domain courses, and weightage of theory and practical of the undergraduate 4-year program in Bachelor of Architectural Engineering Technology.
12. List of courses, core and electives, and semester wise breakup of courses were finalized.
13. Admission and intake criteria were adopted as defined in NTC, for admission to engineering technology programs, the students must:
    • Have minimum 50% marks in F.Sc. (Pre-Engineering) or Equivalent Qualification A-level / ICS / DAE / B.Sc. (Excluding Sports and Hafiz-e-Quran)
    • Have passed the Entrance Test
14. Supervised industrial training (SIT) was discussed in detail. There was a consensus that SIT must be mandatory in the 8th Semester, and optional in the 7th Semester.
15. HEI's that are geared to provide SIT in two semesters can do this in 7th and 8th Semesters.
16. In line with the experience and expertise of NCRC members, list of courses of various domains were distributed among the Sub-Committees.
17. These Sub-Committees were assigned responsibility for reviewing course objectives, adding course learning outcomes, appropriate mapping with taxonomy and PLOs, updating list of contents, adding teaching-learning methods and assessment, and updating bibliography/ references/ suggested books.
18. The following Core Committee's, along with four Sub-Committees, were constituted with separate Convenors and Secretaries:

Architectural Engineering Technology Core Committee		
Sr#	**Name**	**Role**
1	Engr. Prof. Dr. Anwar Khitab	Convenor
2	Engr. Prof. Dr. Ayub Elahi	Co-convenor
3	Engr. Sadaf Noshin	Secretary
4	Engr. Nijah Akram	Co-secretary
1. Sub-Committee: Computing, Humanities and Social Sciences Courses		
Sr#	**Name**	**Role**
1	Engr. Dr. Muhammad Kaleem Ullah	Convenor
2	Ar. Shahid Mansoor Khan	Member
3	Engr. Dr. Rahat Mahmood	Member
4	Engr. Dr. Khursheed Ahmed	Member
2. Sub-Committee: Architectural Engineering Technology Foundation Courses		
Sr#	**Name**	**Role**

1	Prof. Engr. Dr. Ayub Elahi	Convenor
2	Ar. Muti Ul Haq	Member
3	Engr. Dr. Rahat Mahmood	Member
3. Sub-Committee: Architectural Engineering Technology Core (Breadth) Courses		
1	Prof. Engr. Dr. Imran Hafeez	Convenor
2	Engr. Dr. Saeed Ullah Jan Mandokhail	Member
3	Engr. Dr. Rashid Farooq	Member
4. Sub-Committee: Architectural Engineering Technology Core (Depth) Courses		
Sr#	**Name**	**Role**
1	Ar. Fariha Amjad Ubaid	Convenor
2	Engr. Dr. Rao Arsalan Khushnood	Member
3	Engr. Dr. M. Kamran Bhatti	Member
3	Engr. Prof. Dr. Anwar Khitab	Member

18. After conclusion of the Preliminary Meeting, the Sub-Committees submitted the proposed course contents for theory and practicals, along with CLOs, list of recommended books, list of experiments and relevant information of each course.
19. The first draft was compiled by the Engr. Sadaf Noshin, Secretary NCRC, and distributed to Members for review.
20. The preliminary curriculum draft was submitted to NTC and sent to international reviewers.

APPENDIX E: Minutes of the Final Meeting of NCRC

1. The Final Meeting of the was held on 15-11-2022 to 17-11-2022 at Higher Education Commission (HEC), Regional Office, Lahore.
2. The inaugural session started with recitation of the Holy Quran, and was chaired by Prof. Dr. Murtaza Jafari, Vice Chancellor, National College of Arts, Lahore. Prof. Dr. Syed Faisal Sajjad, Head, Department of Architecture, National College of Arts, Lahore, also accompanied him.
3. Engr. Imtiaz Hussain Gilani, Chairman NTC, joined the meeting online. He thanked and appreciated the efforts by Members and highlighted their invaluable contribution for the national cause in setting standards for quality-education in Architectural Engineering Technology.
4. Lt. Col Rao Rashid Ali (R), Director General (operation II), TEVTA Punjab and Mr. Aqib Sharif, Manager Accreditation TEVTA Punjab also participated in the inaugural session.
5. Mr. Hafiz Ghulam Muhammad represented NTC, and Mr. Ghafoor Ahmed Choudhary, In-charge HEC regional center Lahore represented HEC.
6. The following members attended the meeting:

Sr.	NCRC Members	Role
1.	Engr. Prof. Dr. Anwar Khitab Professor and Dean, Mirpur University of Science & Technology, AJ&K	Convener
2.	Engr. Prof. Dr. Ayub Elahi Professor, Project Director (PDSP Projects) University of Taxila, Taxila	Co-Convener
3.	Engr. Sadaf Noshin Assistant Professor, The University of Lahore, Lahore	Secretary
4.	Engr. Nijah Akram HoD Punjab Tianjin University of Technology (PTUT), Lahore	Co-Secretary
	1. **Sub-Committee: Computing, Humanities and Social Sciences Courses**	
Sr#	**Name**	**Role**
1.	Engr. Dr. Muhammad Kaleem Ullah Associate Professor and HOD, The University of Lahore, Lahore	Convenor
2.	Engr. Dr. Khursheed Ahmed Assistant Professor and HOD, Karakoram International University, Gilgit	Member
	2. **Sub-Committee: Architectural Engineering Technology Foundation Courses**	
1.	Engr. Prof. Dr. Ayub Elahi Professor, Project Director (PDSP Projects) University of Taxila, Taxila	Convener
2.	Ar. Muti Ul Haq HoD Punjab Tianjin University of Technology (PTUT), Lahore	Member
	3. **Sub-Committee: Architectural Engineering Technology Core (Breadth) Courses**	
1.	Engr. Dr. Saeed Ullah Jan Mandokhail Associate Professor and HOD, BUTEMS, Quetta	Member
2.	Engr. Dr. Rashid Farooq Assistant Professor and Chairman,	Member

Sr.	NCRC Members	Role
	Islamic International University, Islamabad	
3.	Ar. Ayesha Ramzan Instructor Architecture, Government College Technology Railway Road Lahore, Lahore	Co-opted Member
4.	**Sub-Committee: Architectural Engineering Technology Core (Depth) Courses**	
1.	Engr. Dr. Rao Arsalan Khushnood Associate Professor, National University of Science & Technology, Islamabad	Member
2.	Engr. Prof. Dr. Anwar Khitab Professor and Dean, Mirpur University of Science and Technology, Mirpur (AJK)	Member
3.	Ar. Afshan Mansoor Instructor Architecture, Government College Technology Railway Road Lahore, Lahore	Co-opted Member

7. After the introductory session, deliberations on the agenda of the second meeting formally commenced and were moderated by the Convener Engr. Prof. Dr. Anwar Khitab, Co-Convener Engr. Prof. Dr. Ayub Elahi, Secretary Engr. Sadaf Noshin and Co-Secretary Engr. Nijah Akram.
8. After extensive deliberations, Members of NCRC resolved the following:
    - Defined curriculum preface, mission, vision, preamble, rationale, scope, course scheme etc.
    - Finalized bench marking of recommended scheme of studies, engineering technology domain and non-engineering technology domain courses, in line with the framework and list of electives defined earlier.
    - Approved semester-wise break-up of courses, credit hours', and Breadth and Depth courses.
    - Recommended sample course profiles and contents.
    - Recommended sample weekly lecture plan and laboratory work for Foundation and Breath courses.
12. The final draft was compiled by Secretary Engr. Sadaf Noshin and Co-Secretary Engr. Nijah Akram.
13. After review by Members and with the approval of Convener Engr. Prof. Dr. Anwar Khitab and Co-Convener Engr. Prof. Dr. Ayub Elahi, it was submitted to NTC.
14. Honorable Members were informed that valuable feedback was received from the following international experts:

Sr#	Foreign Expert Name	Affiliation
1	Dr.Zhihong Nie	Department of Civil Engineering, Central South University, Changsha China
2	Engr. Dr. Yasmine Sabry Hegazi	Department of Architectural Engineering, Zagazig University, Egypt
3	Engr. Dr. Rihab Khalid	Department of Architecture, University of Cambridge
4	Engr. Maqsood Ali	The Synergy International (TSI) construction, USA
5	Engr. Dr. Saddy Ahmed	Shimizu Corporation, Japan

15. In this regard, international experts appreciated the efforts made by NCRC to compose a balanced and standardized curriculum for Electrical Engineering Technology.

16. Their proposed suggestions are incorporated in the curriculum, which are mostly related to lab outlines, software's list and content of the courses.

APPENDIX F: Supervised Industrial Training Logbook Sample Format

Student Details:
Name:
Roll Number:
Address:
Email:

Course of Study:
Year/Semester of Study:

Training Start Date:
Training End Date:

Training Organization Details:

Name of Organization:
Address:

Contact Person:
Contact Number:

On-the-job Trainer Name:
On-the-job Trainer Contact Number:

Daily Training Log

Please specify training information by descriptive statements, tables, sketches, figures, photographs, and so forth. Feel free to incorporate attachments wherever necessary.

Training Week: _____

Date	Time	Training Log

Declaration:

I, _____ Roll Number_____, do hereby declare that all information provided above is true and correct to the best of my knowledge.

_____
Student signature with date

_____ _____
Organization Supervisor signature with date HEI Coordinator signature & date

APPENDIX G: Supervised Industrial Training Report Sample Format

Sample table of content for supervised industrial training report is provided so that students can develop an understanding of what is expected of them when making the submission. Students are encouraged to expand upon the content presented below. A declaration page validating the originality of work duly signed by the student and the trainee is also to be attached at the beginning of the submitted report.