Curriculum

for

Bachelor of Electrical Engineering Technology Degree

(2022)

Higher Education Commission
Islamabad
Curriculum Division

Acronyms, Abbreviations & Definitions

Acronym/Abbreviation	Definition
NTC	National Technology Council
NCRC	National Curriculum Review Committee
IDEE	Integration of Data in Engineering Environment.
MATLAB	Matrix Laboratory
HEI	Higher Education Institution
SMEs	Small and Medium Enterprises
PLC	Programmable Logic Controller
DIAC	Diode for Alternating Current
RIC	Resistance, Inductance, Capacitance
IEEE	Institute of Electrical and Electronics Engineers
LTI	Linear Time-Invariant
BJT	Bipolar Junction Transistor
SCR	Silicon Controlled Rectifier
MOSFET	Metal–Oxide–Semiconductor Field-Effect Transistor
IGBT	Insulated-Gate Bipolar Transistor
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 resource 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 Appendix 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 Electrical Engineering Technology is benchmarked to HEC's Undergraduate Policy and is in accordance with NTC Curriculum Framework. It conforms substantially to the standards laid out by the Sydney Accord and the International Engineering Alliance pertaining to engineering technology programs [See Appendix A through C].

The Scheme of Studies clearly defines, and differentiates, the program from Electrical Engineering by contact hours spent in classrooms, laboratories, and the industry.

Ideally an engineering program is designed with classroom to practical training ratio of 70:30 contact hours, with emphasis on design aspects. Whereas for engineering technology programs, the ratio of contact hours is reversed to 30:70, providing more opportunity for hands-on and 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.
- 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.
- NCRC Members elect a Convenor, a co-Convenor, and a Secretary amongst themselves for the proceedings of NCRC, after mutual consultations.
- A draft of program 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 is received, 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 Electrical Engineering Technology are enlisted below:

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

3. Curriculum Details

Bachelor of Electrical 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	39	45**
Engineering Technology Domain Courses	28	26	31**
Non-Engineering Technology Domain Courses	13	13	13**
Total Credit Hours	124 – 136	129	129
Engineering Technology Domain Credit Hours	85	96	94
Percentage of Engineering Technology Domain Courses	74.42%	74.42%	72.87%
Non-Engineering Technology Domain Credit Hours	39	33	35
Percentage of Non-Engineering Technology Domain Courses	31.45%	25.58 %	27.13 %
No. of Credit Hours per Semester	15 – 18	15 – 17	15 – 17
** Optional Courses shall be included for Framework B (SIT in 8th Semester only)			
1 credit hour: (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**
Computing	Information and Communication Technology	1+1=2	1+3=4	6	6	3	3
	Computer Programming	1+1=2	1+3=4				
	Computing Elective **	1+1=2	1+3=4				
Electrical Engineering Technology (Foundation)	Linear Circuit Analysis	1+1=2	1+3=4	18	20	9	10
	Electrical Network Analysis	1+1=2	1+3 =4				
	Environment, Health, and Safety	1+0=1	1+0 =1				
	Electrical Workshop	0+2=2	0+6=6				
	Signals and Systems	1+1=2	1+3=4				
	Technical Drawing	0+1=1	0+3=3				
	Electronic Devices and Circuits	2+1=3	2+3=5				
	Logic Circuits and Applications	1+2=3	1+6=7				
	Micro-Controller Systems	1+1=2	1+3 =3				
Electrical Engineering Technology (Breadth)	Instrumentation and Measurements	2+1=3	2+3=5	11	24	4	6
	Electrical Machines	2+1=3	2+3=5				
	Breadth Elective-I	2+1=3	2+3=5				
	Breadth Elective-II	1+1=2	1+3 =3				
Electrical Engineering Technology (Depth)	Control Technology	2+1=3	2+3=5	21 / 33**	14	7 / 11**	5
	Communication Systems	2+1=3	2+3=5				
	Depth Elective-I	2+1=3	2+3=5				
	Depth Elective-II	2+1=3	2+3=5				
	Depth Elective-III	2+1=3	2+3=5				
	Depth Elective-IV	2+1=3	2+3=5				
	Depth Elective-V	2+1=3	2+3=5				

	Depth Elective-VI **	2+1=3	2+3=5				
	Depth Elective-VII **	2+1=3	2+3=5				
	Depth Elective-VIII **	2+1=3	2+3=5				
	Depth Elective-IX **	2+1=3	2+3=5				
IDEE	IDTE-I	1+1=2	1+3=4	4	5	2	2
	IDTE-II	1+1=2	1+3=4				
Senior Design Project	Project Part-I	0+3=3	0+9=9	6	6	2	2
	Project Part-II	0+3=3	0+9=9				
Training	Supervised Industrial Training-(Opt.)	0+16=16	0+16=16	16**		0	
	Supervised Industrial Training	0+16=16	0+16=16	16		0	
Total Credit Hours and Courses (For Engineering Technology Domain Courses)		42+68 = 110	42+140 = 182	98 - 110		27 - 31	
** Optional Courses 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
Humanities and Social Sciences	English (Expository Writing)	Communication Skills	3+0=3	3+0=3	6	6	2	2
		Technical Report Writing	3+0=3	3+0=3				
	Culture	Islamic Studies / Ethics	3+0=3	3+0=3	6	6	2	2
		Pakistan Studies	3+0=3	3+0=3				
	Social Sciences Electives	Elective-I (Professional Ethics)	3+0=3	3+0=3	3 / 5**	9	1 / 2**	3
		Elective-II (Optional)	2+0=2	2+0=2				
Management Sciences	Management Sciences	Elective-III (Optional)			6 / 6**	6	2 / 2**	3
		Elective-I	3+0=3	3+0=3				
		Elective-II	3+0=3	3+0=3				
Natural Sciences	Math (Quantitative Reasoning)	Calculus and Analytical Geometry	2+0=2	2+0=2	6	6	3	2
		Differential Equations	2+0=2	2+0=2				
		Linear Algebra	2+0=2	2+0=2				
	Physics	Applied Physics	2+1=3	2+3=5	3	4	1	1
	Elective	Elective-I	2+1=3	2+3=5	3	4	1	1
Total Credit Hours and Courses ** Optional Courses shall be included for Framework B (SIT in 8th Semester only)					Cr. Hrs. **33-35**		Courses **12 -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
➢ Project 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>➢ Multivariable Calculus
➢ Discrete Mathematics
➢ Numerical Analysis
➢ Chemistry
➢ Biology
➢ Elective Courses by HEI*</td></tr>
<tr><th>Breadth Electives*</th></tr>
<tr><td>➢ Electrical Power Transmission
➢ Electrical Power Distribution and Utilization
➢ Elective Courses by HEI*</td><td>➢ Switchgear and Protective Devices Technology
➢ Industrial Drives and PLC
➢ High Voltage Technology
➢ Renewable and Alternative Energy Technologies
➢ Machine Repair and Maintenance
➢ Electrification Technology
➢ Electrical Appliances Repair
➢ Smart Grid Technology
➢ Electrical Safety
➢ Automobile/Electric Vehicle Technology
➢ Fiber Optics Technology
➢ Sensor Networks
➢ Embedded Systems
➢ Integrated Circuits Technology
➢ Mobile Phone Assembly and Repair
➢ Telecommunication Systems Technology
➢ Wireless Technology
➢ Robotics Technology
➢ 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 Electrical 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 eligibility features 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 Electrical Engineering Technology program spanning 04 years, spread over 08 semesters, and encompassing 129 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)**	
ELH-111/ ELH-112	Islamic Studies / Social Ethics	Art & Humanities-I	3+0	3+0
ELE-111	Communication Skills	Expository Writing-I	3+0	3+0
ELQ-111	Calculus & Analytical Geometry	Quantitative Reasoning-I	2+0	2+0
ELN-112	Applied Physics	Natural Sciences-I	2+1	2+3
ELC-111	Information and Communication Technology	Computing-I	1+1	1+3
ELT-111	Electrical Workshop	Electrical Engineering Technology Foundation-I	0+2	0+6
	Subtotal		**11+4 =15**	**11+12 =23**
SEMESTER-II				**Weekly Contact Hrs. (Th+Lab**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
ELH-121	Pakistan Studies	Art & Humanities -II	3+0	3+0
ELQ-121	Differential Equations	Quantitative Reasoning-II	2+0	2+0
ELN-122	Natural Science Elective-I	Natural Sciences-II	2+1	2+3
ELM-121	Management Science Elective-I	Management Sciences-I	3+0	3+0
ELC-121	Computer Programming	Computing-II	1+1	1+3
ELT-121	Linear Circuit Analysis	Electrical Engineering Technology Foundation-II	1+1	1+3
ELT-122	Environment, Health and Safety	Electrical Engineering Technology Foundation-III	1+0	1+0

	Subtotal		**13+3 =16**	**13+9 =22**
SEMESTER-III				**Weekly Contact Hrs. (Th+Lab**
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ELH-211	Professional Ethics	Social Science-I	3+0	3+0
ELE-211	Technical Report Writing	Expository Writing-II	3+0	3+0
ELQ-211	Linear Algebra	Quantitative Reasoning-II	2+0	2+0
ELT-211	Technical Drawing	Electrical Engineering Technology Foundation-IV	0+1	0+3
ELT-212	Electronic Devices and Circuits	Electrical Engineering Technology Foundation-V	2+1	2+3
ELT-213	Logic Circuits and Applications	Electrical Engineering Technology Foundation-VI	1+2	1+6
ELT-214	Electrical Network Analysis	Electrical Engineering Technology Foundation-VII	1+1	1+3
	Subtotal		**12+5 =17**	**12+15 =27**
SEMESTER-IV				**Weekly Contact Hrs. (Th+Lab**
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ELT-221	Instrumentation and Measurements	Electrical Engineering Technology Breadth Core-I	2+1	2+3
ELT-222	Electrical Machines	Electrical Engineering Technology Breadth Core-II	2+1	2+3
ELT-223	Signals and Systems	Electrical Engineering Technology Foundation-VI	1+1	1+3
ELT-224	Micro-Controller Systems	Electrical Engineering Technology Foundation-VII	1+1	1+3
ELT-225	Breadth Elective-I	Electrical Engineering Technology Breadth Elective-I	2+1	2+3
ELI-221	IDTE-I	Inter Disciplinary Technology Elective-I	1+1	1+3

	Subtotal		**9+6 =15**	**9+18 =27**
SEMESTER-V				**Weekly Contact Hrs. (Th+Lab**
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ELT-311	Control Technology	Electrical Engineering Technology Depth Core-I	2+1	2+3
ELT-312	Communication Systems	Electrical Engineering Technology Depth Core-II	2+1	2+3
ELT-313	Breadth Elective-II	Electrical Engineering Technology Breadth Elective-II	1+1	1+3
ELT-314	Depth Elective-I	Electrical Engineering Technology Depth Elective-I	2+1	2+3
ELT-315	Depth Elective-II	Electrical Engineering Technology Depth Elective-II	2+1	2+3
ELT-316	Project Part-I	Electrical Engineering Technology Domain Project	0+3	0+9
	Subtotal		**9+8 =17**	**9+24 =33**
SEMESTER-VI				**Weekly Contact Hrs. (Th+Lab**
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ELM-321	Management Elective-II	Management Sciences-II	3+0	3+0
ELT-321	Depth Elective-III	Electrical Engineering Technology Depth Elective-III	2+1	2+3
ELT-322	Depth Elective-IV	Electrical Engineering Technology Depth Elective-IV	2+1	2+3
ELT-323	Depth Elective-V	Electrical Engineering Technology Depth Elective-V	2+1	2+3
ELI-321	IDTE-II	Inter Disciplinary Technology Elective-II	1+1	1+3
ELT-324	Project Part-II	Electrical Engineering Technology Domain Project	0+3	0+9

	Subtotal		**10+7 =17**	**10+21 =31**
SEMESTER-VII				**Weekly Contact Hrs. (Th+Lab**
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ELT-411	**Supervised Industrial Training (Optional)**	**Electrical Engineering Technology Domain Industrial Training**	**16**	**40 (Per Week)**
ELH-411 ELM-411	Social Sciences / Management Sciences Elective	Social Science-II / Management Sciences-III	2+0	2+0
ELT-412	Depth Elective-VI	Electrical Engineering Technology Depth Elective-VI	2+1	2+3
ELT-413	Depth Elective-VII	Electrical Engineering Technology Depth Elective-VII	2+1	2+3
ELT-414	Depth Elective-VIII	Electrical Engineering Technology Depth Elective-VIII	2+1	2+3
ELT-415	Depth Elective-IX	Electrical Engineering Technology Depth Elective-IX	2+1	2+3
ELC-411	Computing Elective-I	Computing-III	1+1	1+3
	Subtotal		11+5=16	**11+15 =26**
SEMESTER-VIII				**Weekly Contact Hrs. (Th+Lab**
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
ELT-421	**Supervised Industrial Training (Compulsory)**	**Electrical Engineering Technology Domain Industrial Training**	**16**	**40 (Per Week)**
	Subtotal		**0+16= 16**	**0+40= 40**
Total Credit Hours & Contact Hours in Four Years (When SIT conducted in both 7th and 8th Semester)			**64+65 = 129**	**64+195=259**
Theory vs Practical with respect to Contact Hours			Theory Practical	64 (24.71%) 195 (75.29%)

Total Credit Hours & Contact Hours in Four Years (When optional courses conducted instead of SIT in 7th Semester**)**	**75+54 = 129**	**75+162 =237**
Theory vs Practical with respect to Contact Hours	Theory Practical	75 (31.65%) 162 (68.35%)

6. Course Codes

Course Codes are defined below:

- Each course has a unique three letter prefix, followed by three-digit code
- Letters are acronyms for course description, and numbers define the chronological position in the academic year and sequence number in the program.
- Program will span over 4 years, with 2 semesters per year, Spring and Fall (with possible inclusion of Summer Semester).

Letters in course-code prefix are defined below:

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

Digits in course-code are defined in table below:

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

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

7. Elective Courses

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

Elective Breadth Courses				Weekly Contact Hrs.
Course Code	**Title**	**Knowledge Area**	**Credit Hrs.**	
ELT-225	Electrical Power Transmission	Electrical Engineering Technology Breadth Elective-I	2+1	2+3
ELT-313	Electrical Power Distribution and Utilization	Electrical Engineering Technology Breadth Elective-II	1+1	1+3

Elective Depth Courses				Weekly Contact Hrs.
Course Code	**Title**	**Knowledge Area**	**Credit Hrs.**	
ELT-314	▪ Switchgear and Protective Devices Technology ▪ Power Electronics ▪ Energy Conservation and Auditing ▪ Industrial Drives and PLC ▪ Power Generation Technology ▪ High Voltage Technology ▪ Renewable Energy Technologies ▪ Machine Repair and Maintenance ▪ Electrification Technology ▪ Electrical Appliances Repair ▪ Smart Grid Technology ▪ Electrical Safety ▪ Automobile and Electric Vehicle Technologies ▪ Fiber Optics Technology ▪ Sensor Networks ▪ Embedded Systems ▪ Integrated Circuits Technology ▪ Mobile Phone Assembly and Repair ▪ Telecommunication Systems Technology ▪ Wireless Technology	Depth Elective-I	2+1	2+3
ELT-315		Depth Elective-II	2+1	2+3
ELT-321		Depth Elective-III	2+1	2+3
ELT-322		Depth Elective-IV	2+1	2+3
ELT-323		Depth Elective-V	2+1	2+3
ELT-412		Depth Elective-VI	2+1	2+3
ELT-413		Depth Elective-VII	2+1	2+3
ELT-414		Depth Elective-VIII	2+1	2+3
ELT-415		Depth Elective-IX	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 Islamic Studies/Social Ethics

CODE & TITLE (ELH-111/112) **Islamic Studies/Social Ethics**	**CREDIT & CONTACT HOURS** (3+0) **48 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	**Recite** Holy Quran with correct pronunciation.	C-1	11
CLO-2	**Apply** understanding of basic concepts of teaching of Islam (faith, pillars, Dawit, preaching and Seerat).	C-3	11
CLO-3	**Produce** Compilation of the Holy Quran and Basic Concepts of Hadith.	A-2	11
CLO-4	**Present** Islam as a complete code of life.	A-3	9

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. (Latest Edition)
2. An Introduction to Islam, by Dr. Muhammad Hameedullah. (Latest Edition)
3. What is Islam? by Maulana Manzoor Nomani. (Latest Edition)
4. Islamiat (A standard book for CSS), Prof. Dr. Arif Naseem. (Latest Edition)

Course Content

8.2 Communication Skills

CODE & TITLE (ELE-111) **Communication Skills**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Expository Writing-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Acknowledge** importance and basic concepts of communications.	A-1	9
CLO-2	**Identify** common errors usually made by learners of English as a second language.	A-2	9
CLO-3	**Communicate** effectively through technical writing and presentations, using basic- to-intermediate level English, and develop understanding of communication skills essentials.	A-3	9

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

8.3 Calculus and Analytical Geometry

CODE & TITLE (ELQ-111) **Calculus and Analytical Geometry**		**CREDIT & CONTACT HOURS** (2+0) **32 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** the ideas of rate of change, derivatives and it basic Applications.	C-2	1
CLO-2	**Apply** the techniques of integration for solving and analyzing problems in integral calculus.	C-3	2
CLO-3	**Describe** the vector calculus and analytical geometry in multiple dimensions for investigation of different engineering problems.	C-2	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 (or Latest Edition)
3. G. B. Thomas, A. R. Finney, "Calculus", 14th edition (or Latest Edition), Pearson, USA, 2017.
4. S.M Yousaf, "Calculus and Analytic Geometry" (or Latest Edition).
5. Advanced Engineering Mathematics by Erwin Kreyszig, 10th Ed. (or Latest Edition) Willey 2014.

Course Content

8.4 Applied Physics

CODE & TITLE (ELN-112) **Applied Physics**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Natural Science-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the fundamental physical principles.		C-2	1
CLO-2	**Apply** these principles, together with logical and mathematical reasoning, to situations of the physical world.		C-3	2
CLO-3	**Analyze** different physical problems using the laws of physics.		C-4	2
CLO-4	**Identify** knowledge of constructing basic circuits and demonstration of relevant theorems using Resistors and Capacitors.		P-1	2
CLO-5	**Differentiate** classroom knowledge and laboratory techniques for learning of basic principle used in Magnetism.		P-1	1

Course Outline for Theory

Electric charge, Conductors and insulators, Coulomb's law, Electric field, Field due to a point-charge Electric dipole and line of charge, Flux of an electric field, Permittivity of a medium, Gauss's law, Application of Gauss's Law,

Electric potential, calculating the potential from electric field, Potential due to a point-charge and a group of point-charges. Potential due to a dipole, Potential due to a continuous charge distribution. Capacitors, calculating capacitance, Capacitors in series and parallel, Factors affecting capacitance, Application of Capacitors. Current and Conductors, Electric current and current density, Resistance and resistivity, Ohm's law, The Steady Magnetic Field, Resistors in series and parallel, Temperature dependence of resistance and other factors affecting resistance, Application of resistors. The magnetic field, Magnetic force on a current carrying conductor, Torque on a current-loop. Magnetic field due to current, Force between two parallel current-carrying conductors, Biot Savart law and its applications, Ampere's law, Inductance and inductors, Factors affecting inductance Permeability Faraday's law of induction, Lenz's law, Energy stored in a magnetic field, Self-induction, Mutual Induction, Magnets and magnetic materials, Di-magnetic material, Para-magnetic material, Ferromagnetism.

Lab Outlines

To investigate the properties of series combination of Capacitors. To determine the given resistance by leakage method using ballistic Galvanometer. To study the variation of Photoelectric current with intensity of incident beam. To determine the temperature coefficient of resistance of coil by wheat stone bridge. To study Ohm's law. To investigate the properties of Series Combination of Resistances. To investigate the properties of Parallel combination

of Resistances. Practical Demonstration of Ampere Law. Practical Demonstration of Faraday Law. To demonstrate the function of transformer as Step Up and Step-Down Transformer
Recommended Books
1. Halliday, Resnick and Walker, “Fundamentals of Physics” (Latest Edition) 2. Hugh D. Young and R.A. Freedman, University Physics. (Latest Edition) 3. Raymond A Serway and John W. Jawett, Jr. Physics for Scientists and Engineers with modern Physics, (Latest Edition) 4. Fundamentals of Electromagnetic Phenomenon by D. Corson & Lorrain. (Latest Edition)

Course Content

8.5 Information and Communication Technology

CODE & TITLE (ELC-111) **Information and Communication Technology**		**CREDIT & CONTACT HOURS** (2+1) **32 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	**Define** the working of computer hardware and software.		C-1	1
CLO-2	**Compare** problem solving skills and develop small scale computer programs.		C-2	1
CLO-3	**Use** the concepts of data communication and networks.		C-3	1
CLO-4	**Explain** the working of hardware components of computer.		P-2	1
CLO-5	**Follow** typing speed and develop office application skills.		P-3	1
CLO-6	**Express** problem-solving skills by developing computer programs.		C-2	3
Course Outline for Theory				
Introducing Computer Systems: Basic Definitions, Computer and Communication Technology, the applications of ICT - particularly for engineering technology. Basic Operations and Components of a Generic Computer System: Basic operations: Input, Processing, output, storage Basic components: Hardware, Software, Data, Users, types of storage devices. Processing Data: Transforming data into information, how computers represent and process data, Processing Devices, CPU architectures. The Internet: The Internet and the World Wide Web- browsers, HTML, URLs/ How DNS works, Email and other programs. Introduction to Embedded Systems: What is an Embedded System, Applications, Components, Programming Languages, Popular Development Platforms. Networking Basics: Uses of networks, Common types of networks (LAN, WAN, MAN etc.), Introduction to OSI Model, Future of Networks. Database Management: Hierarchy of Data, Maintaining Data, Database Management Systems. Exposure to ICT Tools and Blogs (Student Assignment). Protecting your privacy, your computer and your data: Basic Security Concepts, threats to users, threats to hardware, threats to Data				
Lab Outlines				
Introduction to the very basics of the internet e.g., using search engines, using Wikipedia, checking your Email. Personal computer components, inside the CPU. Introduction to typing tutors, typing practice. Introduction to MS word. Introduction to MS Power point. Introduction to MS Excel. Introduction to HTML. Introduction to HTML codes.				

Writing small HTML codes. Introduction to web designing. Introduction to web designing. Introduction to programming languages. Introduction to programming languages.
Recommended Books
1. "Introduction to Computers", Peter Norton, McGraw-Hill. (Latest Edition) 2. "Computing Essentials", Timothy O'Leary and Linda O'Leary, McGraw-Hill. (Latest Edition) 3. Using Information Technology: A Practical Introduction to Computers & Communications", Williams Sawyer, McGraw-Hill. (Latest Edition) 4. "Discovering Computers, Complete: Your Interactive Guide to the Digital World. Cengage Learning" Shelly GB, Vermaat ME, (Latest Edition)

Course Content

8.6 Electrical Workshop

CODE & TITLE (ELT-111) **Electrical Workshop**		CREDIT & CONTACT HOURS (0+2) **0 Theory + 96 Lab**	KNOWLEDGE AREA/ DOMAIN **Foundation-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the Skills to Understand the Basic Tools of an Electrical Workshop.		C-1	1
CLO-2	**Practice** on Basics Tools of an Electrical Workshop.		P-3	4
CLO-3	**Participate** Actively in Performing the Experimental Procedures.		A-2	8
Lab Outlines				
Objective: This lab aims to deliver the students hands-on experience on electrical equipment in workshop besides giving them insight about electrical safety, safety regulations, electric shocks and treatment. The main objectives of this lab stresses on delivering general concepts on electrical wiring regulations and testing, electric accessories, and tools. In this lab, students will also learn electric soldering and soldering tools; soldering methods and skills, PCB designing, transferring a circuit to PCB, etching, drilling and soldering component on PCB testing. To sum up, this lab enables students to understand the electrical and electronic circuits generally and gives them confidence to troubleshoot associated problems				
Recommended Books				
1. Adam Wire, 5 Essential Electrician Tools to Amp Up Your Tool Belt, 2020 2. Amin ur Rasheed Noordin, Proteus professional Design, 2011				

Course Content

8.7 Pakistan Studies

CODE & TITLE (ELH-121) **Pakistan Studies**		**CREDIT & CONTACT HOURS** (3+0) **48 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 state.		A-1	6
CLO-2	**Discuss** Pakistan Movement, political and constitutional history of Pakistan.		A-3	11
CLO-3	**Study** current issues of Pakistan, their causes and solution.		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. (Latest Edition)
2. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, (Latest Edition)
3. Struggle for Pakistan by Mr. Ishtiaq Hussain Qureshi (Latest Edition)

Course Content

8.8 Differential Equations

CODE & TITLE (ELQ-121) **Differential Equations**		**CREDIT & CONTACT HOURS** (2+0) **32 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** knowledge about Differential equations, solutions of first and higher orders homogenous and non-homogenous differential equations by appropriate methods.		C-2	1
CLO-2	**Solve** linear differential equations using the Laplace transform technique and power series methods.		C-4	1
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. (Or Latest Edition) 2. W. E. Boyce, R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems, 10th edition", John Wiley & Sons, Inc., 2012. (Or Latest Edition) 3. D. G. Zill, M. R. Cullen, "Differential Equations with Boundary-Value Problems", 10th edition, Brooks/Cole, 2013. (Or Latest Edition)				

Course Content

8.9 Numerical Analysis

CODE & TITLE (ELN-122) Numerical Analysis		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Natural Science-II
After completion of this course, students will be able to:		**Bloom's Taxonomy** (Level)	**PLO**
CLO-1	**Comprehend** different numerical techniques such as: error propagation, interpolation, differentiation, integration, eigenvalues and solution of algebraic and differential equations.	C-2	1
CLO-2	**Apply** the numerical techniques to different linear and nonlinear engineering problems	C-3	2
CLO-3	**Apply** proper software tools and techniques of MATLAB Programming for developing Numerical Computation solutions	P-3	5

Course Outline for Theory

Mathematical preliminaries and error analysis, round- off errors and computer arithmetic, Divided Differences, use of Divided-difference Table. Newton's Interpolation Polynomial, Interpolation with Equally Spaced Data, Newton's Forward & Backward Difference Formulae, Gauss Formulae, Stirling's Interpolation Formula, Bessel's Interpolation Formula, Solution of Nonlinear Equations by Bisection Method, Regula Falsi, Secant, Newton-Raphson Method, Fixed Point Iteration. Solution of Equations by Jacobi Iterative Methods, Gauss Seidel Method. Numerical Differentiation, Numerical Differentiation Formulae Based on Equally Spaced Data. Numerical Differentiation Based on Newton's Forward Differences. Numerical Differentiation Based on Newton's Backward Differences. Numerical Differentiation Based on Stirling's Formula. Numerical Differentiation Based on Bessel's Formula. Numerical Differentiation Based on Lagrange's Formula. Factorization for Linear System.

Lab Outlines

Introduction to MATLAB. Newton Raphson & Bisection Method. False Position & Secant Method. Linear system of equations. Extreme Value Theorem. Gauss Elimination method with backward substitution. LU Factorization for Linear System. Crout factorization of Tridiagonal Linear System S. Jacobi Method of solving linear systems. Gauss Siedel Method of solving linear systems and Lagrange's interpolation. Newton's Divided Difference Interpolation Method. Natural Cubic Spline Method. Open-ended Lab.

Recommended Books

1. Numerical Analysis (9thEdition) by Richard L.Burden, J. Douglas Faires by Brooks/ Cole Boston USA, 2011
2. Numerical Methods for Scientific Computing by J.H. Heinbockel Trafford Publishing USA, 2006
3. Applied Numerical Analysis, by C. F. Gerald and P. O. Wheatley, seventh edition.
4. Numerical Methods Using MATLAB by John H. Mathews and Kurtis D. Fink, fourth edition.

5. Numerical Mathematics and Computing by W. Cheney and D. Kincaid, Sixth edition.
6. E. Kreyszig, Advanced Engineering Mathematics, 9th edition, Wiley, 2006.
7. A. Greenbaum & T. P. Chartier, Numerical Methods, Princeton University Press, 2012.
8. D. P. O'Leary, Scientific Computing with Case Studies, SIAM, 2008.

Course Content

8.10 Economics

CODE & TITLE (ELM-121) **Economics**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Management Science-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Estimate** the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value.		C-2	10
CLO-2	**Predict** the cost effectiveness of individual projects using the methods learnt and the effects of inflation on economic analysis of engineering projects.		C-3	6
CLO-3	**Analyze** the appropriate engineering economics analysis method(s) for problem solving i.e. present worth, annual cost, rate of return, payback, break-even, benefit-cost 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), (Latest Edition)
2. Engineering Economy, Latest Edition, Leland T. Blank and Anthony J. Tarquin, McGraw Hill, (Latest Edition)
3. Contemporary Engineering Economics, Latest edition, Chan S Part Pearson Prentice Hall (Latest Edition)
4. Engineering Economic Analysis by Donald G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, 12th edition, Oxford University Press, (or Latest Edition)

Course Content

8.11 Computer Programming

CODE & TITLE (ELC-121) **Computer Programming**		CREDIT & CONTACT HOURS (1+1) **16 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Computing-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Find** the basic knowledge of C++ and to get the necessary proficiency in C++.	C-1	1
CLO-2	**Apply** the gained knowledge in C++ to analyze and solve problems in effective way.	C-3	2
CLO-3	**Identify** the difference between procedural and object-oriented paradigms.	C-1	1
CLO-4	**Illustrate** the use of Integrated Development Environment (IDE) specially Code Blocks for writing and compiling programs.	P-2	1
CLO-5	**Trace** to write and compile simple programs and remove errors using gained knowledge.	P-3	2

Course Outline for Theory

Introduction to the course, C++ and the IDE. Data types and operators. Functions. Conditions (if, if-else, nested if-else). Conditions (switch statement, conditional operator). Recursion. Iteration (for loop, while, do-while). Iteration (do-while). Strings. File handling Structures. Arrays, Sorting Arrays and passing arrays to functions. Pointers. Calling functions by reference. Introduction to classes and objects.

Lab Outlines

Introduction to C++. Arithmetic operations. Repetitive statements/loops. Functions. Recursion. Arrays- one dimensional. Sorting algorithms. Arrays – 2 dimensional. Strings. Pointers. Open ended Lab

Recommended Books

1. C++ How to Program, latest Edition, Deitel & Deitel, Prentice Hall. (Latest Edition)
2. Problem Solving with C++, latest Edition, Walter Savitch, Addison Wesley (Latest Edition)
3. Introduction to Computation and Programming Using Python: With Application to Understanding Data, latest Edition by Guttag, John. (Latest Edition)
4. "C++ programming in easy steps" by Mike McGrath (Latest Edition)
5. "Thinking in C++" by Bruce Eckel available at http://mindview.net/Books/TICPP/ThinkingInCPP2e.html#Contents
6. For the advanced programmer: "The C++ Programming Language" by Bjarne Stroustrup, published by Addison Wesley (Latest Edition)

Course Content

8.12 Linear Circuit Analysis

CODE & TITLE (ELT-121) **Linear Circuits Analysis**		CREDIT & CONTACT HOURS (1+1) **16 Theory + 48 Lab**	KNOWLEDGE AREA/DOMAIN **Foundation-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Acquire** knowledge related to basic concepts, network laws and theorems used to analyze linear circuits, the behavior of energy storing elements		C-1	1
CLO-2	**Analyze** and understand linear circuits using network laws and theorems.		C-3	2
CLO-3	**Analyze** the different electrical parameters (ohms law, Kirchoff current and voltage law, series, and parallel combination).		P-1	1
CLO-4	**Illustrate** different parameter using network laws and Theorems and combination of RL, RC and RLC circuits and measuring different parameters by suing AC excitation.		P-2	2
CLO-5	**Report** the outcome of an experiments and task.		A-1	8

Course Outline for Theory

Basic Concepts: Voltage, Current, Power and Energy. Independent and Dependent Sources. Series and Parallel Combinations of Elements, Voltage Division and Current Division. Networks Laws: KVL, KCL, Node Analysis, Mesh Analysis, Current & voltage divider rules. Network Theorems: Thevenin's Theorem Norton's Theorem, superposition Theorem.

Capacitance: Permittivity expression for capacitance, charging and discharging, parallel and series connection of capacitors. AC Fundamentals: RMS, Average and Maximum values of current and voltage for sinusoidal signal wave forms, Introduction to phasor representation of alternating voltage and current.

Complex Numbers: Complex Exponential Representations of Sinusoids (Phasors), Impedance and Admittance, Sinusoidal Steady-State (SSS) Analysis. Power Analysis: Instantaneous and Average Power Complex Power, Maximum Power Transfer, Power Factor, Power Factor and Power Factor correction.

Lab Outline

Learn the use of basic instruments in electrical circuit analysis: Multimeter, Voltmeter, Ammeter. Implementation of resistive circuits; series, parallel, KVL and KCL. Verify Circuit-theorems using lab instruments. Verify circuit transformations using lab instruments broadly defined Engineering Technology Problems.

Recommended Books
1. Electric circuits fundamentals by Franco (Latest Edition) 2. PSpice manual for Electric Circuits Fundamentals by J.S. Kang (Latest Edition) 3. Basic engineering Circuit Analysis by Irwin, John Wiley (Latest Edition) 4. Electrical Technology by Edward Hughes (Latest Edition) 5. Basic Engineering Circuit Analysis by J. David Irwin and Robert M. Nelms (Latest Edition) 6. Introductory Circuit Analysis by Robert L. Boylestead (Latest Edition)

Course Content

8.13 Professional Ethics

CODE & TITLE (ELH-211) **Professional Ethics**		CREDIT & CONTACT HOURS (3+0) **48 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	**Comprehend** the basic understanding of a profession, professional ethics, various moral and social issues, importance of values and professional ethics in personal life and professional career, and consequences of acting unethically in organization and society.		C-1	7
CLO-2	**Acquire** knowledge of various roles of engineering technologist in applying ethical principles at various professional levels.		A-3	6
CLO-3	**Resolve** the ethical dilemmas using common ethical values and identify possible 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, IEEE code 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, (or Latest Edition)
2. Kenneth Blanchard, Professional Ethics, 4th Edition (or Latest Edition)
3. Ethics in Engineering 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005. (or Latest Edition)
4. The Seven Habits of Highly effective people by Stephan r. Covey (Latest Edition)
5. Engineering Ethics: Concepts and Cases, 4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008 (or Latest Edition)
6. Professional Ethics: R. Subramanian, Oxford University Press, 2015. (or Latest Edition)
7. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015. (or Latest Edition)

Course Content

8.14 Technical Report Writing

CODE & TITLE (ELE-211) **Technical Report Writing**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Expository Writing-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** the basic concepts in technical writing and use of standard word processing software along with referencing tool for report writing.		A-2	5
CLO-2	**Initiate** technically correct statements, assignments, final year project report, project proposal, short reports, research paper and business/ professional correspondence.		A-3	9
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 (or Latest Edition) 2. Technical Writing and Professional Communication, Leslie Olsen and Thomas Huckin, 2nd Edition. (Or Latest Edition) 3. Communication for Engineering Students by J. W. Davies, (or Latest Edition) 4. Science Research Writing for Non-Native Speakers of English by Hilary Glassman-Deal, Imperial College Press. (Latest Edition)				

Course Content

8.15 Linear Algebra

CODE & TITLE (ELQ-211) **Linear Algebra**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-III**
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basic definitions, properties, and theorems of linear algebra.		C-2	1
CLO-2	**Illustrate** the operations on matrices to solve systems of linear equations.		C-2	1
CLO-3	**Apply** linear transformations and applies matrix theory to model real-life situations.		C-3	1

Course Outline for Theory

System of linear equations, row reduction and echelon forms, vector equations, the matrix equation ax=b. Solution sets of linear systems, applications of linear systems. Concept of matrices, types of matrices, operation on matrices i.e., addition, subtraction, multiplication, properties of matrix operation, the elementary row operation, echelon form, solution of linear system of equation by gauss elimination method, concept of consistent and inconsistent solution, polynomial interpolation. inverse of matrix using Gauss-Jordon method. Determinant of matrix: definition and properties of determinants and their theorem, concept of singular and nonsingular matrix, solution of non-homogenous linear system of equation using Cramer's rule. Introduction to linear transformation, daily life application i.e., cryptography example coding and decoding the messages, computer graphic.

Recommended Books

1. Introductory Linear Algebra by Bernard Kolman (Latest Edition)
2. Advanced Engineering Mathematics by Erwin Kreyszig, 10th Ed. Willey 2014. (or Latest Edition)
3. D. C. Lay, S. R. Lay, J. J. McDonald, "Linear Algebra and Its Applications", 5th Edition, Pearson Education, 2015. (or Latest Edition)
4. Linear Algebra and its Applications by Gilbert Strang, 4th Edition, (or Latest Edition)

Course Content

8.16 Technical Drawing

CODE & TITLE (ELT-211) **Technical Drawing**		CREDIT & CONTACT HOURS (0+1) **0 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Foundation-IV**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Recognize** Basic Tools and Shapes of Engineering Drawing.	C-1	1
CLO-2	**Understand** Engineering Drawing Tools and Use its principles to Represent Engineering Drawing Models.	C-2	1
CLO-3	**Practice** Engineering Drawing Principles to Draw 2-D & 3D Sketches.	P-3	5

Lab Outlines

Mechanical Drawing: Use of drafting instruments. Basic drafting techniques, drawing and lettering, dimensioning, projections and section of solids, orthographic projections, isometric views with reference to piping and ducting, practice of assembly drawing. Civil drawing: plan, elevations (front, left and right) and details of buildings. Elements of perspective drawings. Electrical Drawing: Electrical safety drawings, electric substation equipment layout, schematic diagrams of substations, lighting, and power distribution boards in contrast with house and industrial wiring diagrams, electrical symbols and one-line diagrams of a typical power system and its parts using all details.

Recommended Books

1. Mitchel & Spencer, "Technical Drawing" (Latest Edition)
2. Choudhry, "Elements of Workshop Technology" Volume –I. (Latest Edition)
3. Chapman, "Workshop technology" Part-I, II, & III. (Latest Edition)

Course Content

8.17 Electronic Devices and Circuits

CODE & TITLE (ELT-212) **Electronic Devices and Circuits**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-V**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** and explain the basic construction, operation and characteristics of semiconductor devices and their circuits.	C-2	1
CLO-2	**Analyze** dc and ac response of small signal amplifier circuits using device models.	C-3	2
CLO-3	**Observe** characteristics of semiconductor devices.	P-1	1
CLO-4	**Demonstrate** and analyze different electronic circuits to achieve desired outputs.	P-3	2
CLO-5	**Contribute** to perform the lab task in a group.	A-2	8

Course Outline for Theory

Study formation of PN junction from semiconductor materials and diodes circuits and its application in different areas. Study the AC/DC configuration of bipolar junction transistor (BJT). Study of FETs and MOSFETs; operation and applications.

Lab Outline

This lab course explains the basic concepts of semi-conductor diode and its current-voltage relationship. Various applications of junction diode are discussed, and various types of diodes are also explained. Different configurations of Bipolar Junction Transistors (BJTs) amplifiers are discussed. Relations of various currents and voltages in these transistors are explained in detail. Configuration of FETs and MOSFETS circuits. The course is directly supported with lab experiments embracing the design principles.

Recommended Books

1. Electronic Devices and Circuit Theory, H. Boylestad and L. Nashelsky, (Latest Edition)
2. Electronic Devices, Thomas L. Floyd, (Latest Edition)
3. Electronics Principles, Alberto P Malvino (Latest Edition)
4. Electrical Technology By B.L Theraja and A.K Theraja (Latest Edition)

Course Content

8.18 Electrical Network Analysis

CODE & TITLE (ELT-214) Electrical Network Analysis		CREDIT & CONTACT HOURS (1+1) 16 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Foundation-III
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the behavior of energy storing elements and their transient response analysis.	C-2	1
CLO-2	**Analyze** and understand the AC circuits using the theorems and the steady state response of reactive elements to AC excitation.	C-3	2
CLO-3	**Describe** the knowledge of RLC, transient and resonance response of series and parallel circuits by using modern tools/ simulators P-Spice.	P-1	1
CLO-4	**Demonstrate** the Ability of AC networks theorems and impedance of RLC circuits by using AC excitation.	P-4	2
CLO-5	**Report** the outcome of an experiments and task.	A-1	8

Course Outline for Theory

RL, RC and RLC circuit analysis with Ac excitation. AC circuit power analysis with RL, RC and RLC circuit. Analog filters: Low pass, high pass, band pass and stop band filter. Transient analysis: Transient analysis of series and parallel circuits. Laplace Transform for the analysis of linear time-invariant networks will be made - poles, zeros, and frequency response. The concept of Polyphase and Resonance Circuits. Transient Analysis with DC Excitations. Determine the unknown parameters of two-port circuits

Lab Outline

Simulate RL, RC and RLC Circuits transient response in P- Spice. Implement circuits using R, RL and RC and verify the node voltages and loop currents using instruments. Verify Circuit-theorems using lab instruments. Verify circuit transformations using lab instruments broadly defined Engineering Technology Problems.

Recommended Books

1. D. Irwin and R. M. Nelms, "Basic Engineering Circuit Analysis", Wiley, 9th Edition, 2008 (Latest Edition)
2. Robert L. Boylestad, "Introductory Circuit Analysis" Amazon, 12th Edition, 2012 (Latest Edition)
3. Alexander and M. Sadiku, "Fundamentals of Electric Circuits", McGraw-Hill, 4th Edition, 2008 (Latest Edition)

Course Content

8.19 Logic Circuits and Applications

CODE & TITLE (ELT-213) **Logic Circuits and Applications**		CREDIT & CONTACT HOURS (1+2) **16 Theory + 96 Lab**	KNOWLEDGE AREA/ DOMAIN **Foundation-VI**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** and explain fundamental concepts of digital logic Circuits including basic and universal gates, number systems, and binary coded systems, basic components of combinational and sequential circuits.	C-2	1
CLO-2	**Demonstrate** the acquired knowledge to apply techniques related to the analysis of digital logic circuits and their application.	C-3	2
CLO-3	**Identify** Logic Gates and Match with their truth table.	P-1	PLO-2
CLO-4	**Demonstration**s of each circuit of logic gates and verify Boolean Expression of each circuit.	P-3	2
CLO-5	**Report** the outcome of an experiments/ task	A-1	8

Course Outline for Theory

Logic circuits and Application is a technological subject which is intended to make students familiar with different types of implementations of sequential logic circuits, combinational logic circuits, trouble shooting of various digital systems, study of various digital systems. It is an introductory digital electronics course Number systems, Conversions, Logic Gates, Boolean Algebra, Combination Circuit Design, Flip-Flops, Shift Registers and Counters.

Lab Outline

Logic circuits and Application course gives a hands-on experience with 74 family ICs. The course starts with logic gates like AND, OR NOR, NAND, XOR, and XNOR gates. After learning the pin configuration of these ICs, the circuits are made from them, for example half subtractor, full subtractor, half adder, full adder and then it moves on to decoders, encoders. The course ends on flip flops, registers, and counters.

Recommended Books

1. Digital Fundamentals by Thomas L. Floyd. (Latest Edition)
2. Digital Logic and Computer Design by Morris Mano. (Latest Edition)
3. Digital Electronics Principles, Devices and Applications by Anil K. Maini. (Latest Edition)

Course Content

8.20 Micro-Controller Systems

CODE & TITLE (ELT-224) **Micro-Controller Systems**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-VII**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the architecture of microcontroller and its assembly instructions.	C-2	1
CLO-2	**Understand** built-in I/O's micro-controller.	C-3	2
CLO-3	**Practice** and programing of microcontroller-based circuits.	P-3	3
CLO-4	**Report** the outcome of an experiment and task.	A-3	8

Course Outline for Theory

Introduction to microcontrollers; architecture and programming. Architecture and instruction set of microcontrollers, built-in I/O's, serial communication, timers, interrupts, ADC, DAC, compare and capture, PWM, configuration registers, arithmetic instructions, logic instructions, program control instructions, introduction to interrupts.

Lab Outline

Introduction to development kit of any microcontroller. Development of different applications on microcontroller kit.

Recommended Books

1. Douglas V. Hall, "Microprocessor and Interfacing", Tata McGraw-Hill. (Latest edition)
2. Mazidi, Books on microcontroller. (Latest edition)

Course Content

8.21 Signals and Systems

CODE & TITLE (ELT-223) **Signals and Systems**		CREDIT & CONTACT HOURS (1+1) **16 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Foundation-VI**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the understanding of fundamental concepts in different types of continuous and discrete time signals and system.	C-3	1
CLO-2	**USE** system tools, especially convolution and transformations, to determine the behavior of continuous and discrete time signals and systems.	C-3	2
CLO-3	**Confirm** basic concepts of programming in MATLAB, express knowledge of handling matrices and explain use of built-in functions to perform assigned task and state how to use SIMULINK.	P-1	1
CLO-4	**Produce** signals, apply transforms, and manipulate and feed signals to systems as per the needs.	P-3	2
CLO-5	**Report** the outcome of an experiment and task.	A-1	8

Course Outline for Theory

The course covers the fundamentals of signal and system analysis, focusing on representations of discrete-time and continuous-time signals (complex exponentials, Fourier representations, Laplace transforms. Representations of linear, time-invariant systems (difference and differential equations, system functions, poles and zeros, convolution, impulse and step responses, frequency responses).

Lab Outline

In Signal and systems lab course the student will acquire hands-on experience with programming in MATLAB.
MATLAB will enable students to study and understand the theory behind signals and systems as well as validate the theory with real-word examples. The labs will cover linear time-invariant systems, Fourier series and Fourier transform, sampling, digital filters.

Recommended Books

1. Signals and Systems by Alan V. Oppenheim, Alan S. Willi sky and S. Hamid Nawab, 2nd Edition, Prentice Hall (Latest edition)
2. Signals and Systems by Phillips (Latest edition)

Course Content

8.22 Electrical Machines

CODE & TITLE (ELT-222) **Electrical Machines**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Breadth Core-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Appl**y the concepts of magnetic fields to analyze magnetic circuits and principle of operation of a transformer, and compute various parameters of transformer.		C-3	2
CLO-2	**Use** and compute the various parameters of ac motors and generators, their equivalent circuits, rotating magnetic field, the induced voltage and torque, phasor diagrams and the relationships between speed, power, torque and applications.		C-3	2
CLO-3	**Compute** the various parameters of DC generators and motors, their equivalent circuits, the relationships between speed, power, torque, and applications.		C-3	2
CLO-4	**Perform** experiments in a laboratory enabling the students to gain insight into the functioning of transformer, ac and dc machines.		P-4	2

Course Outline for Theory

DC Motors: Introduction and fundamental concepts, working principle, types, construction, operation, EMF equations, torque equations, characteristics, commutation, armature reaction, speed and voltage regulation, losses, open and short circuit test, no load and blocked rotor test, nameplate ratings and applications. Transformers: Introduction and fundamental concepts, working principle, types, construction, ideal transformer, operation and equivalent circuit, voltage regulation, losses, open and short circuit test, efficiency, instrument and auto transformers, nameplate ratings and applications. Induction and Synchronous Machines: Introduction and fundamental concepts, working principle, rotating magnetic field, magneto motive force and flux distribution, types, construction, operation, EMF equations, torque equations, speed and voltage regulation, losses, open and short circuit test, no load and blocked rotor test, nameplate ratings and applications. Fractional-Horsepower Motors: Hysteresis Motors, Stepper Motors, Universal Motors, Brushless DC Motors, etc.

Lab Outline

Basic Principle of Machine. Single and Three Phase Transformers. DC Generator and Motor. Induction and Synchronous Machines.

Recommended Books

1. Theodore Wildi "Electrical Machines, Drives, and Power Systems (Latest edition)
2. Stephen J. Chapman, "Electric Machinery Fundamentals", McGraw-Hill. (Latest Edition)
3. Hindmarsh, "Electrical Machines", McGraw-Hill. (Latest Edition)

Course Content

8.23 Instrumentation and Measurements

CODE & TITLE (ELT-221) **Instrumentation and Measurements**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Breadth Core-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the theory of analogue DC and AC measuring instruments and associated errors.	C-1	2
CLO-2	**Analyze** the design of instruments and measurement of parameters using instruments.	C-2	3
CLO-3	**Demonstrate** use of sensors, transducers, and electronic measuring instruments mismatch losses.	P-3	5

Course Outline for Theory

Introduction: Principles of Measurement, measurement units, elements of a measurement system, Choosing appropriate measuring instruments, instrument types, smart and non-smart instruments, static characteristics of instruments (e.g., Accuracy and inaccuracy/ Precision and others), Dynamic characteristics of instruments, Necessity for calibration, Errors during the measurement process, systematic errors, random errors. DC/AC Indicating Meters: The d'Arsonval movement, galvanometer, DC ammeters, DC voltmeters and resistance measurements. DC meter calibration. Half wave and full wave rectifier meters. Single phase wattmeter and energy measurement meters. Instrument transformers (CT and PT). Electronics/Digital Meters: Sampling, Quantization, Data Acquisition, A/D conversion. Analog Electronic Meters: Transistor voltmeter circuits and operational amplifier voltmeter circuits, AC electronic voltmeters and current and resistance measurement. Digital Multimeters: Digital voltmeter, ohm meters and current meter.AC and DC Bridges: Resistance, capacitance and inductance bridges, The Wagner ground and commercial RLC bridges. Transducers and Sensors: Temperature transducers, Pressure transducers, Resistance and inductance transducers, Linear variable differential transformer (LVDT), Capacitive, photoconductive, and piezo-electric transducers, thermos-electric transducers. Basic principle of different sensor technologies (e.g., Capacitive, and resistive sensors/ Magnetic sensors/ Hall-effect sensors/ Piezoelectric transducers / Strain gauges/ Piezo-resistive sensors/ Optical sensors (air path)/ Optical sensors (fiber-optic)/ Ultrasonic transducers /Micro-sensors).

Lab Outline

To study and become familiar with Oscilloscope, Measurement of Self-Inductance by Three Ammeter Method, Measurement of Capacitance by Three Voltmeter Method, Wheatstone bridge, Kelvin bridge, Maxwell Bridge, Hay Bridge, Schering Bridge, Wien Bridge, LDR & RTD, Ultrasonic Sensor, Electronic Wattmeter & Energy Meter.

Recommended Books

1. Modern Electronic Instrumentation and Measurement Technique Copper. W.D and Helfrick. A.D, Pearson, 2005. (Or Latest edition)
2. Alan S. Morris, "Measurement and Instrumentation Principles", (or Latest edition)
3. Robert B. Northrop, "Introduction to Instrumentation and Measurements", 2nd Ed., Taylor, and Francis - Boca Raton, 2005. (Or Latest edition)

4. David A. Bell, "Electronic Instrumentation and Measurement", 2nd Ed., Oxford University Press, 2010 (or Latest edition).
5. H. Kalsi, "Electronic Instrumentation", 2nd Ed., Tata McGraw-Hill, 2004Theodore Wildi “Electrical Machines, Drives, and Power Systems (or Latest edition)

Course Content

8.24 Energy and Environment

CODE & TITLE (ELI-221) **Energy and Environment**		CREDIT & CONTACT HOURS (1+1) **16 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Inter Disciplinary Elective-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Provide** basic knowledge of Fundamentals of Energy and/or Environmental Technology.	C-1	6
CLO-2	**Analyze** the energy sources, environmental impact.	C-4	6
CLO-3	**Evaluate** remedies and potential solution to the supply and the environmental issues may be associated.	C-5	6
CLO-4	**Identify** Ecological Impact through Environmental Impact Assessment (EIA).	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 systems. Steps involved in Environmental Impact Assessment (EIA).

Recommended Books

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

Course Content

8.25 Electrical Power Transmission

CODE & TITLE (ELT-225) **Electrical Power Transmission**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Elective-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** basic and advance concepts in Electrical Transmission System.		C-1	1
CLO-2	**Compare** the components of a transmission system to the conditions of short, medium and long lines.		C-2	4
CLO-3	**Show** the flow of active and reactive power in a large power system, symmetrical and unsymmetrical faults in power systems.		P-4	2
CLO-4	**Recognize** Line and Phase currents and voltages of a transformer and transmission line.		P-4	2

Course Outline for Theory

Electrical Power System: Overview of electrical power system i.e. generation, transmission and distribution. AC and DC power systems. Important elements of a substation. Requirements for a satisfactory electrical supply system. Transmission Lines: Purpose of transmission and advantages of high voltage transmission. Comparison of AC and DC transmission. Important elements of a transmission system. Economics of power transmission. Transmission system of Pakistan. Corona and skin effects transmission lines. Parameters of overhead transmission lines, types and calculations of transmission lines. Mechanical Design of Overhead Transmission Lines: Conductor materials used in transmission lines. Line support. Insulators and their types. Voltage distribution over insulator string, string efficiency and methods of improving the string efficiency. Sag and tension calculations and effect of wind pressure and ice loading.

Lab Outline

Power Systems Overview. Primary Parameters of Transmission Line. Steady State Analysis of Transmission Lines. Insulators for Overhead Transmission lines. Transient Analysis of Transmission Lines. Mechanical Design of Overhead Lines

Recommended Books

1. Electrical Transmission and Distribution Reference Book by Central Station Engineers, Westing house (Latest edition)
2. Principles of Power System by V.K Mehta and Rohit Mehta (Latest edition)
3. Electrical Power System by C L Wadhwa (Latest edition)
4. Electric Power Transmission and Distribution by S. Sivanagaraju and S. Satyanarayana (Latest edition)

Course Content

8.26 Electrical Power Distribution and Utilization

CODE & TITLE (ELT-313) **Electrical Power Distribution and Utilization**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Elective-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** functions of power substation and equipment.		C-4	1
CLO-2	**Distinguish** Characteristics of cable selection process and design the cable size for a given location.		C-4	3
CLO-3	**Proceed** and Carryout soil resistivity and earthing resistance measurement in a practical ground.		P-4	4
Course Outline for Theory				
DC and AC distrbutors: pointed and uniform ac and dc distributors, distributors fed at one and both ends, ring mains, stepped mains, unbalanced loading of three-phase ac distributors. Underground Cables: cable resistance, inductance and capacitance, methods of cable installation, voltage drop and power loss, types of cables used in industries, cable fault localization. Static Substation: substation location and layout, classification of substations, bus bar arrangement, grounding of star neutral point. Utilization: illumination, electrical heating- resistive, induction and dielectric heating, electric furnaces. Electrical traction systems, classification and layout				
Lab Outline				
Introduction to distribution system, power cables, grounding and earthing, power factor, electrochemical processes, heating and welding, fundamentals of illumination.				
Recommended Books				
1. Dale R. Patrick and Stephen W. Fardo, "Electrical Distribution Systems", CRC Press. (Latest edition) 2. Jan de Kock and Cobus Strauss, "Practical Power Distribution for Industry", Newnes-Elsevier, (Latest edition)				

Course Content

8.27 Control Technology

CODE & TITLE (ELT-311) **Control Technology**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Core-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** control technology in term of various types, applications, performance analysis of open loop and closed loop systems and familiarization of stability.	C-1	2
CLO-2	**Illustrate** and develop a mathematical model electrical and mechanical systems also understand the block diagram representation and signal flow graph techniques.	C-2	3
CLO-3	**Analysis** the stability of Linear Time Invariant systems using stability tools. E.g., Routh Hurwitz Criteria, Bode etc.	C-4	4
CLO-4	**Analyze** industrial applications of control technology, having servo mechanism and PID controller familiarization.	C-4	5
CLO-5	**Explain** the characteristics and functions for calculation of trainer.	P-2	4
CLO-6	**Trace** the problems associated with sensors, transmitter and actuator by Servomotor control using PID controller.	P-3	5

Course Outline for Theory

Introduction to control systems, open and close loop control systems. Principle of feedback systems. Modeling of electrical and mechanical control systems, time and frequency domain analysis. Block diagram, transfer function, unit and impulse response, signal flow graphs. Control system components, gear trains, levers, servo mechanism; study of feedback system for automatic control of physical quantities such as voltage, speed and mechanical position. Industrial application of servo mechanism. Overview of PID controllers. Stability, Routh-Hurwitz stability criteria.

Lab Outlines

Using MATLAB for control systems, Modelling of physical systems, linear control system modelling, LTI Systems, First and Second Order system response, computing Nyquist Criteria, root-locus and Bode plots. PI, PD and PID controllers. servo motor control.

Recommended Books
1. S.K. Bhattacharya, Control Systems Engineering (Latest edition) 2. Norman Nice, Control Systems (Latest edition) 3. B. Kuo, Automatic Control Systems. (Latest edition) 4. D'Azzo Control System (Latest edition) 5. Shaum Series. Feedback Control System (Latest edition)

Course Content

8.28 Communication Systems

CODE & TITLE (ELT-312) **Communication Systems**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Core-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the fundamental concepts of analog and digital communication systems.	C-1	9
CLO-2	**Illustrate** various types of analog and digital modulation and demodulation techniques and their properties, including bandwidth, channel capacity, transmission techniques.	C-2	3
CLO-3	**Demonstrate** the waveforms of modulation/demodulation techniques in time/frequency domain and error performance in the presence of noise in both time and frequency domain.	C-3	5
CLO-4	**Analyze** the performance of modulation and demodulation techniques and effect of noise in various transmission environments.	C-4	9
CLO-5	**Design** a hardware project by incorporating theoretical knowledge and practical skill.	C-4	3
CLO-6	**Implement** and analyze various analog and digital modulation and demodulation techniques by applying simulation tool.	C-4	5
Course Outline for Theory			
Block diagram of a communication system, modes of communication, transmission methods, bandwidth, signal-to-noise ratio, Double Sideband Suppressed Carrier (DSB-SC) System, Double Sideband Large Carrier (DSB-LC) System, Single Sideband (SSB) System, Vestigial Sideband (VSB) System, Basic concepts of frequency and phase modulation, narrowband and wideband frequency modulation, Spectra and bandwidth of frequency modulated systems, Power in FM systems, demodulation of angle modulated systems, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Pulse Code Modulation (PCM), Laws of Companding, Line Codes, Differential PCM, Delta Modulation, Frequency Division Multiplexing, Time Division Multiplexing, Wavelength Division Multiplexing, an introduction to orthogonal frequency division multiplexing, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Amplitude Modulation, Coherent and Non coherent detection, Performance analysis in terms of BER & bandwidth, Matched Filters.			

Lab Outlines
Amplitude Modulation: Baseband and carrier communications, Double Sideband (DSB), Single Sideband (SSB), Vestigial Sideband (VSB), Super-hetrodyne AM Receiver, Carrier Acquisition, Television. Angle Modulation: Instantaneous frequency, Bandwidth of FM/PM, Generation of FM/PM, Demodulation of FM/PM. Noise: Mathematical representation, Signal to Noise Ratio, Noise in AM, FM, and PM systems Pulse Modulation: Sampling and Quantization, Pulse Amplitude Modulation, Pulse Position and Pulse width Modulation, Quantization Noise, Signal to Quantization Noise Ratio, Pulse code Modulation, Delta Modulation, Frequency Shift Keying, Phase Shift Keying.
Recommended Books
1. Simon Haykin, "Communication Systems", John Wiley, (Latest edition) 2. B. P. Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", Oxford University Press, (Latest edition)

Course Content

8.29 Power Generation Technology

CODE & TITLE (ELT-314) **Power Generation Technology**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Elective – I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** fundamentals and operating principles of different power plant technologies.	C-2	1
CLO-2	**Analyze** electricity generation technologies for a better environment.	C-4	6
CLO-3	**Operate** power generation equipment and practice various characteristics of operation.	P-3	4
CLO-4	**Conduct** experiments in a laboratory to observe various conditions of power generation considering electrical design parameters.	P-4	5

Course Outline for Theory

Introduction of Electricity Generation Technologies: History and Evaluation, Electrical Networks, Renewable Energy and Distributed Generation, Environmental Effects. Coal Fired Power Plants: Traditional Coal-Fired Power Generation Technology, Integrated Gasification Combined Cycle, Emission Control, Combustion, Cost. Natural Gas-Fired Gas Turbine and Combined Cycle Power Plants: Gas turbine principle, Modern Gas Turbine Design, Advanced Gas Turbine Cycles, Combined Cycle Power Plants, Piston-Engine Based Power Plant. Combine Heat and Power: Principles and Application of CH&P, Piston Engines, Steam Turbines, Gas Turbines, Nuclear Power, Cost Analysis. Fuel Cells Technology: Principle of Operation, Types, Hydrocarbon Gas Reformation, Cost. Hydro Power: Hydro Power Plant, Categories, Generators, Water Turbines, Small and Large Hydro Power Stations, Design and Technical Issues. Cost. Energy Storage Technologies: Types of Energy Storage, Pumped Storage, Compressed-Air Energy Storage, Large-Scale Batteries, Operations, Storage. Renewable Power Generation: Wind Power, Solar Power, Geothermal Power, Tidal Power, Bio-Mass Based Power Generation.

Lab Outlines

Demonstration on power generation technology equipment like generators, turbines, and various other components used in hydro and thermal power plants in well-equipped labs or by industrial visits. Operate various power generation trainers in a laboratory and perform experiments using defined technology problems.

Recommended Books

1. Paul Breeze, "Power Generation Technologies", Elsevier- Newnes, (Latest edition)
2. Wakeel, "Power Plant Technology", Oxford University Press, (Latest edition)
3. G.D. Rai, "An Introduction to Power Plant Technology" Khanna Publishers, (Latest edition)
4. M.U. Deshpande, "Elements of Electric Power Station Design", PHI Learning, (Latest edition)

Course Content

8.30 Renewable Energy Technology

CODE & TITLE (ELT-315) **Renewable Energy Technology**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Elective – II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the fundamental characteristics of different renewable energy sources and mechanism to harness these technologies.		C-3	1
CLO-2	**Compare** the traditional energy sources and renewable energy sources to analyze their impact on the environment and the society.		C-4	6
CLO-3	**Operate** equipment and practice the design the characteristics of various renewable source configurations.		P-3	4
CLO-4	**Express** the observations during a power plant visit and write a comprehensive report.		A-3	8

Course Outline for Theory

Introduction to Renewable Energy Systems: Worldwide Energy Scenario, Types of Renewable Energy Technologies, Classifications of wind and solar systems, best locations for Solar and wind Energy systems. Designing of Wind and Solar Energy systems, Weibull probability distribution and TSR Speed-Power relations and designing of blades, Power vs speed Blade designing. Designing of Solar System Designing of parameters for maximum efficiency of solar systems, Types of solar cells and losses, Design of parameters for a high efficiency solar cell, Heterojunction, thin films and other promising solar cells. Costing of Renewable Energy Systems, Capital cost of system, Payback period, Maintenance Cost. Grid Connected Systems: Exploitation of Alternate energy sources, Review of present energy state of energy sector, Different sources of energy, Components of power systems, Energy crises. Problems in energy sector: WAPDA's Plan, Short term and long-term measures. Distributed generation Resources and their economics: Fossil fuels, Tidal, Ideal and practical values, Demand charges, Electricity utility rates

Lab Outlines

Learn the use of basic renewable energy gadgets. Study the various concepts and characteristics of renewable energy sources. Visit a thermal/solar or Nuclear power plant

Recommended Books

1. Efstathios E. Stathis Michaelides 'Alternative Energy Sources' (Latest edition)
2. Bent Sorensen , " Renewable Energy ", (Latest edition)
3. Aldo Vieira Da Rosa , " Fundamental of Renewable Energy Process ", (Latest edition)
4. Bent Sorensen, " Renewable Energy Conversion, Transmission, and Storage ", (Latest edition)

Course Content

8.31 Project Part-I

CODE & TITLE (ELT-316) **Project Part-I**		**CREDIT & CONTACT HOURS** (0+3) **0 Theory + 144 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Domain Project**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** and Identify background knowledge of engineering fundamentals in proposed idea and compare with previous related.	C-3	1
CLO-2	**Analyze** the problem statement through research and literature review.	C-4	2
CLO-3	**Defend** the impact of proposed idea in societal and environmental contexts and demonstrate knowledge of sustainable development.	C-5	10
CLO-4	**Develop** a wide range of technical skills by delivering a working prototype using latest design tools that has passed through the design, implementation, testing and evaluation stages.	C-6	3
CLO-5	**Integrate** the solution of Complex Engineering problem for improvement of Society or Environment.	A-4	7
CLO-6	**Practice** various methods to avoid Plagiarism in reports to adapt ethical values.	A-5	7
CLO-7	**Organize** effectiveness as an individual and in a teamwork management.	A-4	8
CLO-8	**Display** their communication skills through presentations, technical report, and poster.	A-5	9
CLO-9	**Display** the results of hardware components testing which could be used for SDP.	P-5	5

Course Content

8.32 Entrepreneurship

CODE & TITLE		CREDIT & CONTACT HOURS	KNOWLEDGE AREA/ DOMAIN	
(ELM-321) **Entrepreneurship**		(3+0) **48 Theory + 0 Lab**	**Management Science-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the understanding of entrepreneurship concept as a whole and the role of entrepreneurship in economic development.		A-3	10
CLO-2	**Compare** the role and importance of the small and medium sized enterprises in the economy.		A-4	6
CLO-3	**Apply** the ability to find an attractive market and apply the understanding of business planning concept for new business creation and growth.		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

8.33 Switchgear and Protective Devices Technology

CODE & TITLE	CREDIT & CONTACT HOURS	KNOWLEDGE AREA/DOMAIN
(ELT-321) **Switchgear and Protective Devices Technology**	(2+1) **32 Theory + 48 Lab**	**Depth Elective-III**

	After completion of this course, students will be able to:	**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** the basic knowledge of protection system attributes and understand the concepts of various protection schemes.	C-3	1
CLO-2	**Solve** and evaluate the protection schemes for a power system.	C-5	2
CLO-3	**Design** a protection scheme for a given problem and run its simulation.	P-7	3
CLO-4	**Construct** the behavior of various protection systems and ensure protection coordination on simulation software (like ETAP).	P-4	3

Course Outline for Theory

Protective Relays: Need for protective relaying in power systems, basic attributes of protective relaying, principles and characteristics of protective relaying, theory and classification of relays, Instrument Transformers, CT burden and accuracy classes. Overcurrent Protection: Inverse characteristics of overcurrent relays (OCR), inverse definite minimum time (IDMT) relays, primary and backup protection, relay coordination, application of IDMT relays, definite time overcurrent (DTOC) relays, application of DTOC relays, protection of a three-phase feeder. Differential Protection: Dot convention and CT placement, Simple Differential Protection, Zone of Protection of the Differential Relay, Percentage Differential Relay, Earth Leakage Protection.

Protection of Transformers: Transformer faults, differential Protection of a three-winding transformer, Inrush current and differential protection, Bucholz relays, Over-fluxing in a transformer. Protection of Generators: Faults in stator and rotor windings, Protective devices for stator, rotor, and prime mover of a generator, Abnormal operating conditions (unbalanced loading, over-speeding, loss of excitation and loss of prime mover) and their protection. Protection of Motor: Fuse protection motor, Single phasing protection, Protective devices for stator, rotor faults. Protection of Transmission Lines: Drawbacks of overcurrent protection, Distance protection, Zones of protection. Fuses and Circuit Breakers: Fuses Introduction, HRC/HBC fuse as the best protection against short circuits, principle and current-limiting phenomenon in HRC/HBC fuses, Principle of circuit interruption in circuit breakers, Circuit Breaker-Types and characteristics, Ratings of HRC/HBC fuses and circuit breakers.

Lab Outline
Protective Relays Overcurrent Protection. Differential Protection. Protection of Transformers. Protection of Generators and Transmission Lines. HRC/HBC Fuses and Circuit Breakers
Recommended Books
1. Fundamentals of Power System Protection by Y.G. Paithankar and S.R. Bhide (Latest edition) 2. Protective Relaying; Principles and Applications, by J. Lewis Blackburn, Thomas J. Domin. (Latest edition)

Course Content

8.34 Industrial Drive and PLC

CODE & TITLE (ELT-322) **Industrial Drive and PLC**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/DOMAIN **Depth Elective-IV**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** various industrial sensors**.**		C-2	1
CLO-2	**Analyze** various control mechanisms related to industrial drives**.**		C-4	4
CLO-3	**Apply** PLC for different industrial process applications**.**		C-3	3
CLO-4	**Perform** the DC and AC motor control using various derives.		P-2	8
CLO-5	**Conduct** experiments in a laboratory using PLC Ladder logic programming.		P-5	5

Course Outline for Theory

Classification of Motors: DC Motors, AC Motors (with detail on induction motors), Selection of Motors, Motor nameplate data, Electrical Characteristics, and Mechanical Characteristics of motors, Electric Braking: Requirements of Braking System, Types of Braking. Electrical Drives: Concept of Electric drive, Types of drive, Trends in Drive Technology, DC-DC converters, DC motor operation modes, Single Phase Drives, Three-Phase Drives, Stator voltage control, rotor voltage control, Stator current control, Stator voltage and frequency control, Variable frequency drives (VFD). Industrial sensors: Flow, temperature, pressure, level sensors. Proximity sensors and their application in industry. Chemical Analyzers. Programmable Logic Controller: Introduction to PLC, types of PLC, PLC hardware, Ladder logic diagram and programming of PLC, Human machine Interface (HMI) of PLC.

Lab Outline

Perform speed control operation of DC motor. Shunt Motor. Series Motor. Compound motor. VFD. Study Mechanical and Electrical Braking Systems. Perform a simple ON-OFF operation on a standard PLC. Perform AND, OR, AND-OR, OR-AND operation on a standard PLC. Perform a Time Delay operation on a standard PLC.

OFF-Time Delay. ON-Time Delay Perform a Counter operation on a standard PLC. Perform a Flip-Flop Operation on a standard PLC. Perform Reverse-forward operation on a standard PLC. Perform a motor speed control operation on a standard PLC.

Recommended Books

1. Fundamentals of Industrial Drives by B.N. Sarkar (Latest edition)
2. Electric Motors and Drives by Austin Hughes and Bill Drury (Latest edition)
3. PLC Manuals for Siemens and Mitsubishi. (Latest edition)

Course Content

8.35 High Voltage Technology

CODE & TITLE (ELT-323) **High Voltage Technology**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/DOMAIN **Depth Elective-V**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Learn** the principles governing theory and practices in High voltage technology.		C-1	1
CLO-2	**Comprehend** the principles of different types of insulating materials with respect to voltage levels**.**		C-2	4
CLO-3	**Perform** high voltage generation, measurement, and testing in the laboratory.		P-2	8
CLO-4	**Observe** the effect of high voltage on insulators.		P-1	2

Course Outline for Theory

Fundamental principles of high-voltage test techniques, generation and measurement of high AC voltages, DC and impulse voltages and currents, dimensions and technical equipment of the test setups, fencing, shielding and earthing of test setups, circuits for high high-voltage experiments, construction elements for high voltage circuits, experiments with AC, DC and impulse high voltages, experiments with liquid and solid insulating materials and partial discharges, switching and lightning impulse voltages, standards to test electrical equipment against BIL and BSL levels, introduction to insulation coordination.

Lab Outline

Generation of AC high voltages and measurements. Generation of DC voltages and their measurements. Observation of corona inception and breakdown voltage in air. Measurement of high voltage by sphere gap. Measurement of dielectric strength of solid overhead insulation. Measurement of dielectric strength of cable insulation. Measurement of dielectric strength of insulating liquids. Generation and measurement of impulse voltages. Testing of high voltage equipment (AC, DC and impulse voltages).

Recommended Books

1. Dieter Kind and Kurt Feser, "High Voltage Test Techniques", Newnes, 2001. (or Latest edition)
2. Ravindra Arora and Bharat Singh Rajpurohit, "Fundamentals of High-Voltage Engineering". (or Latest edition)

Course Content

8.36 Energy Conservation and Auditing

CODE & TITLE (ELT-32x) Energy Conservation and Auditing		CREDIT& CONTACT HOURS (1+1) 16 Theory + 48 Lab	KNOWLEDGE AREA/DOMAIN Depth Elective	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Construct** the energy flow diagram of an industry and identify the energy wasted.		C-3	3
CLO-2	**Select** an appropriate energy conservation method to reduce the wastage of energy.		C-4	6
CLO-3	**Carry** out energy audit of an industry/organization.		P-3	8

Course Outline for Theory

Energy Conservation Approaches in Industries a. Energy saving opportunities in electric motors, Benefits of Power factor improvement and its techniques-Shunt capacitor, Synchronous Condenser etc. b. Effects of harmonics on – Motors, and remedies leading to energy conservation. c. Energy conservation by Variable Speed Drives (VSD) d. Methods and techniques of energy conservation in ventilation and air conditioners - compressors pumps, fans and blowers e. Area Sealing, Insulating the Heating / cooling fluid pipes, automatic door closing- Air curtain, Thermostat /Control, Energy conservation in electric furnaces, ovens and boilers f. Lighting techniques – Natural, Compact Fluorescent Lamps (CFL), Light Emitting Diodes (LED) lighting sources and fittings g. Calculation and costing of proposed energy conservation measure, Depreciation cost, sinking fund method. Cost evaluation by Return on Investment (ROI) and pay back method, Risk Analysis, Case study Energy Auditing a. Energy audit and its benefits b. Energy flow diagram c. Preliminary, Detailed energy audit. Methodology of preliminary energy audit and detailed energy audit (Pre audit, Audit and Post audit), ISO 50001 d. Energy audit report e. Introduction to tools required for energy auditing. Required tools for conducting energy audit (Power analyzer, combustion analyzer, fuel efficiency monitor, thermometer contact infrared, pitot tube and manometer, water flowmeter, leak detector, tachometer, and lux meter)

Lab Outline

Experiments related to Energy Conservation and Auditing will be covered in the lab classes for example: Hands-on training on various Equipment such as, power analyzer, thermal imager, and lux meter required for energy audit in industry. Practical case/study of energy conservation, management & audit. Performance assessment of HT distribution transformer operation in campus. Practical case studies of Bill analysis of HT consumer. Practical case studies on significance of power factor in HT consumer billing and working of Automatic Power Factor Controller (APFC) panel in distribution control room. Performance analysis of energy saving in lightning systems in the campus using energy saving devices like LED lights and motion control sensors. Practical case studies of power quality issues using Power Quality Analyzer. Simulation and analysis Electrical motor efficiency and remedial measures to improve efficiency. Hands on experiment of Harmonic analysis of supply system at source point

Recommended Books
1. Electric Energy Generation, Utilization and Conservation by Sivaganaraju, S Pearson, New Delhi, 2012 (Latest edition) 2. Energy Management Handbook by Wayne C. Turner (Latest edition) 3. Energy Management by Paul O Callaghan, McGraw Hill, New Delhi (Latest edition)

Course Content

8.37 Project Part-II

CODE & TITLE (ELT-324) **Project Part-II**		**CREDIT & CONTACT HOURS** (0+3) **0 Theory + 144 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective – IV**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Devise** an experimentally verified system which can solve a Broadly Define Engineering Technology Problem.	C-6	3
CLO-2	**Implement** proposed design using modern technology for solution of Broadly Define Engineering Technology Problem.	C-3	5
CLO-3	**Investigate** and analyze the results obtain from the implemented design.	C-4	4
CLO-4	**Practice** ethical principles (Plagiarism in particular) and engineering norms.	A-5	7
CLO-5	**Display** effectiveness as an individual and in a teamwork management.	A-4	8
CLO-6	**Display** their communication skills through presentations, technical report, and poster.	A-5	9
CLO-7	**Demonstrate** management skills as a member and/or leader to manage the project.	A-4	10
CLO-8	**Alter/Revise** the conventional solutions by adapting modern technology.	P-6	11

Course Content

8.38 Project Management

CODE & TITLE		CREDIT & CONTACT HOURS	KNOWLEDGE AREA/DOMAIN	
(ELM-411) **Project Management**		(2+0) **32 Theory + 0 Lab**	**Management Science -III**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** and understand the basic concepts of management with a special focus on project management.		A-1	10
CLO-2	**Demonstrate** competency in various project management knowledge areas, project scheduling and controlling techniques including Critical Path Method and Earned Value Management.		A-3	10
CLO-3	**Use** computers in Project Management, especially a tool like MS Project & Primavera etc.		C-3	5

Course Outline

Introduction to Management: History of management, functions and functional areas of management, levels of management, managerial skills, types of organizations, managerial control, principles of management. Introduction to Project Management: Definition of Project and Project Management, knowledge areas of project management, project life cycle, project characteristics, project constraints, project organization structure. Project Quality Management: History of Quality Management, defining quality, relationship between project management and quality management, Quality Management Frameworks.

Project Stakeholder Management: The roles of project manager and project sponsor, project team selection, skills, and competencies of project manager, building and managing successful project teams, stakeholder management .Project Cost Estimating and Budgeting: Cost components and methods for cost estimation in projects, cost control in projects, life cycle cost, cost scheduling and forecasting, project resource allocation and levelling, estimation of outstanding work, elements of budgets and estimates, earned value management.

Project Risk Management: Defining risk and uncertainty, business and project risk, probability and impact of risk, risk management process. Project Time Management: Introduction to project scheduling, Critical Path Method, network representation of projects, critical activities, and critical path, project Gantt Chart. Project Closure: Project evaluation, project and project management success, success criteria for projects, project audits, project termination process. Project Management Tools: Introduction and use of project management tools like MS Project and Primavera.

Recommended Books
1. Project Management: A System Approach to Planning Scheduling and Controlling by Harold Kerzner, 11th edition, John Willey 2013, (or Latest edition) 2. Project Management: A managerial approach 7th edition, Jack R. Meredith and Samuel J. Mantel, Jr. John Wiley and Sons, Inc. Project Management for Business, (or Latest edition) 3. Project Management for Engineering and Technology: Principles and Practice 3rd Edition, by John M. Nicholas and Herman Steyn, Elsevier Publications (or Latest edition) 4. Project Management: A Strategic Planning Approach by Paul Gardiner, 2nd Edition, Palgrave Macmillan, 2017, (or Latest edition)

Course Content

8.39 Electrification Technology

CODE & TITLE		CREDIT & CONTACT HOURS	KNOWLEDGE AREA/DOMAIN	
(ELT-412) **Electrification Technology**		(2+1) **32 Theory + 48 Lab**	**Depth Elective-VI**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** the basic electrification techniques, cost, and methods of electrification.		C-1	1
CLO-2	**Understand** the wiring and equipment installation methods of a residential, commercial, and industrial building.		C-2	2
CLO-3	**Perform** laboratory work to understand electrification system for a building.		P-2	8
CLO-4	**Build** and installing wiring and equipment according to the requirement of a building, industry, or traction system.		P-4	8

Outline for Theory

Residential Wiring: Types and sizes of wiring cables, wiring accessories and cables current carrying capacity, wiring system, protection of house wiring, distribution boards, testing of wiring, electricity rules about domestic wiring and earthing, voltage drop in cables and its calculation.

Industrial and Commercial Wiring: Power wiring system, three phase power distribution board, multistory distribution board, cable and fuse/circuit breaker size for motor, magnetic contactors, push button & thermal overload relay. Electric Traction: Introduction, advantages and disadvantages, electrification systems of electric traction, motors used for electric traction, trolley bus control equipment, master controllers. Overhead feeding and distributing equipment, trolley wires, trolley wheels, frogs, pantograph.

Current collectors – trolley collector, BOW collector, pantograph collector. Illumination: Laws of illumination, inverse square law, Lambert's Cosine law, depreciation factor, utilization factor, waste light factor, lighting scheme and its design, flood lighting, its purpose and arrangements. Earthing System: Testing, rules, and regulations of installation. Service Lines: Methods of installation of service lines for buildings.

Signal Communication Circuits: Systems used in industrial and commercial buildings and their applications. Planning and Design of Electrical Installation: Steps of planning, estimating residential building, determining number of light points and number of outlets, determining number of circuits for residential installation, factors for selecting cable size.

Cost Estimates: Steps and factors to be considered in preparation of cost estimate are Labor cost, material cost, transport cost, quantity of material required for industrial-residential wiring.

Outline for Laboratory Experiments
To control three lamps individually by 3 one-way switches & install a fuse. To construct a test board. To construct a fuse indication circuit. To control a bell through an indicator by push button. Jointing of low and medium voltage cables. To prepare a wiring switchboard with 4 switches, one fan regulator, one socket and a lamp. To install a 1-phase energy meter, main switch, and distribution fuse board. Wiring 3-phase motor contractor, push button starter and thermal relay.Typical commercial wiring in conduit, having distributed light and power circuit. House wiring test (Short circuit, leakage current, polarity and continuity test). Measurement of earth resistance by earth tester. Designing Protective Multiple Earth System for industrial installation. Construct lighting scheme for a hall. Planning of electrical installation for concealed conduit wiring. Planning of Multiple earthing system for an industrial installation. Planning of service and distribution of multi-storey building. Drawing of connection for a panel board for each floor of building. Preparation of estimation list for equipment & materials, for building.
Recommended Books
1. Industrial Electricity 9th Edition by Michael E. Brumbach (or Latest edition) 2. Practical Electrical Wiring: Residential, Farm, Commercial, and Industrial 22nd Edition, by Herbert P. Richter, F. P. Hartwell (or Latest edition)

Course Content

8.40 Fiber Optics

CODE & TITLE (ELT-413) **Fiber Optics**		CREDIT & CONTACT HOURS (2+ 1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/DOMAIN **Depth Elective-VII**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** and understand the principles governing theory in optical communication.	C-2	1
CLO-2	**Analyze** the working and construction of optical fibers.	C-4	4
CLO-3	**Identify** and test the performance of the optical fibers.	P-1	8
CLO-4	**Measure** a basic optical system using different optical components.	P-4	3

Outline for Theory

Introduction: Historical perspectives, the basic communication systems, nature of light, advantages of light, application of fiber optic communications. Optics Review: Ray theory and applications, numerical aperture, diffraction. Light Wave Fundamentals: Electromagnetic waves, dispersion, pulse dispersion and information, polarization, resonant cavities, reflection at a plane boundary, critical angle reflection. Optic Fiber Waveguide: Step-index Fiber, Graded-index fiber, Attenuation, Modes in step-index fibers, Modes in graded-index fibers, Pulse distortion and information rate in optic fiber, Construction of optic fiber, Optic fiber cables. Light Sources: Light emitting diodes, light emitting diodes operating characteristics, laser principles, laser diodes, laser diodes operating characteristics, distributed feed-back laser diodes, optical amplifiers, fiber laser. Light Detectors: Principles of photo-detection, photomultiplier, semiconductor photo diodes, PIN photodiodes, avalanche photodiodes. Couplers and Connectors: Connector principles, fiber end preparation, splices, connectors, source coupling, Modulation: Light emitting diodes modulation and circuits, laser diode modulation and circuits, analog modulation formats, digital modulation formats, optic heterodyne receiver, noise and detection, thermal and shot noise, signal to noise ratio, error rates, mode-noise, mode partition noise, amplifier noise, laser noise and jitter, additional noise contributor, receiver circuit design. Systems Design: Analog systems design, digital systems design. Photonic Networks: WDM, TDM Networks, OADMs, OXCs, Switching, OCS, OPS, OBS, Concept of Light paths

Outline for Laboratory Experiments

To study the basic structure and types of optical fiber. Polish and visually inspect terminated plastic optical fibers. Power launching and the testing of optic power loss between two plastic optical fibers in ST connectors. Measuring optical power attenuation in optical fiber. Measuring the numerical aperture, NA of optical fiber. Measuring the end separation loss of optical fiber. Measuring the axial separation loss of optical fiber. Measuring the angular misalignment loss of optical fiber.

Recommended Books
1. Optical Fiber Communications – Gerd Keiser, Tata Mc Graw-Hill International edition, 4th Edition (or Latest edition) 2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002 (or Latest edition)

Course Content

8.41 Robotics Technology

CODE & TITLE (ELT-414) **Robotics Technology**		CREDIT & CONTACT HOURS (2+1) **32 Th + 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** working principles of mobile robots and serial chain manipulators.		C-2	1
CLO-2	**Solve** kinematic and inverse kinematics of serial chain mechanisms.		C-3	3
CLO-3	**Execute** the working of various mobile robots and manipulator through simulation and prototypes.		P-2	5
CLO-4	**Adapt** robot prototypes for various applications.		P-4	3

Outline for Theory

Types of robots, links, and joints. Rotation and translational matrix. DH table, and its formation. Kinematics, and inverse kinematics of two and three link mechanisms. Actuators, and sensors used in the robots. Introduction to robotic hands, grippers, exoskeleton, prosthetics. Types and working of mobile robots, and various path planning algorithms. Understand working of UAVs and quadcopters.

Outline for Laboratory Experiments

Learn the use of basic robotics range-based sensors including IR sensors, ultrasound sensors, LIDAR etc. Use mobile robots to understand their working. Design and develop mobile robots for line following applications. Design and develop arm mechanisms using servo or stepper motors.

Recommended Books

1. Introduction to Robotics: Mechanics and Control: Craig, John J. 3/E. Pearson Education India, 2009. (Or Latest edition)
2. Robotics, Vision and Control: Fundamental Algorithms in MATLAB: Corke, Peter I., and Oussama Khatib Berlin: Springer. (Or Latest edition)
3. Principles of Robot Motion: theory, algorithms, and implementations: Choset, Howie, Kevin M. Lynch, Seth Hutchinson, George A. Kantor, and Wolfram Burgard. (Latest edition)
4. Robot Modeling and Control: Spong, Mark W., Seth Hutchinson, and Mathukumalli Vidyasagar, John Wiley & Sons. (Latest edition)

Course Content

8.42 Smart Grid Technology

CODE & TITLE		CREDIT & CONTACT HOURS	KNOWLEDGE AREA/DOMAIN	
(ELT-415) **Smart Grid Technology**		(2+1) **32 Theory + 48 Lab**	**Depth Elective-IX**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the technologies and methodologies used in the smart electrical grids.		C-2	1
CLO-2	**Analyze** intelligent electrical power system dynamics in smart grid technology.		C-4	2
CLO-3	**Operate** smart grid trainer for hands on practice on several components and modules.		P-3	4
CLO-4	**Conduct** experiments in the laboratory to interpret experimental data and observe its conformance using an integrated approach.		P-4	8

Outline for Theory

Introduction to Smart Grid: Integrated networks, renewable energy sources and modelling, modern monitoring, phasor measurement units, intelligent power system networks and their dynamics.

Demand Side Management: Communication technologies for smart grid, SCADA and WAMS. Energy Management and Dispatch Plans: The optimal power flow problem, load flows. demand response Intelligent Electrical Power

System Dynamics: Frequency and active power balance, identify control-room technologies for system-wide remote monitoring, protection, and risk management of smart grid cyber security.

Outline for Laboratory Experiments

Demonstration on smart grid trainer having simulation of main energy sources (wind, hydro, solar, and coal) and power supplies. Perform experiment using resistive, capacitive, and inductive loads, fed by AC or DC supply.

Use of protected equipment which permits the application of domestic and industrial rated electric magnitudes as well as their instrumentation.

Synchronization methods, power and instrumentation transformers, and the inner physical phenomena can be measured and studied as individual elements or as part of the whole power distribution system.

Recommended Books
1. Smart Grid and Enabling Technologies: Shady S. Reffat et.al, Willey- IEEE Press, (Latest edition) 2. Smart Grid Technology: A Cloud Computing Data Management Approach: Sudip Misra, Samaresh Bera, Cambridge University Press, (Latest edition) 3. Smart Grid, Technology and Applications: Janaka Ekanayake, et.al, John Wiley, (Latest edition) 4. Smart Grids Fundamental and Technologies in Electricity Networks: Bernd M. Buchholz, Zbigniw Styczynski, Springer, (Latest Edition).

Course Content

8.43 Artificial Intelligence

CODE & TITLE (ELC-411) Artificial Intelligence	CREDIT & CONTACT HOURS (1+1) 16 Theory + 48 Lab	KNOWLEDGE AREA/DOMAIN Computing-III	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** the characteristics of different types of decision-making environments, appropriate decision-making approaches, and tools to be used in each type.	C-1	1
CLO-2	**Solve** the Transportation Models and Assignment Models.	C-3	1
CLO-3	**Calibrate** the basic methodology for the solution of linear programs and integer programs.	P-4	3

Outline for Theory

Introduction: Basic component of AI, identifying AI systems, branches of AI, etc. Reasoning and Knowledge Representation: Introduction to Reasoning and knowledge representation, propositional logic, first order logic.

Problem Solving by Searching: Informed searching, uninformed searching, local searching, constraint satisfaction problems, adversarial search, min-max algorithm, alpha beta pruning, game-playing. Learning: Unsupervised learning, supervised learning, reinforcement learning.

Uncertainty Handling: Uncertainty in AI, fuzzy logic. Recent Trends in AI and Applications of AI Algorithms: Trends, case study of AI systems, analysis of AI systems

Outline for Laboratory Experiments

Learn the basic terminology Artificial Intelligence. Evaluate applications of Artificial Intelligence.

Recommended Books

1. Artificial Intelligence. A Modern Approach: Stuart Russell and Peter Norvig, , 3rd edition, Prentice Hall, Inc., 2010. (Or Latest edition)
2. Pattern Classification: Hart, P.E., Stork, D.G. and Duda, R.O., 2001... John Willey & Sons. (Latest edition)
3. AI algorithms, Data Structures, and Idioms in Prolog, Lisp, and Java: Luger, G.F. and Stubblefield, W.A., 2009...Pearson Addison-Wesley. (Or Latest edition)

Course Content

8.44 Power Electronics

CODE & TITLE	CREDIT & CONTACT HOURS	KNOWLEDGE AREA/DOMAIN
(ELT-41x) **Power Electronics**	(2+1) **32 Theory + 48 Lab**	**Depth Elective**

	After completion of this course, students will be able to:	Bloom's Taxonomy Level	PLO
CLO-1	**Discuss** power electronic circuits for application in controlled and uncontrolled rectification.	C-2	1
CLO-2	**Analyze** the designed circuits for their performance parameters	C-4	2
CLO-3	**Perform** experiments in laboratory related to power Electronics.	P-4	8

Outline for Theory

Principles of Power Electronics: converters and applications, circuit components and their effects, control aspects. Power Electronic Devices: Power diode, power BJT, power MOSFET, IGBT and SCR, GTO, TRIAC and DIAC. Construction Characteristics: Operations, losses, ratings, control and protection of thyristors, halfwave and full-wave rectifiers with resistive and inductive loads, un-controlled, semi controlled and fully controlled rectifiers, three-phase rectifiers: un-controlled, semi controlled and full controlled, six-pulse, PWM converters, DC to AC converters, three-phase inverter, six-pulse, PWM inverters, switching mode power supplies, DC to DC conversation, buck converter, boost converter and buck-boost converters, isolated converters, forward converters, flyback converters.

Outline for Laboratory Experiments

Uncontrolled Rectifiers. TRIAC Characteristics SCR Characteristics. Single Phase Controlled rectifiers. 3 Phase Controlled rectifiers. Buck Converter (non-isolated DC-DC convertor). First Quadrant Chopper (DC Motor Speed Control). AC Power Control Using TRIAC-DIAC Combination. PWM Inverter

Recommended Books

1. Power Electronics: Circuits, Devices and Applications: M. H. Rashid, Prentice Hall, (Latest edition)
2. Power Electronics: C. W. Lander, McGraw Hill, (Latest edition)
2. Power Electronics: D. W. Hart, McGraw Hill, (Latest edition)
3. Elements of Power Electronics: Philip T. Krein, Oxford University Press, (Latest edition).

Course Content

8.45 Telecommunication Technology

CODE & TITLE	**CREDIT & CONTACT HOURS**	**KNOWLEDGE AREA/DOMAIN**
(ELT-41x) **Telecommunication Technology**	(2+1) **32 Theory + 48 Lab**	**Depth Elective**

	After completion of this course, students will be able to:	**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** different principles involved in communication systems and recognize each in different communication systems.	C-1	1
CLO-2	**Analyze** the different modulation techniques in terms of signal to noise ratio along with their comparison.	C-4	4
CLO-3	**Perform** experiments in laboratory related to communication systems.	P-4	8

Outline for Theory

Introduction to Communication Systems (at block level): Information, transmitter, channel, receiver, & modulation. Noise: Types of noises, bandwidth & review of Fourier Series and Fourier Transforms, orthogonal signals, power spectrum density, heterodyning & commercial radio receiver, signal to noise ratio, noise figure, dBm, dBW, evaluating the effect of noise in different techniques of AM and their comparison in terms of signal to noise ratio Sensitivity &

Selectivity: Hilbert transform & single side band (SSB), modulation generation & detection, analyzing Frequency division multiplexing, Vestigial side band (VSB) modulation, angle modulation: Frequency & Phase modulation: Narrow & wideband FM, Bandwidth approximation in FM.

Generation and detection of FM signals, generation and detection of PM signals, comparison of FM & PM. Analog to Digital Conversion: Sampling theorem, quantization & coding (types, error, and implementation). Pulse modulation: Pulse Amplitude Modulation, Pulse Width Modulation, & Pulse Position Modulation.

Digital Modulation: Amplitude shift keying (ASK, OOK), Frequency shift Keying (FSK, OTS). Analyze Time division Multiplexing, Digital base band signals format in time & frequency domain. To Analyze Phase shift keying (PSK), Minimum shift keying (MSK). Evaluating M-ary modulation (4PSK, QAM etc), Bit error rate in digital communication

Outline for Laboratory Experiments
Generate Gaussian noise sequence with zero mean and variance. Process a binary data stream using a communication system that consists of base band modulator, channel and demodulator. Simulate BER of system and plot BER vs SNR. Simulate QPSK modulation scheme and compare it to BPSK scheme. Study cellular systems using their simulators. Plot relative power drop of the signal at a mobile station.
Recommended Books
1. Digital Communications, Principles and Applications by Bernard Sklar Pearson Education, 2nd Edition (or Latest edition) 2. Introduction to Communication Systems by Ferral G. Stemler (Latest edition) 3. Communication Systems by Simon Haykin 4th Edition. (or Latest edition) 4. Fundamentals of Communication Systems by Michael P.Fitz, 1st Edition. (or Latest edition)

Course Content

8.46 Sensor Networks

CODE & TITLE		CREDIT & CONTACT HOURS	KNOWLEDGE AREA/DOMAIN	
(ELT-41x) **Sensor Network**		(2+1) **32 Theory + 48 Lab**	**Depth Elective**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** industrial communication and networks.		C-2	1
CLO-2	**Solve** industrial issues using acquired knowledge.		C-4	4
CLO-3	**Perform** experiments related to IoT and sensor networks.		P-1	5
CLO-4	**Adapt** various communication protocol for industrial sensing and control applications.		P-6	3

Outline for Theory

Introduction: To different types of industrial sensor communication networks, data communication basics, communication model, routing, localization and synchronization, sensor fusion and aggregation, compressive sensing graph signal processing. IOT: Key components that make up an IoT system, levels of the IoT stack and key technologies and protocols employed at each layer of the stack. Industrial networks: OSI reference model, industry network and their selection, network architectures, modbus and fieldbus, Highway Addressable Remote Transducer (HART) Protocol, wireless protocols and ZigBee.

Outline for Laboratory Experiments

Basics of IoT programming using the Raspberry and Arduino Platform. Sensing data using the MKR1000 board. Programming a MKR1000 board over the air in a stand-alone WiFi network. Collecting and exchanging data on 433mHz frequency. Sensing audio data and interpreting results. Visualizing sensed data.

Recommended Books

1. Foundational Elements of an IoT Solution: J. Biron and J. Follett, O'Reilly Media, 2016. (Or Latest edition)
2. Wireless Sensor Network Designs: Anna Hac, John Wiley & Sons, December 2003, (or Latest edition)

9. Supervised Industrial Training (SIT)

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 the 7th (optional) and 8th semester, Bachelor of Electrical Engineering Technology students will undergo Mandatory continuous SIT of 16 (or 32) weeks. This training shall be arranged by HEIs in leading industries, 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 (mandatory) semester according to a scheduled timeline.

9.4 Responsibilities of Students

a. Bachelor of Electrical Engineering Technology students shall get enrolled for SIT during the 6th semester and before commencement of the 7th semester.
b. Students shall have to undergo continuous training of 16 (or 32) credit hours. One week'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 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 (7^{th} and 8^{th}), 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 and 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 emergency/s, 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 leaves 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 counter-part 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.
b. To obtain feedback on students' performance and training progress through discussion with training supervisor(s).
c. To make courtesy visits and establish industrial relations between the HEI and the industries where students will receive their SIT.
d. To discuss the possibility of students' job placement with the training organization.
e. To survey new industries as potential training placement locations in the future.

9.6 Changing Student Placement During SIT

Students are discouraged to change placement during the training period from one organization to another.

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

9.8 Industrial Training Report

An Industrial Training Report will be submitted upon completion of SIT. The Report must describe 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 at 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 needs 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. Problem solving process or approach
v. Hands-on skills acquired.
vi. How productivity can be further enhanced.
vii. Quality Management system in place.
viii. Safety at work.

(e) Conclusion

Students provide an overall assessment in this section and arrive at a conclusion with regards to the SIT undergone. Contents 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 mentioned in the main text of the Report.

(i) Notations, Symbols & Acronyms

If the report contains notations, symbols, and acronyms, these must be defined before they first appear in the main text. It is good practice to put 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 a 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 parameters:

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

It 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. Preliminary Meeting of National Curriculum Review Committee (NCRC) was held on 20-10-2021 to 22-10-2021 for 3 days at the University of Engineering & Technology, Taxila.

2. 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 Honorable Vice Chancellor UET, Taxila. Then, the Chairman NTC explicitly elaborated importance of curriculum development for B.Sc. engineering technology programs through more practical work engagement as well as keeping in view the futuristic approach, market demand and societal needs as per the scope of NTC and guidelines of Sydney Accord.

3. HEC representation was ensured by Mr. Hidayatullah Kasi, Deputy Director, Academics Division, HEC, while Mr. Muhammad Fahd Amin, Acting Registrar, NTC with Mr. Hafiz Ghulam Muhammad represented NTC. They highlighted the agenda of this meeting and emphasized adaptation of general rules of curriculum development and revision such as scope of the subject/program, horizontal & vertical alignment, rule of flexibility and adaptability. Moreover, scope and template for adopting new undergrad policy was discussed to adopt for the uniformity and alignment of curriculum.

4. In the second session, Honorable Engr. Prof. Dr. Madad Ali Shah, Vice Chancellor, The Benazir Bhutto Shaheed University of Technology & Skill Development, Khairpur Mirs (BBSUTSD), Kahirpur shared procedure and execution of agenda in NCRC. Then he invited the house to nominate the Convener, Co-Convener, Secretary and Co-Secretary of the NCRC for smooth functioning. After discussion with members Engr. Prof. Dr. Syed Hassan Mujtaba Jafri was nominated as Convenor, and Engr. Prof. Dr. Muhammad Amjad, Engr. Prof. Dr. Ahmed Muddassir Khan and Engr. Dr. Haider Ali were nominated as Co-Convener, Secretary and Co-Secretary for the Committee, respectively. Following nominated members represented various HEIs from all over the Pakistan in NCRC for B.Sc. Electrical Engineering Technology.

Sr#	NCRC Members	Role
1	Engr. Prof. Dr. Syed Hassan Mujtaba Jafri Professor and Dean, Mirpur University of Science & Technology, AJ&K	Convener
2	Engr. Prof. Dr. Muhammad Amjad Professor and Dean, The Islamia University of Bahawalpur	Co-Convener
3	Engr. Prof. Dr. Ahmed Muddassir Khan Professor and Dean, Indus University, Karachi	Secretary
4	Engr. Dr. Haider Ali, Assistant Professor and HoD Shuhada-e-APS University of Technology, Nowshera	Co-Secretary
5	Engr. Prof. Dr. Madad Ali Shah Professor and Vice Chancellor,	Member

Sr#	NCRC Members	Role
	The Benazir Bhutto Shaheed University of Technology & Skill Development, Khairpur Mir's.	
6	Engr. Prof. Dr. Aftab Ahmad Professor and Dean, University of Engineering & Technology, Taxila	Member
7	Engr. Prof. Dr. Amjad Ullah Professor and Dean, University of Engineering & Technology, Peshawar	Member
8	Engr. Prof. Dr. Nisar Ahmed Professor, Ghulam Ishaq Khan Institute of Engineering Sciences & Technology, Topi, Swabi	Member
9	Engr. Prof. Dr. Muhammad Asghar Saqib Professor, University of Engineering & Technology, Lahore	Member
10	Engr. Prof. Dr. Muhammad Amir Professor, International Islamic University, Islamabad	Member
11	Engr. Prof. Dr. Syed Waqar Shah Professor and Chairman, University of Engineering & Technology, Peshawar	Member
12	Engr. Prof. Dr. Muhammad Iram Baig Professor and Chairman, University of Engineering & Technology, Taxila	Member
13	Engr. Dr. Gulzar Ahmad Associate Professor, University of Engineering & Technology, Peshawar	Member
14	Engr. Prof. Dr. Zahoor Baloch Professor, Baluchistan University of Engineering & Technology, Khuzdar	Member
15	Engr. Prof. Dr. Faizullah Khan Kakar Professor, Baluchistan University of Information Technology, Engineering and Management Sciences, Quetta	Member
16	Engr. Dr. Amjad Ali Associate Professor and Chairman, University of Engineering & Technology, Peshawar (Jalozai Campus)	Member
17	Engr. Dr. Yousaf Khan Associate Professor and Chairman, University of Engineering & Technology, Peshawar (Kohat Campus)	Member
18	Engr. Dr. Shahid Atiq Associate Professor and Chairman, Khawaja Fareed University of Engineering and IT Rahim Yar Khan	Member

Sr#	NCRC Members	Role
19	Engr. Dr. Adnan Yousaf Associate Professor and Chairman, Superior University, Lahore	Member
20	Engr. Dr. Javed Iqbal Associate Professor and HoD, Sarhad University of Science & Information Technology, Peshawar	Member
21	Engr. Dr. Tariqullah Jan Associate Professor, University of Engineering & Technology, Peshawar	Member
22	Engr. Dr. Abdul Rauf Bhatti Associate Professor and Chairman, Government College University, Faisalabad	Member
23	Engr. Dr. Muhammad Kamran Liaqat Bhatti Associate Professor and Chairman, NFC Institute of Engineering and Technology, Multan	Member
24	Engr. Dr. Muhammad Irfan Abid Associate Professor and HoD, Riphah College of Engineering, Faisalabad	Member
25	Engr. Dr. Raza Haider Associate Professor, Baluchistan University of Engineering & Technology, Khuzdar	Member
26	Engr. Dr. Ghulam Jawad Sirewal Assistant Professor and HoD, The Benazir Bhutto Shaheed University of Technology & Skill Development, Khairpur Mir's	Member
27	Engr. Dr. Sajjad Manzoor Assistant Professor and Director, Mirpur University of Science & Technology, AJ&K	Member
28	Mr. Hidayatullah Kasi Deputy Director, Academics Division, HEC, Pakistan	HEC Representative
29	Mr. Muhammad Fahd Amin, Acting Registrar, NTC, Pakistan	NTC Representative
30	Mr. Hafiz Ghulam Muhammad NTC, Pakistan	NTC Representative

5. After taking charge by the nominated Committee, Convenor, Engr. Prof. Dr. Syed Hassan Mujtaba chaired the meeting and emphasized to ensure the reflection of Sydney Accord in curriculum and course titles as well as to develop curriculum that provides a unified framework for offering degrees under the title of electrical engineering technology.

6. In continuation of above guidelines, Prof. Dr. Muhammad Amjad, Co-Convener, Prof. Dr. Ahmed Muddassir Khan, Secretary and Dr. Haider Ali, Co-Secretary highlighted the objectives of curriculum development.

7. Agreed upon objectives were categorized and assigned to Subcommittees, where Honorable Members reviewed, discussed, and submitted the following resolutions:

    - Develop an undergraduate curriculum of electrical engineering technology which is at par with international standards and in substantial conformity with the Sydney Accord.
    - Clearly define program education objectives (PEOs), course learning outcomes (CLOs) with Bloom's Taxonomy levels, and course contents aligned with program learning outcomes (PLOs).
    - Incorporate latest relevant reading materials/ references.
    - Ensure that course content that is uniform across other disciplines (HEC's Gen Ed requirements) is not duplicated.
    - Curriculum must be futuristic, and answer needs of society.

8. In next session, the house discussed the nomenclature of the discipline, preface, objectives of the programs, PLOs, methods of instruction and learning environment, assessment, and operational framework.

9. After long deliberation, 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 undergraduate 4-years program in electrical engineering technology.
10. Furthermore, list of courses (core and elective) and semester wise breakup of courses were also discussed thoroughly and finalized.

11. Admission/intake criteria were discussed and adopted same as defined in NTC Accreditation Manual.

12. Supervised industrial training (SIT) was discussed in detail. There was a consensus that SIT will be mandatory for 8th Semester.

13. Those HEI's that can provide only one semester of SIT (in 8^{th}), shall offer optional courses instead of SIT in the 7^{th} semester to cover credit hours and other requirements.

14. HEI's that are geared to provide SIT in two semesters can do this in 7^{th} and 8^{th} Semesters.

15. In line with the experience and expertise of NCRC members, list of courses in various domains were distributed among the Sub-Committees.

16. These Committees were assigned responsibility for reviewing course objectives, adding course learning outcomes, appropriate mapping with Bloom's Taxonomy and PLOs, updating list of contents, adding teaching-learning methods and assessment, and updating bibliography/ references/ suggested books.

17. The following Core Committee's, along with four Sub-Committees, were constituted with separate Convenors and Secretaries:

Electrical Engineering Technology Core Committee		
Sr#	**Name**	**Role**
1	Engr. Prof. Dr. Syed Hassan Mujtaba Jafri	Convenor
2	Engr. Prof. Dr. Muhammad Amjad	Co-convenor
3	Engr. Prof. Dr. Ahmed Muddassir Khan	Secretary
4	Engr. Dr. Haider Ali	Co-secretary
1. Sub-Committee: Computing, Humanities and Social Sciences Courses		
Sr#	**Name**	**Role**
1	Engr. Dr. Faizullah Khan Kakar	Convenor
2	Engr. Prof. Dr. Madad Ali Shah	Member
3	Engr. Prof. Dr. Zahoor Baloch	Member
4	Engr. Dr. Yousaf Khan	Member
5	Engr. Dr. Amjad Ali	Secretary
2. Sub-Committee: Electrical Engineering Technology Foundation Courses		
Sr#	**Name**	**Role**
1	Engr. Prof. Dr. Nisar Ahmed	Convenor
2	Engr. Prof. Dr. Amjad Ullah Khattak	Member
3	Engr. Prof. Dr. Muhammad Iram Baig	Member
4	Engr. Prof. Dr. Muhammad Amir	Member
5	Engr. Dr. Engr. Javed Iqbal	Secretary
3. Sub-Committee: Electrical Engineering Technology Core (Breadth) Courses		
1	Engr. Dr. Tariq Ullah Jan	Convenor
2	Engr. Prof. Dr. Aftab Ahmad	Member

3	Engr. Dr. Muhammad Irfan Abid	Member
4	Engr. Prof. Dr. Syed Waqar Shah	Member
5	Engr. Dr. Gulzar Ahmed	Member
6	Engr. Dr. Muhammad Asghar Saqib	Secretary

4. Sub-Committee: Electrical Engineering Technology Core (Depth) Courses

Sr#	Name	Role
1	Engr. Dr. Abdul Rauf Bhatti	Convenor
2	Engr. Dr. Adnan Yousaf	Member
3	Engr. Dr. M. Kamran Bhatti	Member
4	Engr. Dr. Shahid Atiq	Member
5	Engr. Dr. Raza Haider	Member
6	Engr. Dr. Sajjad Manzoor	Member
7	Engr. Dr Ghulam Jawad Sirewal	Secretary

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. Prof. Dr. Ahmed Muddassir Khan, Secretary NCRC, and distributed to Members for review.

20. Preliminary curriculum draft was submitted to NTC and sent to international reviewers.

APPENDIX E: Minutes of the Final Meeting of NCRC

1. The second meeting of the NCRC in the discipline of electrical engineering technology for the bachelor's degree program was held on 13-01-2022 to 15-01-2022 for 03 days at the University of Engineering & Technology, Taxila.

2. The inauguration session was started with recitation of Holy Quran, and chaired by Honorable Vice Chancellor UET, Taxila.

3. Engr. Imtiaz Hussain Gilani, Chairman NTC, joined the meeting online. He appreciated the efforts by Members, and highlighted their valuable contribution for the national cause in setting standards for quality-education in electrical engineering technology.

4. The Chair also extended his gratitude to the entire team and briefed the objectives and arrangements for the second NCRC.

5. Mr. Muhammad Fahd Amin, Acting Registrar, NTC with Mr. Hafiz Ghulam Muhammad represented NTC.

6. The following members attended the meeting:

Sr.	NCRC Members (Name, Designation and Affiliation)	Role
1	Engr. Prof. Dr. Syed Hassan Mujtaba Jafri Professor and Dean, Mirpur University of Science & Technology, AJ&K	Convener
2	Engr. Prof. Dr. Muhammad Amjad Professor and Dean, The Islamia University of Bahawalpur	Co-Convener
3	Engr. Prof. Dr. Ahmed Muddassir Khan Professor and Dean, Indus University, Karachi	Secretary
4	Engr. Dr. Haider Ali, Assistant Professor and HoD Shuhada-e-APS University of Technology Nowshera	Co-Secretary
5	Engr. Prof. Dr. Aftab Ahmad Professor and Dean, University of Engineering & Technology, Taxila	Member
6	Engr. Prof. Dr. Amjad Ullah Professor and Dean, University of Engineering & Technology, Peshawar	Member
7	Engr. Prof. Dr. Muhammad Asghar Saqib Professor, University of Engineering and Technology, Lahore	Member
8	Engr. Prof. Dr. Muhammad Amir Professor, International Islamic University, Islamabad	Member

Sr.	NCRC Members (Name, Designation and Affiliation)	Role
9	Engr. Prof. Dr. Syed Waqar Shah Professor and Chairman, University of Engineering & Technology, Peshawar	Member
10	Engr. Prof. Dr. Muhammad Iram Baig Professor and Chairman, University of Engineering & Technology, Taxila	Member
11	Engr. Dr. Gulzar Ahmad Associate Professor, University of Engineering & Technology, Peshawar	Member
12	Engr. Prof. Dr. Zahoor Baloch Professor, Baluchistan University of Engineering & Technology, Khuzdar	Member
13	Engr. Prof. Dr. Faizullah Khan Kakar Professor, Baluchistan University of Information Technology, Engineering and Management Sciences, Quetta	Member
14	Engr. Dr. Amjad Ali Associate Professor and Chairman, University of Engineering & Technology, Peshawar (Jalozai Campus)	Member
15	Engr. Dr. Yousaf Khan Associate Professor and Chairman, University of Engineering & Technology, Peshawar (Kohat Campus)	Member
16	Engr. Dr. Adnan Yousaf Associate Professor and Chairman, Superior University, Lahore	Member
17	Engr. Dr. Javed Iqbal Associate Professor and HoD, Sarhad University of Science & Information Technology, Peshawar	Member
18	Engr. Dr. Abdul Rauf Bhatti Associate Professor and Chairman, Government College University, Faisalabad	Member
19	Engr. Dr. Muhammad Irfan Abid Associate Professor and HoD, Riphah College of Engineering, Faisalabad	Member
20	Engr. Dr. Raza Haider Associate Professor, Baluchistan University of Engineering & Technology, Khuzdar	Member

7. After the introductory session, deliberations on the agenda of the second meeting formally commenced which was headed by Convener Engr. Prof. Dr. Syed Hassan Mujtaba Jafri, Co-Convener Engr. Prof. Dr. Muhammad Amjad, Secretary Engr. Prof. Dr. Ahmed Muddassir Khan and Co-Secretary Engr. Dr. Haider Ali.

8. Honorable Members were informed that valuable feedback was received from the following international experts:

Sr#	Foreign Expert Name	Affiliation
1	Engr. Dr. Danish Khan	Southern University of Science & Technology, China
2	Engr. Dr. Hassan Tanveer	Kennesaw State University, Georgia/Virginia Tech, USA
3	Engr. Dr. Sami Ahmed	Department of Computing, University of Worcester, UK
4	Engr. Dr. Saeed Ahmed	Korea Polytechnic University, Gyeonggi-do, South Korea
5	Engr. Dr. Imran Saleem	Siemens Germany

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

10. Their proposed suggestions are incorporated in the curriculum, particularly an additional course titled "Environment, Health and Safety" of 1 credit hour in 2nd Semester, as this has great importance in the field.

11. Various issues were thoroughly deliberated upon by Members of NCRC in Sub-Committees, and Honorable Members submitted the following resolutions:

    - Agreed upon 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 comparison with framework and list of Electives as defined earlier.
    - Approved the Semester-wise break-up of courses, credit hours allocations and Breadth and Depth courses.
    - Recommended sample course profiles and contents.
    - Recommend sample weekly lecture plan and laboratory work for Foundation and Breath courses.

12. The final draft was compiled by Secretary Engr. Prof. Dr. Ahmed Muddassir Khan and Co-Secretary Engr. Dr. Haider Ali.

13. After review by Members and with the approval of Convener Engr. Prof. Dr. Syed Hassan Mujtaba Jafri and Co-Convener Engr. Prof. Dr. Muhammad Amjad, it was submitted to NTC.

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.