

Curriculum
for
Bachelor of Science in
Electrical Engineering Technology
(2026)



Higher Education Commission
Islamabad
Curriculum Division

Acronyms and Abbreviations

Acronym/Abbreviation	Full Form
CLO	Course Learning Outcome
Cont. Hrs.	Contact Hours
CQI	Continuous Quality Improvement
Cr. Hrs.	Credit Hours
GA	Graduate Attributes
HEI	Higher Education Institution
IDS	Inter disciplinary Subject
IEA	International Engineering Alliance
IR 5.0	Industry Revolution 5.0
KPI	Key Performance Indicator
Lb/Lab	Laboratory
MOOCs	Massive Open Online Courses
NCRC	National Curriculum Review Committee
NTC	National Technology Council
OBE	Outcome Based Education
PEO	Program Educational Objective
PLO	Program Learning Outcome
SA	(Sydney Accord) Graduate Attribute
SDG	Sustainable Development Goal
SK	(Sydney Accord) Knowledge and Attitude Profile
SP	(Sydney Accord) Range of Problem Identification and Solving
TA	(Sydney Accord) Range of Engineering Activities
TC	(Sydney Accord) Professional Competence Profile
Th	Theory

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1. Preamble

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.

In this curriculum general education courses are adopted from HEC undergraduate education policy 2023, which ensures the 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 is providing the opportunity to cover the inter-disciplinary subject's knowledge, and entrepreneurial concepts to address the challenges in diverse cultural and societal issues.

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 with the essential attributes proved in IEA document and is in consonance with the essence of Sydney Accord related Knowledge & Attitude Profiles, Graduates Attributes, Professional Competence, Correlation among Profiles, Characteristics of Broadly-defined Engineering Problem and Activities (See Appendix A to E). Furthermore, to incorporation of Sustainable Development Goals (SDGs), Massive Open Online Courses (MOOCs), Mandatory Certification and emerging technologies (such as IR 5.0) in the curriculum for compliance the HEC Pakistan directives, guidelines are also provided (See Appendix F to I). 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 to E). Moreover, guidelines for incorporation of SDGs, MOOCs, Mandatory Certification and Emerging technologies (such as IR 5.0) are also included (See Appendix F to I) in compliance the directives of HEC, Pakistan.

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

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 Convener, a co-Convener, 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 then all member submits assigned course profiles.
- Then two online follow up meetings of preliminary meeting are conducted for further review.
- Then, 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 four 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 J]
- First Online Follow Up meeting of Preliminary NCRC meeting
- Second Online Follow Up meeting of Preliminary NCRC meeting
- Final Meeting of NCRC [See Appendix K]

2.4 Program Mission, Program Educational Objectives (PEOs) and Program Learning Outcomes (PLOs)

The following Program Mission Statement and Program Educational Objectives (PEOs) are suggested as a reference for Electrical Engineering Technology program. However, HEIs are encouraged to formulate their own Mission Statement and PEOs in consultation with their stakeholders, taking into account the program's mission, institutional context, industry needs, and societal expectations.

2.4.1 Suggested Program Mission

Electrical Engineering Technology program will provide a rigorous, hands-on, and student-centered education that bridges electrical theory and practical application. The program prepares diverse, career-ready graduates to design, test, troubleshoot, and maintain electrical systems. By fostering technical competence, ethical responsibility, and effective communication, graduates will be empowered to solve real-world industry problems, adapt to emerging technologies, and drive sustainable economic growth within their communities.

2.4.2 Suggested Program Educational Objectives (PEOs)

For an Electrical Engineering Technology program, the Program Educational Objectives (PEOs) describe the professional accomplishments and career progression that graduates are expected to achieve within a few years of graduation.

PEO 1: Graduates will demonstrate proficiency in applying contemporary engineering technology knowledge and modern tools to analyze, implement, operate, troubleshoot, and maintain electrical systems in professional practice.

PEO 2: Graduates will demonstrate professionalism through responsible conduct, sound judgment, effective collaboration, and adherence to quality, safety, and sustainability principles.

PEO 3: Graduates will pursue continuous professional development and adapt to emerging technologies and evolving industrial practices to enhance their technical competence.

2.4.3 Program Learning Outcomes (PLOs)

As per NTC Program Accreditation Policy and Procedures Manual (Revised 2023), Program Learning Outcomes (PLOs) are narrower statements describing what students are expected to know, and able to do, on graduation. These relate to knowledge, skills, and attitude that the students acquire during the program. The PLOs must demonstrate that graduates have attained a minimum, acceptable level of knowledge, skills, and behavioral traits, after completing the program. It is expected that graduates have acquired the following Graduate Attributes (PLOs are same SAs) according to the guidelines of International Engineering Alliance (IEA) guidelines for Engineering Technologist in Sydney Accord also provided in Appendix B.

Program Learning Outcomes (PLOs)	Graduate Attributes Profiles in Sydney Accord
PLO1: Engineering Technology Knowledge: Breadth, depth and type of knowledge, both theoretical and practical	SA1: Apply knowledge of mathematics, natural science, computing and engineering fundamentals and an engineering specialization as specified in SK1 to SK4 respectively to defined and applied engineering procedures, processes, systems or methodologies.
PLO2: Problem Analysis Complexity of analysis	SA2: Identify, formulate, research literature and analyze broadly-defined engineering problems reaching substantiated conclusions using analytical tools as appropriate to the discipline or area of specialization. (SK1 to SK4)
PLO3: Design/development of solutions: Breadth and uniqueness of engineering problems i.e., the extent to which problems are original and to which solutions have not previously been identified or codified	SA3: Design solutions for broadly-defined engineering technology problems and contribute to the design of systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required (SK5)
PLO4: Investigation: Breadth and depth of investigation and experimentation	SA4: Conduct investigations of broadly-defined engineering problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions (SK8)
PLO5: Tool Usage: Level of understanding of the appropriateness of technologies & tools	SA5: Select and apply, and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to broadly-defined engineering problems (SK2 and SK6)

PLO6: The Engineering Technologist and the World: Level of knowledge and responsibility for sustainable development	SA6: When solving broadly-defined engineering problems, analyze and evaluate sustainable development impacts* to: society, the economy, sustainability, health and safety, legal frameworks, and the environment (SK1, SK5, and SK7)
PLO7: Ethics: Understanding and level of practice	SA7: Understand and commit to professional ethics and norms of engineering technology practice including compliance with national and international laws. Demonstrate an understanding of the need for diversity and inclusion (SK9)
PLO8: Individual and Collaborative Team work: Role in and diversity of team	SA8: Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (SK9)
PLO9: Communication: Level of communication according to type of activities performed	SA9: Communicate effectively and inclusively on broadly-defined engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, taking into account cultural, language, and learning differences
PLO10: Project Management: Level of management required for differing types of activity	SA10: Apply knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.
PLO11: Lifelong learning: Duration and manner	SA11: Recognize the need for, and have the ability for i) independent and life-long learning and ii) critical thinking in the face of new specialized technologies (SK8)
<i>*Represented by the 17 UN Sustainable Development Goals (UN-SDG)</i>	

3. Curriculum Details

Bachelor of Electrical Engineering Technology Program			
Parameter	HEC Framework	Framework - A (SIT in 7 th & 8 th Semesters)	Framework - B (SIT in 8 th 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	44	45	50**
Engineering Technology Domain Courses	29	29	34**
General Education Domain Courses	15	16	16**
Total Credit Hours	132 (122 – 148)	139	139
Engineering Technology Domain Credit Hours	98	105	105
Percentage of Engineering Technology Domain Courses	74.24%	75.54%	75.54%
Non-Engineering Technology Domain Credit Hours	34	34	34
Percentage of Non-Engineering Technology Domain Courses	25.76%	24.46 %	24.46 %
No. of Credit Hours per Semester	15 – 21	16 – 19	16 – 19
** Optional Courses shall be included for Framework B (SIT in 8 th Semester only)			
1 credit hour: (1) For theory: 1 contact hour per week for a minimum of 16 weeks for theory. (2) For practical: 3 consecutive contact hours per week for a minimum of 16 weeks for practical.			

**General Education Domain Courses in
Proposed Schemes of Studies of Electrical Engineering Technology
As per NTC and HEC Framework 2026**

Courses Domain	Name of Courses	Credit Hours (Th+Lb)	Weekly Contact Hours (Th+Lb)	Total Credit Hours		Number of Courses	
				NCRC Proposed	NTC Framework	NCRC Proposed	NTC Framework
General Education	Arts and Humanities Elective	2+0=2	2+0=2	2	2	1	1
	Social Sciences Elective	2+0=2	2+0=2	2	2	1	1
	Applied Physics (Natural Sciences Elective)	2+1=3	2+3=5	3	3	1	1
	Functional English	3+0=3	3+0=3	3	3	1	1
	Technical Report Writing (Expository Reporting)	3+0=3	3+0=3	3	3	1	1
	Calculus and Analytical Geometry	2+0=2	2+0=2	2	6	3	2
	Differential Equations	2+0=2	2+0=2	2			
	Linear Algebra	2+0=2	2+0=2	2			
	Islamic Studies / Ethics	2+0=2	2+0=2	2	2	1	1
	Ideology and Constitution of Pakistan	2+0=2	2+0=2	2	2	1	1
	Pakistan Studies	2+0=2	2+0=2	2	2	1	1
	Entrepreneurship	2+0=2	2+0=2	2	2	1	1
	Application of ICT	2+1=3	2+3=5	3	3	1	1
	Understanding of the Holy Quran-I/ Fehm e Quran-I	0+1=1	0+3=3	1	2	2	1
	Understanding of the Holy Quran-II/ Fehm e Quran-II	0+1=1	0+3=3	1			
	Civics and Community Engagement	2+0 =2	2+0=2	2	2	1	1
	Total	30+4 = 34	30+12 = 42	34	34	17	15
		Cr Hrs	Cont. Hrs	Cr Hrs (NCRC)	Cr Hrs (NTC)	Courses (NCRC)	Courses (NTC)

Technology Domain Courses in Proposed Schemes of Studies Electrical Engineering Technology As per NTC and HEC Framework 2026							
Courses Domain	Name of Courses	Credit Hours (Th+Lb)	Weekly Contact Hours (Th+Lb)	Total Credit Hours		Number of Courses	
				NCRC Proposed	NTC Framework	NCRC Proposed	NTC Framework
Electrical Engineering Technology (Foundation)	Electrical Workshop Practice	0+2=6	0+2=6	14+10 = 24	14+7 = 21	10	7-10
	Computer Programing	2+1=3	2+3=5				
	Linear Circuit Analysis	2+1=3	2+3=5				
	Environment, Health, and Safety	1+0=1	1+0 =1				
	Electrical Network Analysis	2+1=3	2+3=5				
	Fundamentals of Signals and Systems	2+1=3	2+3=5				
	Technical Drawing and CAD	0+1=1	0+3=3				
	Electronic Devices and Circuits	2+1=3	2+3=5				
	Digital Logic Circuits and Applications	2+1=3	2+3=5				
	Embedded Systems	1+1=2	1+3=4				
Electrical Engineering Technology (Breadth)	Instrumentation and Measurements	2+1=3	2+3=5	8+4 =12	8+4 = 12	4	4-5
	Electrical Machines	2+1=3	2+3=5				
	Power Systems Transmission	2+1=3	2+3=5				
	Power Systems Distribution & Utilization	2+1=3	2+3=5				
Electrical Engineering Technology (Depth)	Control Technology	2+1=3	2+3=5	22+11 = 33**	14+7 = 21**	11	7-10
	Communication Systems	2+1=3	2+3=5				
	Power System Analysis	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				
IDS	IDS-I (Natural Sciences Elective)	2+1=3	2+3=5	11+3 = 14	12	6	Min 12 Cr Hrs
	IDS –II	2+1=3	2+3=5				
	IDS –III (Applications of Artificial Intelligence (AI))	2+1=3	2+3=5				
	IDS-IV	2+0=2	2+0=2				
	IDS -V (Management Sciences Elective-I)	2+0=2	2+0=2				
	IDS -VI** (Management Sciences Elective-II) (Quality Management and Reliability)	1+0=1	1+0=1				
Senior Design Project	Project Part-I	0+2=2	0+6=6	0+6 =6	6	2	2
	Project Part-II	0+4=4	0+12=12				
Training	**Supervised Industrial Training (8 th semester) Supervised Industrial Training (7th & 8 th semester)	0+16=16 0+32=32	0+40=40 0+40=40	16** 32			
Mandatory Certification	* Industry-relevant Certifications: Department shall accept credit hours for certifications subject to course mapping and approval from statutory university bodies as per HEC guidelines (for further details See Appendix –H)						
Total		55+50=105 44+61= 105*	55+142=197 44+167=211	105	105 105	28 33	29
		Cr Hrs	Cont. Hrs	Cr Hrs (NCRC)	Cr Hrs (NTC)	Courses (NCRC)	Courses (NTC)

Total Credit and Contact Hours Details with Ratio of Theory vs Lab							
Engineering COURSE SCHEME OPTIONS	General Education Courses Credit Hours (Th+Lb)	Major Courses Credit Hours (Th+Lb)	Total (GE+Maj) Credit Hours (Th+Lb)	Total (GE+Maj) Contact Hours (Th+Lb)	NTC Frame work Credit Hours (Th+Lb)	Proposed Total Courses	NTC Frame work Total Courses
Total Credit Hours and Courses (SIT in 8th semester only)	30+4 =34 30+12= 42	55+50 = 105 55 + 142 = 197	85+54 = 139 % (61.2 : 38.8)	85+154 =239 % (35.6 : 64.4)	124-148	51	
Total Credit Hours and Courses (SIT in 7th and 8th semesters)	30+4 =34 30+12= 42	44 + 61 = 105 44 + 167 = 211	74+65 = 139 % (53.2 : 46.8)	74+179 =253 % (29.2 : 70.8)	124-148	46	

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 **139 credit hours** is presented below, along with weekly contact hours for each course.

Proposed Course Scheme
BS Electrical Engineering Technology
4 Years, 8 Semesters, Total 139 Credit Hours

SEMESTER-I			
Course Title	Knowledge Area/Domain	Credit Hrs. (Th+Lb)	Contact Hrs. (Th+Lb)
Islamic Studies (Religious Education / Ethics for non-Muslim students)	General Education-I	2+0	2+0
Understanding of the Holy Quran – I (For Muslim Students/any other course for non-Muslim Students)	General Education-II	0+1	0+3
Applications of Information and Communication Technologies	General Education-III (Computing-I)	2+1	2+3
Civics and Community Engagement	General Education-IV	2+0	2+0
Applied Physics	General Education-V (Natural Science-I)	2+1	2+3
Calculus and Analytical Geometry	General Education-VI (Quantitative Reasoning-I)	2+0	2+0
Functional English	General Education-VII (English-I)	3+0	3+0
Electrical Workshop Practice	Major (Foundation-I)	0+2	0+6
Total Credits Hours and Contact Hours in 1st Semester		13+5 =18	13+15 =28
SEMESTER-II			
Course Title	Knowledge Area/Domain	Credit Hrs. (Th+Lb)	Contact Hrs. (Th+Lb)
Understanding of the Holy Quran – II (For Muslim Students/any other course for non-Muslim Students)	General Education-VIII	0+1	0+3
Linear Algebra	General Education –IX (Quantitative Reasoning-II)	2+0	2+0
Social Science Elective-I	General Education-X	2+0	2+0
Technical Report Writing	General Education-XI (Expository Writing)	3+0	3+0
Natural Science Elective	Inter-disciplinary Subject (IDS-I)	2+1	2+3
Computer Programming	Major (Foundation-II)	2+1	2+3
Linear Circuit Analysis	Major (Foundation-III)	2+1	2+3
Environment, Health and Safety	Major (Foundation-IV)	1+0	1+0
Total Credits Hours and Contact Hours in 2nd Semester		14+4 =18	14+12 =26

SEMESTER-III			
Course Title	Knowledge Area/Domain	Credit Hrs. (Th+Lb)	Contact Hrs. (Th+Lb)
Pakistan Studies	General Education-XII	2+0	2+0
Ideology and Constitution of Pakistan	General Education-XIII	2+0	2+0
Differential Equations	General Education-XIV (Quantitative Reasoning-III)	2+0	2+0
IDS- Elective	Inter-disciplinary Subject (IDS - II)	2+1	2+3
Fundamentals of Signals and Systems	Major (Foundation-V)	2+1	2+3
Technical Drawing and CAD	Major (Foundation-VI)	0+1	0+3
Electronic Devices and Circuits	Major (Foundation-VII)	2+1	2+3
Electrical Network Analysis	Major (Foundation-VIII)	2+1	2+3
Total Credits Hours and Contact Hours in 3rd Semester		14+5 =19	14+15 =29
SEMESTER-IV			
Course Title	Knowledge Area/Domain	Credit Hrs. (Th+Lb)	Contact Hrs. (Th+Lb)
Arts and Humanities Elective	General Education -XV (Arts & Humanities-I)	2+0	2+0
Entrepreneurship	General Education-XVI (Management Science)	2+0	2+0
IDS- Elective (Applications of Artificial Intelligence (AI))	Inter-disciplinary Subject (IDS - III)	2+1	2+3
IDS- Elective	Inter-disciplinary Subject (IDS - IV)	2+0	2+0
Digital Logic Circuits and Applications	Major (Foundation-IX)	2+1	2+3
Instrumentation and Measurements	Major (Breadth Core-I)	2+1	2+3
Electrical Machines	Major (Breadth Core-II)	2+1	2+3
Total Credits Hours and Contact Hours in 4th Semester		14+4 =18	14+12 =26



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SEMESTER-V			
Course Title	Knowledge Area/Domain	Credit Hrs. (Th+Lb)	Contact Hrs. (Th+Lb)
Embedded Systems	Major (Foundation-X)	1+1	1+3
Control Technology	Major (Depth Core-I)	2+1	2+3
Communication Systems	Major (Depth Core-II)	2+1	2+3
Power Systems Transmission	Major (Breadth Core-III)	2+1	2+3
Power Systems Distribution and Utilization	Major (Breadth Core-IV)	2+1	2+3
Capstone Project-I	Technology Domain Project	0+2	0+6
Total Credits Hours and Contact Hours in 5th Semester		9+7 =16	9+21 =30
SEMESTER-VI			
Course Title	Knowledge Area/Domain	Credit Hrs. (Th+Lb)	Contact Hrs. (Th+Lb)
Power System Analysis	Major (Depth Core-I)	2+1	2+3
Depth Elective-I	Major (Depth Core Elective-I)	2+1	2+3
Depth Elective-II	Major (Depth Core Elective-II)	2+1	2+3
Depth Elective-III	Major (Depth Core Elective-III)	2+1	2+3
Management Science Elective-I	Inter-disciplinary Subject (IDS - V)	2+0	2+0
Capstone Project-II	Technology Domain Project	0+4	0+12
Total Credits Hours and Contact Hours in 6th Semester		10+8 =18	10+24 =34



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SEMESTER-VII			
Course Title	Knowledge Area	Credit Hrs. (Th+Lb= Tot)	Contact Hrs. (Th+Lb= Tot)
Supervised Industrial Training (Optional)	Electrical Engineering Technology Domain Industrial Training	16	40
Depth Elective-IV	Major (Depth Core Elective-IV)	2+1	2+3
Depth Elective-V	Major (Depth Core Elective-V)	2+1	2+3
Depth Elective-VI	Major (Depth Core Elective-VI)	2+1	2+3
Depth Elective-VII	Major (Depth Core Elective-VII)	2+1	2+3
Depth Elective-VIII	Major (Depth Core Elective-VIII)	2+1	2+3
Management Science Elective-II (Quality Management and Reliability)	Inter-disciplinary Subject (IDS -VI)	1+0	2+0
Total Credits Hours and Contact Hours in 7th Semester		11+5=16	11+15 =26
SEMESTER-VIII			
Supervised Industrial Training (Compulsory)	Electrical Engineering Technology Domain Industrial Training	16	40
Total Credits Hours and Contact Hours in 8th Semester		0+16= 16	0+40= 40
Total Credit Hours & Contact Hours in Four Years (When Optional Courses will be conducted instead of SIT in 7 th semester)		85+54 = 139	85+154=239
Theory vs Practical (%) with respect to Credit Hours and Contact Hours		85 (61.2%) 54 (38.8%)	85 (35.6%) 154 (64.4%)
Total Credit Hours & Contact Hours in Four Years (When SIT will be conducted in both 7 th and 8 th Semester)		74+65 = 139	74+179 =253
Theory vs Practical (%) with respect to Credit Hours and Contact Hours		74 (53.2%) 65 (46.8%)	74 (29.2%) 179 (70.8%)
Notes	Guidelines		
Course Code	Course Codes of courses for proposed Course scheme will be followed by HEIs as per their approved policies. However, a general guideline is provided in section 6 , for prefixes (ABC) for course codes i.e. ABC-XXX on next page		
Elective Courses	List of Electives is provided in section 7 , the HEIs can choose Electives as per available resources.		
Mandatory Certification	Industry-relevant Certifications: Department shall accept credit hours for certifications subject to course mapping and approval from statutory university bodies as per HEC guidelines (for further details See Appendix –H)		

6. Course Codes

Course Codes prefix descriptions are described 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.)

Course Code Prefixes (ABC-XXX)		
Sr.	Course Code Prefix	Description
1	ELT-XXX	Electrical Engineering Technology Foundation/ Breadth/ Depth
2	ELE-XXX	Expository Writing
3	ELH-XXX	Art & Humanities
4	ELS-XXX	Social Sciences
5	ELQ-XXX	Quantitative Reasoning
6	ELN-XXX	Natural Sciences
7	ELC-XXX	Computing
8	ELM-XXX	Management Sciences
9	ELI-XXX	Inter Disciplinary Subject

7. Elective Courses

The lists of elective courses – grouped across depth core, general education and inter disciplinary categories are given below, showing credit hours' details.

Depth Core Electives		
(a) Power Systems		
Sr#	Course Title	Cr Hrs
1	Renewable Energy Technology	2+1
2	Electrical Safety	2+1
3	High Voltage Technology	2+1
4	Switchgear and Protective Devices Technology	2+1
5	Electrification Technology	2+1
6	Industrial Drive and PLC	2+1



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7	Power Generation Technology	2+1
8	Energy Conservation and Auditing	2+1
9	Power Electronics Technology	2+1
10	Any other Elective Approved by HEI	2+1
(b) Telecommunication		
1	Cloud Application Development and Operations	2+1
2	Computer Vision for Technologists	2+1
3	Cyber Security for Critical Infrastructures	2+1
4	Industrial Communication Systems	2+1
5	Smart Embedded and Automation System	2+1
6	Sensor Networks and IoT	2+1
7	Satellite and RADAR Communication	2+1
8	Robotics and Automation Technology	2+1
9	Predictive Maintenance Technologies	2+1
10	Any other Elective Approved by HEI	2+1
(c) Smart and Intelligent Systems		
1	AI Driven Industrial Automation	2+1
2	AI Integrated Electrical Systems	2+1
3	Data Analytics for Smart Energy System	2+1
4	Electric Vehicle Technology	2+1
5	Green Sustainable Engineering Technology	2+1
6	Unmanned Aerial Vehicle System	2+1
7	Machine Learning Applications in Power Systems	2+1
8	Robotics and Autonomous System Technology	2+1
9	Smart Grid Technology	2+1
10	Any other Elective Approved by HEI	2+1
General Education Electives		
(d) Social Science Electives		
Sr#	Course Title	Cr Hrs

1	Social Sciences	2+0
2	Applied Economics	2+0
3	Professional Ethics	2+0
4	Sociology	2+0
5	Psychology	2+0
6	Any other Elective Approved by HEI	2+0
(e) Arts and Humanities Electives		
Sr#	Course Title	Cr Hrs
1	Introduction to Foreign language and Culture	2+0
2	Philosophy	2+0
3	History	2+0
4	Creative Arts	2+0
5	Any other Elective Approved by HEI	2+0
Interdisciplinary Subjects Electives (6* x courses) <i>*IDS-III Application of Artificial Intelligence (2+1) is fixed</i>		
(f) Natural Sciences Elective (1 X Course)		
Sr#	Course Title	Cr Hrs
1	Applied Chemistry	2+1
2	Geology	2+1
3	Any other Elective Approved by HEI	2+1
(g) Management Science Elective (2 X Course)		
Sr#	Course Title	Cr Hrs
1	Project Management	2+0
2	Quality Management and Reliability	1+0
3	Any other Elective Approved by HEI	2+0



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		1+0
(h) Inter-disciplinary Subjects (2x Courses)		
Sr#	Course Title	Cr Hrs
1	Applications of Industry Revolution 5.0	2+1
2	IDS from Electronics Engineering Technology	2+1
3	IDS from Computing Engineering Technology	2+1
4	IDS from Civil Engineering Technology	2+1
5	IDS from Mechanical Engineering Technology	2+1
6	Any other Elective Approved by HEI	2+1

8. Course Contents

8.1 Calculus and Analytical

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
Calculus and Analytical		(2+0)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:
SK1 (Natural Sciences) SK2 (Mathematics and Analysis) SK3 (Engineering Fundamentals)		SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues)	TA1 (Range of Resources) TA2 (Level of Interactions) TA5 (Familiarity)
Sustainable Development Goals (SDGs)		Professional Competence Profile	
		TC-1 (Comprehend and Apply Universal Knowledge) TC-3 (Problem Analysis) TC-5 (Evaluation) TC-10 (Communication and Collaboration)	
Course Objective			
The objective of this course is to develop understanding of calculus, analytical geometry, vector analysis, and multivariable functions for solving engineering technology problems.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand the concepts of differentiation, integration, vectors, and multivariable functions used in engineering technology applications.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze functions and solve engineering technology problems using differentiation and applications of derivatives.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Apply integration techniques and vector operations to solve geometrical and engineering technology-related problems.	C3 (Cognitive) Apply	PLO-3 / SA3 (Design and Development of Solutions)
Course Outline for Theory			
• Differential Calculus: Basic definition of derivative, differentiation of algebraic, trigonometric, exponential, and logarithmic functions, rules of differentiation, chain rule, and implicit			

differentiation.

- Applications of Derivatives: Slope of curve, equation of tangent and normal, maxima and minima, point of inflection, and engineering applications of derivatives.
- Integral Calculus: Indefinite integration and techniques of integration including integration by parts, substitution, partial fractions, and trigonometric identities.
- Definite Integrals and Applications: Area under the curve, area between curves, mean value theorem, volume by slicing, volume of solid revolution using Disk and Washer methods, moment and center of mass.
- Vector Algebra and Analytical Geometry: Vectors in plane and space, dot product, cross product, line and plane in space, angle between vectors, area of triangle and parallelogram.
- Vector Calculus and Multivariable Functions: Vector fields, divergence, curl, directional derivatives, partial derivatives, multivariable functions, polar, cylindrical, and spherical coordinates

Lab Work Outline for Practical

NA

RECOMMENDED BOOKS

1. H. Anton, I. C. Bivens, S. Davis, Calculus, Early Transcendentals, (Latest Edition), John Wiley, New York,
2. James Stewart, Essential Calculus, (Latest Edition).
3. G. B. Thomas and A. R. Finney, Calculus, (Latest Edition), Pearson, USA,
4. S. M. Yousaf, Calculus and Analytic Geometry (Latest Edition).
5. Erwin Kreyszig, Advanced Engineering Mathematics, (Latest Edition), Wiley

8.2 Functional English

COURSE TITLE		CREDITS HOURS:	PRE-REQUISITE
Functional English		(3+0)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK7 (Communication and Society) SK8 (Critical Thinking and Literature) SK9 (Professional Practice)		SP2 (Range of Conflicting Requirements) SP4 (Familiarity of Issues)	TA2 (Level of Interactions) TA5 (Familiarity)
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
		TC-7 (Legal, regulatory, and cultural) TC-8 (Ethics) TC-10 (Communication and Collaboration)	
Course Objective			
The objective of this course is to develop effective communication, professional writing, listening, speaking, and interpersonal skills for academic and professional environments.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Demonstrate awareness of effective communication practices, grammatical accuracy, listening skills, and professional behavior in academic and social interactions.	A2 (Affective) Responding	PLO-9 / SA9 (Communication)
CLO-2	Organize and present ideas effectively through written, oral, and interpersonal communication using appropriate language, tone, and communication strategies.	A4 (Affective) Organization	PLO-9 / SA9 (Communication)
CLO-3	Demonstrate confidence and professionalism in public speaking, presentations, teamwork, and cross-cultural communication activities.	A5 (Affective) Characterization	PLO-8 / SA8 (Individual and Collaborative Teamwork)
Course Outline for Theory			
- Foundations of Functional English: Communicative grammar including subject-verb agreement, verb tenses, fragments, run-ons, modifiers, articles, and word classes. - Word Formation and Sentence Structure: Affixation, compounding, clipping, back formation, simple, compound, complex, and compound-complex sentences.			

- Pronunciation and Listening Skills: Sound production, pronunciation, active listening, overcoming listening barriers, and focused listening.
- Comprehension and Analysis: Understanding audience, purpose, and context, contextual interpretation, reading strategies including skimming, scanning, SQ4R, and critical reading.
- Effective Communication: Principles of communication including clarity, coherence, conciseness, courteousness, and correctness.
- Professional and Informal Communication: Structuring documents, inclusivity in communication, public speaking, presentation skills, networking, conversational skills, business emails, memos, reports, and formal letters.

Lab Work Outline for Practical

- N/A

RECOMMENDED BOOKS

1. Understanding and Using English Grammar by Betty Schramper Azar. (Latest Edition).
2. English Grammar in Use by Raymond Murphy. (Latest Edition).
3. English for Specific Purposes: A Learning-Centered Approach by Tom Hutchinson and Alan Waters. (Latest Edition).
4. Cambridge English for Job-Hunting by Colm Downes. (Latest Edition).
5. Practical English Usage by Michael Swan. (Latest Edition).
6. Improving Reading: Strategies, Resources, and Common Core Connections by Jerry Johns and Susan Lenski. (Latest Edition).
7. Comprehension: A Paradigm for Cognition by Walter Kintsch. (Latest Edition).
8. Communication Skills for Business Professionals by J. P. Verma and Meenakshi Raman. (Latest Edition).

8.3 Applications of ICT

COURSE TITLE:		CREDIT HOURS	PRE-REQUISITE
Applications of ICT		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK2 (Technology Concepts and Operational Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirements) SP4 (Familiarity of Issues)	TA1 (Range of Resources) TA2 (Level of Interaction) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSSIONAL COMPETENCE PROFILE	
		TC-1 (Comprehend & apply universal knowledge) TC-2 (Comprehend & apply local knowledge) TC-4 (Design and Development) TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to provide fundamental understanding and practical exposure to Information and Communication Technologies (ICT), including computer systems, networking, internet technologies, cloud computing, digital communication tools, and cyber security practices. The course also develops practical skills in office automation, online collaboration, data management, and ICT-based problem solving for engineering technology applications.			
CLO	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcom es (PLO)
CLO-1	Explain the fundamentals of Information and Communication Technologies, computer systems, networking concepts, and internet technologies.	C2 (Understanding)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply office automation tools, internet applications, cloud services, and digital communication platforms for academic and professional tasks.	C3 (Apply)	PLO3 / SA3 (Design/ Development of Solutions)
CLO-3	Analyze data communication methods, networking models, cybersecurity threats, and safe ICT practices in engineering environments.	C4 (Analysis)	PLO2 / SA2 (Problem Analysis)
CLO-4	Use ICT tools including word processing, spreadsheets, presentations, databases, and online collaboration platforms for technical applications.	P3 (Guided Response)	PLO5 / SA5 (Tool Usage)
CLO-5	Develop ICT-based solutions using cloud platforms, multimedia tools, and communication technologies for real-world applications.	P5 (Mechanism)	PLO4 / SA4 (Investigation)

CLO-6	Demonstrate teamwork, ethical ICT usage, digital responsibility, and effective communication during ICT-based projects and presentations.	A3 (Valuing)	PLO8 / SA8 (Ethics)
Course Outline for Theory			
• Introduction to Information and Communication Technologies (ICT), evolution of ICT, components of ICT systems, applications in education, industry, healthcare, and engineering technology • Fundamentals of computer systems including hardware, software, operating systems, storage devices, and input/output peripherals • Number systems, data representation, binary and digital information concepts relevant to ICT systems • Computer networks, communication models, LAN, WAN, internet architecture, networking devices, and wireless communication technologies • Internet technologies including web browsers, search engines, web services, email systems, FTP, VoIP, and online communication platforms • Office automation systems including word processing, spreadsheets, databases, presentation tools, and document management systems • Cloud computing concepts, cloud services, online storage, collaborative platforms, and virtualization technologies • Digital communication tools, video conferencing systems, virtual classrooms, social media platforms, and online collaboration technologies • Fundamentals of databases, data management systems, data security, and information storage techniques • Cybersecurity concepts including malware, phishing, firewalls, encryption, authentication, digital ethics, and safe internet practices • Emerging ICT technologies including Internet of Things (IoT), Artificial Intelligence applications, Big Data, smart systems, and Industry 4.0 concepts • ICT applications in engineering technology including smart communication systems, automation, e-learning systems, e-governance, and industrial information systems			
Lab Work Outline for Practical			
• Introduction to computer systems, operating system environment, file management, installation and configuration of basic software applications • Hands-on practice of word processing tools including document formatting, technical report writing, tables, references, and templates • Spreadsheet applications including formulas, functions, charts, data analysis, and engineering calculations using spreadsheet software • Development of multimedia presentations using presentation software for technical communication and project demonstrations • Internet applications including advanced web search, email configuration, cloud storage usage, and online communication tools • Practical implementation of online collaboration tools including shared documents, online meetings, virtual classrooms, and project management platforms • Basic networking experiments including IP configuration, network device identification, LAN setup, internet connectivity testing, and troubleshooting • Database management exercises including creation of tables, forms, queries, and reports using database software • Cybersecurity awareness practices include password management, antivirus tools, firewall configuration, phishing identification, and safe browsing techniques • Cloud computing applications including online storage systems, collaborative platforms, and			

cloud-based productivity tools

- Practical use of multimedia and communication tools for audio/video conferencing, webinars, and digital content sharing
- Mini project involving ICT-based problem solving such as smart information systems, online survey systems, digital communication platforms, or cloud-based applications Industrial or institutional visit to ICT infrastructure facilities, networking centers, software houses, or telecommunication organizations followed by technical report writing and presentation

RECOMMENDED BOOKS

1. Introduction to Information Technology by ITL Education Solutions Limited, Pearson Education (Latest Edition)
2. Using Information Technology: A Practical Introduction to Computers and Communications by Brian K. Williams and Stacey C. Sawyer, McGraw Hill (Latest Edition)
3. Data and Computer Communications by William Stallings, Pearson Education (Latest Edition)
4. Computer Networks by Andrew S. Tanenbaum and David J. Wetherall, Pearson (Latest Edition)
Information and Communication Technology in Organizations by Angela D. Benson and Niki Davis, Springer (Latest Edition)

8.4 Civics and Community Engagement

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
Civics and Community Engagement		(2+0)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK7 (Communication and Society) SK8 (Critical Thinking and Literature) SK9 (Professional Practice)		SP2 (Range of Conflicting Requirements) SP4 (Familiarity of Issues)	TA2 (Level of Interactions) TA5 (Familiarity)
Sustainable Development Goals (SDGs):			Professional Competence Profile
SDG16- Peace, Justice and Strong Institutions			TC-7 (Communication) TC-8 (Professional Accountability) TC-10 (Communication and Collaboration)
Course Objective			
The objective of this course is to develop civic awareness, social responsibility, ethical behavior, and community engagement skills for active participation in society.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Demonstrate awareness of civic responsibilities, citizenship values, social justice, ethical behavior, and community participation in personal and professional life.	A2 (Affective) Responding	PLO-6 / SA6 (The Engineering Technologist and the World)
CLO-2	Organize and participate in community engagement, advocacy, digital citizenship, and social interaction activities with respect for diversity and inclusion.	A4 (Affective) Organization	PLO-8 / SA8 (Individual and Collaborative Teamwork)
Course Outline for Theory			
- Civics and Citizenship: Concepts of civics, citizenship, civic engagement, foundations of modern society, active and digital citizenship. - State, Government and Civil Society: Relationship between democracy and civil society, right to vote, political participation and representation. - Rights and Responsibilities: Fundamental rights and liberties under Constitution of Pakistan 1973, civic responsibilities, ethical considerations in civic engagement. - Community Engagement: Community development, social cohesion, and case studies of successful community-driven initiatives. - Advocacy and Activism: Role of advocacy in addressing social issues and understanding social			

action movements.

- Digital Citizenship and Technology: Cyber ethics, responsible use of social media, digital divide and its impact on citizenship.
- Diversity, Inclusion and Social Justice: Understanding diversity in society and addressing social inequalities and injustices in Pakistan.

Lab Work Outline for Practical

N/A

RECOMMENDED BOOKS

1. Citizenship in Diverse Societies by Will Kymlicka and Wayne Norman. (Latest Edition),
2. Digital Citizenship in Action: Empowering Students to Engage in Online Communities by Kristen Mattson. (Latest Edition),
3. Globalization and Citizenship: In the Pursuit of a Cosmopolitan Education by Graham Pike and David Selby. (Latest Edition),
4. Community Engagement: Principles, Strategies, and Practices by Becky J. Feldpausch and Susan M. Omilian. (Latest Edition),
5. Creating Social Change: A Blueprint for a Better World by Matthew Clarke and Marie-Monique Steckel. (Latest Edition),

8.5 Applied Physics

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE	
Applied Physics		2+1	None	
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING ACTIVITIES:	
SK1 (Natural Sciences) SK2 (Mathematics and Analysis) SK3 (Engineering Fundamentals)		SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues)	TA1 (Range of Resources) TA2 (Level of Interactions) TA5 (Familiarity)	
Sustainable Development Goals (SDGs):			Professional Competence Profile:	
			TC-1 (Comprehend and Apply Universal Knowledge) TC-3 (Problem Analysis) TC-5 (Evaluation) TC-10 (Communication and Collaboration)	
Course Objective				
After completion of this course students will be able to understand the fundamental concepts of electricity, magnetism, electromagnetic induction, and their applications in engineering technology.				
Course Learning Outcomes	CLOs Statement		Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand electric charge, electric field, electric potential, capacitance, and their engineering applications.		C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze electric circuits, current, resistance, magnetic fields, and electromagnetic laws using fundamental physics principles.		C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Perform experiments related to electrical and magnetic phenomena using laboratory instruments and interpret the obtained results.		P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
Course Outline for Theory				
- Electrostatics: Electric charge, conductors and insulators, Coulomb’s law, electric field, electric dipole, electric flux, permittivity, Gauss’s law and applications. - Electric Potential and Capacitors: Electric potential, potential due to charges and dipoles, capacitors, capacitance, capacitors in series and parallel, applications of capacitors. - Electric Current and Resistance: Electric current, current density, resistance, resistivity, Ohm’s law, resistors in series and parallel, factors affecting resistance, applications of resistors. - Magnetism and Electromagnetism: Magnetic field, force on current carrying conductor, torque on				

current loop, Biot-Savart law, Ampere's law and applications.

- Electromagnetic Induction and Magnetic Materials: Inductance, Faraday's law, Lenz's law, self and mutual induction, magnetic materials including diamagnetic, paramagnetic and ferromagnetic materials.

Lab Work Outline for Practical

- 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 using Wheatstone 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's law.
- Practical demonstration of Faraday's law.
- To demonstrate the operation of step-up and step-down transformers.

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. Jewett Jr., Physics for Scientists and Engineers with Modern Physics (Latest Edition)
4. Fundamentals of Electromagnetic Phenomenon by D. Corson & Lorrain (Latest Edition)

8.6 Islamic Studies

COURSE TITLE		CREDITS HOURS:	PRE-REQUISITE
Islamic Studies		2+0	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING ACTIVITIES:
SK7 (Communication and Society) SK8 (Ethics, Society and Professional Responsibility) SK9 (Humanities and Social Sciences)		SP2 (Range of Conflicting Requirements) SP4 (Familiarity of Issues) SP5 (Extent of Applicable Standards and Social Considerations)	TA2 (Level of Interactions) TA5 (Familiarity) TA6 (Social and Ethical Responsibilities)
Sustainable Development Goals (SDGs):			Professional Competence Profile:
SDG10- Reduced Inequalities, SDG16- Peace, Justice and Strong Institutions			TC-6 (Protection of Society) TC-8 (Ethics and Professional Responsibility) TC-10 (Communication and Collaboration) TC-12 (Lifelong Learning and Professional Development)
Course Objective			
The objective of this course is to develop understanding of Islamic teachings, ethics, civilization, human rights, and their applications in personal, social, and professional life.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Demonstrate appreciation of the fundamental beliefs, worship practices, and teachings of Islam in personal, academic, and social life	A2 (Affective) Responding	PLO-7 / SA7 (Ethics)
CLO-2	Organize and advocate Islamic values related to human rights, peace, tolerance, social harmony, and responsible citizenship while interacting with diverse communities.	A4 (Organization)	PLO-9 / SA9 (Communication)
CLO-3	Internalize and exhibit ethical conduct, teamwork, accountability, and professional behavior inspired by the Seerah of the Holy Prophet Muhammad ﷺ and Islamic civilization.	A5 (Characterization)	PLO-8 / SA8 (Individual and Collaborative Teamwork)
Course Outline for Theory			
History of Islam: Compilation of the Holy Quran and Hadith, fundamental doctrines of Islam			

including Tawheed, Prophethood, revealed books, Day of Judgment, and philosophy of worship.

- Islamic Worships (Ibaadaat): Namaz, Zakat, Hajj, Sawm, importance and objectives of worship in Islam.
- Preaching of Islam: Importance, needs, effects, difficulties in preaching Islam, sectarianism, its causes and effects in Muslim society.
- Human Rights in Islam: Definition, classification, and importance of rights, Khutba Hajjatul Wida (Last Sermon of Holy Prophet ﷺ), and Hoqooq-ul-Ibad.
- Seerat-un-Nabi (Peace Be Upon Him): Life of Holy Prophet Muhammad ﷺ before and after Prophethood, Hijrah to Madinah, Treaty of Madinah, Makki and Madani life.
- Islam and Civilization: Definition of civilization, impacts of Islamic civilization on the Subcontinent and the world, ethical, social, and humanistic effects.
- Peace and Society: Importance of peace, causes of terrorism, role of Islam in promoting peace, tolerance, and harmony.
- Knowledge and Islam: Definition and classification of knowledge, importance of technology in the light of Quran and Sunnah, relevant Quranic verses regarding knowledge and technology, relationship between Islamic and scientific knowledge.

Lab Work Outline for Practical

NA

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. Islamiyat by Prof. Dr. Arif Naseem (Latest Edition)

8.7 Fehm e Quran I

COURSE TITLE:	CREDITS HOURS:	PRE-REQUISITE	
Fehm-e-Quran I	(0+1)	None	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING ACTIVITIES:	
SK1 (Natural Sciences/ Social sciences) SK2 (Conceptually based Mathematics)			
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
SDG10- Reduced Inequalities, SDG16- Peace, Justice and Strong Institutions		TC-1(comprehend and apply universal knowledge), TC-8 (Ethics), TC-11 (CPD and lifelong learning)	
Course Objective			
This course, Understanding of Qur’an, is designed to equip students with the essential skills to comprehend the Qur’an directly in its original Arabic. In line with HEC instructions, this course is mandatory at BS, MS, and PhD levels across all disciplines in Pakistani universities to ensure Qur’anic understanding as part of higher education. The course introduces learners to the Muallim-ul-Qur’an System developed by Dr. Ubaid-ur- Rehman Bashir, a structured and progressive method that enables comprehension of the Qur’an without prior grammar study. Instead of heavy grammatical rules, students learn through direct translation, vocabulary recognition, and step-by-step practice, making the method easy, accessible, and effective. Supported by core textbooks, multimedia resources, and guided exercises, the course gradually develops the capacity to understand Qur’anic verses without reliance on translations. Alongside linguistic and analytical skills, it nurtures spiritual reflection, ethical awareness, and practical application, empowering learners to integrate Qur’anic principles into their academic, professional, and personal lives, while also engaging meaningfully in interfaith dialogue and community development.			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Identify key Qur’anic vocabulary, pronouns, and basic sentence structures from Units 1–6 of Muallim-ul-Qur’an.	C2 (Cognitive) Understand	PLO7 / SA7 (Ethics)
CLO-2	Complete Assigned tasks with active individual participation and effective contribution towards teams’ assignments.	A2 (Affective) Responding	PLO8 / SA8 (Individual and Collaborative teamwork)
CLO-3	Apply acquired vocabulary and structural knowledge to translate Qur’anic words, phrases, and simple present-tense sentences directly from the text.	C3 (Cognitive) Application	PLO-11/ SA 11 (Lifelong learning)
Course Outline for Theory			

- Introduction to Arabic Linguistic Rules
 - Proper Nouns: Masculine and Feminine
 - Common Nouns and Types of Plurals
 - Coordinating Particle “و” (And)
 - Demonstrative Nouns for Masculine and Feminine (تلك ذلك، هذه، هذا)
 - Laam for Emphasis (التأكيد لام)
 - Superlative Degree in Arabic Grammar
 - Emphatic Particle (إن) and Its Usage
- Prepositions Arabic (إلى، من، في، على، الباء ·)
- Negation in Arabic Grammar (النافية ما النافية، لا)
 - Exceptive Particle (إلا)
 - Subordinating Conjunction (أن)
 - Introduction to the Verb “Kana” (كان)
 - Vocative Particles (النداء حروف)
 - Translation and Interpretation of Quranic Words and Sentences
 - Sentence Structure and Basic Quranic Grammar
 - Revision of Linguistic Concepts and Practical Exercises

RECOMMENDED BOOKS

Course Book:

- Dr. Ubaid-ur-Rehman, Muallim-ul-Qur’an, Volumes I-III (**Latest Edition**),

Reference Material:

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

8.8 Electrical Workshop Practice

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
Electrical Workshop Practice		(0+2)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF BROADLY DEFINED ACTIVITIES:
SK4 (Engineering Technology Specialized Knowledge)		SP1 (Depth of Knowledge Required) SP4 (Familiar Problems Solution)	TA1 TA4 TA5
Sustainable Development Goals (SDGs)			Professional Competence Profile:
			TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-10 (Communication & Collaboration)
Course Objective			
After completion of this course, students will be able to develop fundamental workshop skills required in Electrical Engineering Technology. The course emphasizes safe handling of tools, electrical wiring practices, soldering, fabrication, measurements, troubleshooting and practical implementation of basic electrical systems commonly used in industry.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Identify and safely use common electrical workshop tools, equipment and measuring instruments.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Perform basic electrical wiring, cable termination, jointing and installation practices according to standards.	P3 (Psychomotor) Precision	PLO-3 / SA3 (Design & Development of Solutions)
CLO-3	Construct and test simple electrical circuits using workshop tools and measuring instruments.	P4 (Psychomotor) Articulation	PLO-4 / SA4 (Investigation)
CLO-4	Follow workshop rules, safety regulations and environmental protection procedures.	A2 (Affective) Respond	PLO-7 / SA7 (Ethics)
Course Outline for Practical			

- Familiarization with workshop safety procedures.
- Identification of electrical hand tools and measuring instruments.
- Measurement of voltage, current and resistance using a digital multimeter.
- Wire stripping, jointing and cable termination.
- Conduit and surface wiring practice.
- Soldering and de-soldering of electronic components.
- Construction of simple series and parallel circuits.
- Wiring of lamp holder and switch circuits.
- Wiring of staircase/two-way switching circuit.
- Testing of continuity and insulation resistance.
- Fault diagnosis and troubleshooting exercises.
- Earthing and grounding demonstration.
- Industrial wiring standards demonstration.
- **Industry 5.0:** Introduction to smart electrical tools, digital measuring instruments and modern industrial workshop practices.
- Semester Project.

RECOMMENDED BOOKS

1. Stephen Herman, *Industrial Motor Control*, Latest Edition.
2. Frank Petruzella, *Electric Motor Control*, Latest Edition.
3. Herbert Richter & W. Schwan, *Practical Electrical Wiring*, Latest Edition.
4. Trevor Linsley, *Basic Electrical Installation Work*, Latest Edition.
5. Brian Scaddan, *Electrical Installation Work*, Latest Edition.

8.9 Linear Algebra

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
Linear Algebra		(2+0)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING ACTIVITIES:	
SK1 (Natural Sciences) SK2 (Mathematics and Analysis) SK3 (Engineering	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues)	TA1 (Range of Resources) TA2 (Level of Interactions) TA5 (Familiarity)	
Sustainable Development Goals (SDGs):		Professional Competence Profile	
		TC-1 (Comprehend and Apply Universal Knowledge) TC-3 (Problem Analysis) TC-5 (Evaluation) TC-10 (Communication and Collaboration)	
Course Objective			
The objective of this course is to develop understanding of matrices, linear systems, vector spaces, and linear transformations for solving engineering technology problems.			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand matrices, vector equations, linear systems, and linear transformations used in engineering technology applications.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze and solve systems of linear equations using matrix operations and elimination methods.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Apply determinants, inverse matrices, and linear transformations to solve engineering technology and real-life problems.	C3 (Cognitive) Apply	PLO-3 / SA3 (Design and Development of Solutions)
Course Outline for Theory			
- System of Linear Equations: System of linear equations, row reduction, echelon forms, vector equations, matrix equation $Ax=b$, solution sets of linear systems, and applications of linear systems. - Matrices and Matrix Operations: Concept and types of matrices, matrix addition, subtraction, multiplication, properties of matrix operations, elementary row operations, and echelon forms. - Methods for Solving Linear Systems: Gauss elimination method, consistent and inconsistent systems, polynomial interpolation, inverse of matrix using Gauss-Jordan method. - Determinants and Applications: Definition and properties of determinants, singular and non-			

singular matrices, solution of non-homogeneous linear systems using Cramer's rule.

Linear Transformations and Applications: Introduction to linear transformations, applications in cryptography, coding and decoding of messages, and computer graphics.

Lab Work Outline for Practical

NA

RECOMMENDED BOOKS

1. *Introductory Linear Algebra by Bernard Kolman (Latest Edition)*
2. *Advanced Engineering Mathematics by Erwin Kreyszig, Wiley (Latest Edition)*
3. *D. C. Lay, S. R. Lay, J. J. McDonald, Linear Algebra and Its Applications Pearson Education, (Latest Edition)*
4. *Linear Algebra and its Applications by Gilbert Strang, (Latest Edition)*

8.10 Technical Report Writing

COURSE TITLE		CREDITS HOURS:	PRE-REQUISITE
Technical Report Writing		(3+0)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:
SK7 (Communication and Society) SK8 (Critical Thinking and Literature) SK9 (Professional Practice)		SP2 (Range of Conflicting Requirements) SP4 (Familiarity of Issues) SP5 (Extent of Applicable Codes)	TA1 (Range of Resources) TA2 (Level of Interactions) TA5 (Familiarity)
Sustainable Development Goals (SDGs):			Professional Competence Profile
			TC-8 (Ethic) TC-10 (Communication and Collaboration)
Course Objective			
The objective of this course is to develop professional technical writing, research, and communication skills for engineering technology applications.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Demonstrate awareness of technical writing principles, professional communication practices, research ethics, and documentation standards in engineering technology.	A2 (Affective) Responding	PLO-9 / SA9 (Communication)
CLO-2	Prepare and present professional technical reports, proposals, correspondence, and research documentation using appropriate technical writing formats and communication practices.	A4 (Affective) Organization	PLO-8 / SA8 (Individual and Collaborative Team Work)
Course Outline for Theory			
• Introduction to Technical Writing: Introduction to technical writing and technical communication process. • Proposal Writing and Research: Proposal write-up, improvement strategies, introduction to research and research types, choosing research problems and research advisors, and methods of conducting research. • Technical Report Components: Different parts of technical writing including problem statement, literature review, methodology, data analysis, interpretation, and conclusions. • Writing Techniques: Good writing style techniques, use of correct words, grammar, clarity,			

coherence, and formatting of technical documents.

- Research Communication: Presenting and publishing research, technical presentations, and documentation standards.
- Professional Correspondence: Business and professional correspondence, cover letter, CV writing, meeting minutes, informal writing, and informal reports.

Lab Work Outline for Practical

NA

RECOMMENDED BOOKS

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

8.11 Applied Chemistry

COURSE TITLE:	CREDITS HOURS:	PRE-REQUISITE	
Applied Chemistry	(2+0)	None	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING ACTIVITIES:	
SK1 (Systematic theory based) SK3 (Engineering Fundamentals)			
Sustainable Development Goals (SDGs):		Professional Competence Profile	
		TC-1 (Comprehend & apply universal knowledge), TC-6 (Protection of Society) TC-10 (Communication & Collaboration) TC-11(CPD and Life Long Learning)	
Course Objective			
This Engineering Chemistry course is designed to provide students with fundamental knowledge of chemistry and its applications in civil engineering technology. The course develops students’ understanding of chemical processes, thermodynamic principles, and physico-chemical properties of engineering materials and water systems. It also enables students to analyze water quality parameters and apply chemical concepts in solving engineering and environmental problems related to civil engineering practice.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: To apply knowledge of chemistry in various industrial processes for civil engineering materials.	C3 (Cognitive) Apply	PLO1 / SA1 (Engineering Knowledge)
CLO-2	Explain thermodynamic and physico-chemical properties of water for water quality analysis.	C2 (Cognitive) Understand	PLO2/ SA2 (Problem Analysis)
CLO-3	Perform experiments and carry out calculations to determine conductivity, boiling point, PH, concentration, etc.	P2 (Psychomotor) Imitate	PLO4/SA4 (Investigation)
Course Outline for Theory			

1. Introduction: Periodic table, Atoms and molecule's structure, Introduction to chemical equation and calculations, Types of Chemical Reactions, Basic concept of Chemical bonding and Intra-molecular forces.
2. Properties of Gas & Liquids: Gas Laws, Kinetic gas equation, Surface Tension, Viscosity, Osmosis, Osmotic Pressure, pH-Buffer solution, Spectrophotometer, Basic concepts of Colloidal Chemistry.
3. Chemistry of Construction Materials:
Cement Raw materials, manufacturing process, composition, and Bogue's compounds. The chemistry of setting, hardening, and hydration process. Types of cement and ceramic materials. Nano Materials and Pozzolan materials (Definition, properties and applications). Water chemistry and chemistry of admixtures.
4. Corrosion and its Control: Definition of corrosion and factors affecting corrosion rate. Theories of Dry (chemical) corrosion - Pilling Bedworth rule and Wet corrosion in acidic atmosphere by hydrogen evolution mechanism. Metal coatings, Inorganic coatings, Organic coatings – use of paints varnishes and enamels, Internal corrosion preventive measures- alloying (with reference to passivating, neutralizing and inhibition) and heat treatment (quenching, annealing). Electro and Thermochemistry: Laws of Electrolysis, E.M.F. series, corrosion (Theories, inhibition & protection), Chemical thermodynamics, Hess's Law, Heat of reaction, Relation between H and U measurement of heat reaction. Bomb Calorimeter.

Recommend Lab Work (Optional)

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

RECOMMENDED BOOKS

1. Dara, S.S.; A Textbook of Engineering Chemistry (Tenth Edition) ; S.Chand Latest Edition)
2. Kuriacose, J.; Chemistry in Engineering and Technology (Vol. 1& 2); McGraw Hill, Latest Edition)
3. Barrow, M. Gordon; Physical Chemistry (Fifth Edition); McGraw Hill,. Latest Edition)
4. March, Jerry.; Advance Organic Chemistry Reaction Mechanism and Structure (Fourth Edition); John Wiley & Sons New York Latest Edition)
5. W. kemp; Organic spectroscopy PALGRAVE, Latest Edition)
6. Puri B.R., Sharma L.R., Pathania M.S.; Principles of Physical Chemistry; Vishal Publishing Co. Latest Edition)
7. Instrumental Methods of Analysis by Hobert H.Willard D.L. Merrit & J.R.J.A. Dean, Frank A.Settle; (Latest Edition) Wadsworth Publishing Company.

8.12 Fehm-e-Quran II

COURSE TITLE	CREDITS HOURS	PRE-REQUISITE	
Fehm-e-Quran II	(0+1)	Fehm-e-Quran I	
KNOWLEDGE & ATTITUDE PROFLE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:	
SK1 (Natural Sciences/ Social sciences) SK2 (Conceptually based Mathematics)			
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG10- Reduced Inequalities, SDG16- Peace, Justice and Strong Institution		TC-1 (comprehend and apply universal knowledge), TC-8 (Ethics), TC-12 (CPD and lifelong learning)	
Course Objective			
This course, Understanding of Qur’an, is designed to equip students with the essential skills to comprehend the Qur’an directly in its original Arabic. In line with HEC instructions, this course is mandatory at BS, MS, and PhD levels across all disciplines in Pakistani universities to ensure Qur’anic understanding as part of higher education. The course introduces learners to the Muallim-ul-Qur’an System developed by Dr. Ubaid-ur- Rehman Bashir, a structured and progressive method that enables comprehension of the Qur’an without prior grammar study. Instead of heavy grammatical rules, students learn through direct translation, vocabulary recognition, and step-by-step practice, making the method easy, accessible, and effective. Supported by core textbooks, multimedia resources, and guided exercises, the course gradually develops the capacity to understand Qur’anic verses without reliance on translations. Alongside linguistic and analytical skills, it nurtures spiritual reflection, ethical awareness, and practical application, empowering learners to integrate Qur’anic principles into their academic, professional, and personal lives, while also engaging meaningfully in interfaith dialogue and community development.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Learning Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Identify Qur’anic vocabulary, pronouns, and sentence structures in Units 1–6 of Muallim-ul-Qur’an.	C2 (Cognitive) Understand	PLO7 / SA7 (Ethics)
CLO-2	Explain grammatical and linguistic rules of Qur’anic nominal sentences, plurals, compounds, and particles.	C2 (Cognitive) Understand	PLO8 / SA8 (Individual and Collaborative teamwork)
CLO-3	Apply acquired vocabulary and grammar to translate Qur’anic words, phrases, and present-tense sentences directly from the text.	C3 (Cognitive) Application	PLO-11/ SA 11 (Lifelong learning)

Course Outline for Theory

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

RECOMMENDED BOOKS

Course Book:

Dr. Ubaid-ur-Rehman, Muallim-ul-Qur'an, Volumes I-III (Latest Edition)

Reference Material:

Digital & Multimedia Resources:

Website: www.muallimulquran.com

Flipbook editions of Vol. I-III

Confirmation videos for self-assessment

Workbooks, quizzes, question papers, and supplementary slides (online)

YouTube Playlist:

Muallim-ul-Qur'an Video Lectures (Dr. Ubaid-ur-Rehman)

8.13 Linear Circuit Analysis

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Linear Circuits Analysis		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF BROADLY DEFINED ACTIVITIES
SK3 (Engineering Technology Fundamentals)		SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required)	TA3 TA5
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-10 (Communication & Collaboration)	
Course Objective			
After completion of this course students will be able to understand and analyze the electrical quantities components, theorems and problem solving techniques in AC and DC circuits and validation of concepts in lab work with the interpretation of results.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Interpret fundamental circuit quantities, source models, laws and circuit reductions	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Solve different parameters of RL, RC and RLC circuits	C3 (Cognitive) Apply	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-3	Analyze linear resistive circuits using nodal and mesh analysis, source transformation, and network theorems	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-4	Able to identify various lab equipment and components	P1 (Psychomotor) Imitate	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-5	Perform & demonstrate experiments related to AC, DC analysis	P3 (Psychomotor) Precision	PLO-2 / SA2 (Problem Analysis)
CLO-6	Respond to rules, regulations and safety measures of Lab	A2 (Affective) Respond	PLO-7 / SA7 (Ethics)

Course Outline for Theory
• Voltage, current, power, energy, source models • Ohm's law, KCL, KVL, series-parallel • Nodal & Mesh analysis • Linearity, superposition, source transformation • Thévenin, Norton, maximum power transfer • Dependent sources, bridge networks, op-amp introduction • Capacitors, inductors, first-order concepts • Introduction to RL, RC and RLC • Basic concepts of sinusoids, phasors, impedance, admittance • Introduction to instantaneous, average power and power factor • Industry 5.0: Introduction to energy-efficient electrical circuits and their importance in modern industries
Lab Work Outline for Practical
• Verification of Ohm's law • KCL and KVL verification • Voltage divider and current divider • Nodal-analysis validation • Superposition theorem • Thévenin and Norton equivalence • Maximum power transfer • Introductory to RL & RC response • Introductory RLC response • Phasor-based AC circuit measurements • AC power and power-factor demonstration • Semester Project
RECOMMENDED BOOKS
1. Charles Alexander and M Sadiku, "Fundamentals of Electric Circuits", McGraw- Hill, Latest Edition. 2. S. Franco, "Electric Circuits Fundamentals", Oxford University Press, Latest Edition. 3. RE Thomas, Rosa & G. Toussaint, "The Analysis & Design of Linear Circuits" John Wiley, Latest Edition. 4. J D Irwin and R M Nelms, "Basic Engineering Circuit Analysis", Wiley, Latest Edition. 5. W Hayt, J Kemmerly and S Durbin, "Engineering Circuit Analysis", McGraw- Hill, Latest Edition.

8.14 Computer Programming

COURSE TITLE:		CREDIT HOURS	PRE-REQUISITE
Computer Programming		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK2 (Technology Concepts and Computational Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirements) SP3 (Depth of Analysis Required)	TA1 (Range of Resources) TA2 (Level of Interaction) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSSIONAL COMPETENCE PROFILE	
		TC-1 (Comprehend & apply universal knowledge) TC-3 (Problem Analysis) TC-4 (Design and Development) TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to provide fundamental knowledge of computer programming using Python with emphasis on problem solving, logical thinking, and engineering applications. The course develops practical skills in writing, testing, debugging, and documenting programs for engineering technology problems involving numerical computation, data analysis, automation, and basic graphical visualization.			
CLO	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Explain the fundamentals of computer programming, Python syntax, data types, operators, and program structures.	C2 (Understanding g)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply programming concepts including decision making, loops, functions, and data structures to solve engineering technology problems.	C3 (Apply)	PLO2 / SA2 (Problem Analysis)
CLO-3	Analyze programming logic, algorithms, and computational methods for numerical and engineering applications.	C4 (Analysis)	PLO3 / SA3 (Design/Devel opment of Solutions)
CLO-4	Use Python programming tools and libraries for coding, debugging, visualization, and data processing applications.	P3 (Guided Response)	PLO5 / SA5 (Tool Usage)
CLO-5	Develop Python-based programs for engineering calculations, automation, file handling, and simple graphical applications.	P5 (Mechanism)	PLO4 / SA4 (Investigation)

CLO-6	Demonstrate professional responsibility by following ethical coding practices, software documentation standards, and laboratory guidelines during programming activities	A3 (Valuing)	PLO7 / SA7 (Ethics)
Course Outline for Theory			
• Introduction to computer programming, problem-solving techniques, algorithms, flowcharts, and applications of Python in engineering technology • Introduction to Python programming environment, installation, execution modes, syntax rules, variables, constants, and comments • Data types, input/output operations, type conversion, arithmetic operators, relational operators, logical operators, and expressions • Conditional statements including if, if-else, nested conditions, and multiple decision-making structures • Iterative structures including while loops, for loops, nested loops, and loop control statements • Functions and modular programming including user-defined functions, arguments, return values, recursion, and scope of variables • Introduction to lists, tuples, dictionaries, sets, and string manipulation techniques • File handling operations including reading, writing, appending, and processing text and data files [Exception handling, debugging techniques, and program testing methods • Introduction to numerical computation and mathematical libraries including NumPy and basic scientific computation concepts • Data visualization techniques using Python libraries for plotting graphs and engineering data representation • Applications of Python in Electrical Engineering Technology including engineering calculations, signal analysis, automation, sensor data processing, and simple control applications			
Lab Work Outline for Practical			
• Installation and configuration of Python programming environment and Integrated Development Environments (IDEs) • Writing and execution of simple Python programs involving arithmetic operations, expressions, and user input/output • Practical implementation of conditional statements and decision-making programs • Development of iterative programs using loops for mathematical and engineering calculations • Design and implementation of user-defined functions and modular programs • Practical exercises on lists, tuples, dictionaries, strings, and data manipulation techniques • File handling applications including creation, reading, updating, and processing of engineering data files • Debugging and exception handling exercises for identifying and correcting programming errors • Numerical computation and matrix operations using NumPy library for engineering applications • Data visualization and plotting of engineering graphs using Matplotlib library • Development of mini-projects involving engineering applications such as unit converters, sensor data analysis, power calculations, automation scripts, or basic simulation tools • Team-based programming assignment involving documentation, presentation, and collaborative problem solving • Industrial or institutional exposure to software development, automation systems, or engineering computing facilities followed by technical report writing and presentation			



Curriculum for Bachelor of Electrical Engineering Technology



RECOMMENDED BOOKS

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

8.15 Environment, Health and Safety

COURSE TITLE:		CREDITS HOURS:		PRE-REQUISIT	
Environment, Health & Safety		(1+0)		None	
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING:		RANGE OF BROADLY DEFINED ACTIVITIES:	
SK4 (Engineering Technology Specialized Knowledge)		SP1 (Depth of Knowledge Required) SP4 (Familiar Problems Solution)		TA1 TA2 TA5	
Sustainable Development Goals (SDGs):			Professional Competence Profile:		
SDG3- Good Health and Well-being:			TC-1 (Comprehend & apply universal knowledge), TC-9 (Manage engineering activities) TC-6 (Protection of Society)		
Course Objective					
After completion of this course, students will be able to understand the principles of occupational health, workplace safety, environmental protection, risk assessment, hazard identification, emergency preparedness and sustainable engineering practices. The course prepares students to work safely and responsibly in engineering and industrial environments while complying with national and international safety standards.					
Course Learning Outcomes	CLOs Statement		Taxonomy (Level)	Program Outcomes (PLO)	
CLO-1	After completion of this course students will be able to:				
CLO-1	Explain fundamental concepts of environment, occupational health, workplace safety and sustainable development.		C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)	
CLO-2	Identify workplace hazards and evaluate associated risks in engineering and industrial environments.		C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)	
CLO-3	Apply safety regulations, standards and environmental protection measures to engineering activities.		C3 (Cognitive) Apply	PLO-6 / SA6 (The Engineer and Society)	
Course Outline for Theory					
• Introduction to EHS and safety culture. • Occupational health and workplace hazards. • Physical, chemical, and biological hazards. • Ergonomic and psychological hazards. • OSHA, ISO 45001, and safety regulations. • Hazard identification and Job Safety Analysis (JSA).					

- Risk assessment and control measures.
- Electrical safety and shock protection.
- Lockout/Tagout (LOTO), grounding, and earthing.
- Fire safety, extinguishers, and evacuation procedures.
- Personal Protective Equipment (PPE) and safety signs.
- Environmental pollution and waste management.
- Environmental Impact Assessment (EIA) and sustainability.
- Emergency response, first aid, safety audits, and engineering ethics.
- **Industry 5.0:** Human-centric workplace safety and employee well-being in modern industries.
- **Industry 5.0:** Sustainable engineering practices and resource conservation in electrical industries.
- The HEI is encouraged to demonstrate all safety and environmental practical aspects of Industry to students consistent with the course contents.

RECOMMENDED BOOKS

1. David L. Goetsch, *Occupational Safety and Health for Technologists, Engineers and Managers*, Latest Edition.
2. Charles D. Reese, *Occupational Health and Safety Management*, Latest Edition.
3. R. K. Jain & Sunil Rao, *Industrial Safety, Health and Environment Management Systems*, Latest Edition.
4. Frank R. Spellman, *The Handbook of Safety Engineering*, Latest Edition.
5. National Fire Protection Association (NFPA) Safety Standards.
6. OSHA Safety and Health Standards Manual.

8.16 Differential Equations

COURSE TITLE		CREDITS HOURS:	PRE-REQUISITE
Differential Equations		(2+0)	Calculus and Analytical Geometry
KNOWLEDGE & ATTITUDE PROFLE		RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING ACTIVITIES:
SK1 (Natural Sciences) SK2 (Mathematics and Analysis) SK3 (Engineering Fundamentals)		SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues)	TA1 (Range of Resources) TA2 (Level of Interactions) TA5 (Familiarity)
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
		TC-1 (Comprehend and Apply Universal Knowledge) TC-3 (Problem Analysis) TC-5 (Evaluation) TC-10 (Communication and Collaboration)	
Course Objective			
The objective of this course is to develop understanding of differential equations, Laplace transforms, and power series methods for solving engineering technology problems			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes
CLO-1	Understand the concepts of differential equations, Laplace transforms, and power series used in engineering technology applications.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze and solve first-order and higher-order differential equations using analytical methods.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Apply Laplace transforms and power series methods to solve engineering technology -related differential equations.	C3 (Cognitive) Apply	PLO-3 / SA3 (Design and Development of Solutions)
Course Outline for Theory			
• Introduction to Differential Equations: Basic concepts of differential equations, definition, order, degree, and geometric meaning of differential equations. • First Order Differential Equations: Separable equations, exact differential equations, integrating factors, and linear ordinary differential equations. • Higher Order Differential Equations: Homogeneous linear differential equations with constant coefficients, Cauchy-Euler equations, non-homogeneous equations using undetermined coefficients and variation of parameters. • Laplace Transforms: Finding Laplace and inverse Laplace transforms of different functions, shifting theorem, and solution of differential equations using Laplace transforms			

Lab Work Outline for Practical	
NA	
RECOMMENDED BOOKS	
1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley (Latest Edition) 2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, John Wiley & Sons (Latest Edition) 3. D. G. Zill and M. R. Cullen, Differential Equations with Boundary-Value Problems, (Latest Edition)	

8.17 Fundamental of Signals and Systems

COURSE TITLE:	CREDIT HOURS	PRE-REQUISITE	
Fundamentals Signals and Systems	(2+1)	None	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK3 (Engineering Fundamentals)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSIONAL COMPETENCE PROFILE	
		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis), TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to provide fundamental concepts of continuous discrete-time signals and systems along with mathematical tools for signal analysis. The course also develops practical skills in MATLAB and SIMULINK for modeling, simulation, and analysis of engineering systems relevant to signal processing and communication applications.			
CLO	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Explain and Classify continuous-time and discrete-time signals and systems using appropriate mathematical operations.	C2 (Understanding)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply convolution, difference and differential equation models, transformation techniques (Fourier and Laplace) to analyze continuous-time and discrete-time systems.	C3 (Apply)	PLO-2 / SA2 (Problem Analysis)
CLO-3	Analyze properties of Linear Time-Invariant (LTI) systems including transfer functions, stability, causality, poles and zeros, and frequency response	C4 (Analysis)	PLO4 / SA3 (Investigation)
CLO-4	Use computational tools (MATLAB/Python) for signal generation, visualization, and analysis.	P3 Guided Response	PLO5/ SA5 (Tool Usage)
CLO-5	Design and apply basic signal processing systems (filters and signal conditioning) for real-world applications.	P5 (Mechanism)	PLO-3 / SA-3 (Design/Developme nt of Solution)
CLO-6	Document, interpret, and communicate the outcomes of signal and system analysis using standard engineering reporting	A3 (Valuing)	PLO9 / SA9(Communication

	practices.		
Course Outline for Theory			
• Introduction to signals and systems, classification of continuous-time and discrete-time signals, elementary signals, signal operations including scaling, shifting, and inversion • Classification of systems, properties of systems including linearity, time invariance, causality, memory, and stability • Representation of signals using complex exponentials and sinusoidal functions, periodic and non-periodic signals • Continuous-time and discrete-time convolution, graphical interpretation, and applications of convolution in engineering systems • Differential equation models for continuous-time systems and system response analysis • Difference equation models for discrete-time systems and recursive system analysis • Introduction to Fourier Series, trigonometric and exponential Fourier series representation of periodic signals • Continuous-Time Fourier Transform (CTFT), properties, spectrum analysis, and frequency domain representation • Discrete-Time Fourier Transform (DTFT), properties, and frequency response analysis of discrete systems • Sampling theorem, aliasing effects, reconstruction of sampled signals, and practical applications • Introduction to Laplace Transform, properties, inverse Laplace transform, and region of convergence Transfer functions, poles and zeros, system stability, causality, and frequency response analysis			
Lab Work Outline for Practical			
• Introduction to MATLAB/Python environment, generation and visualization of continuous-time and discrete-time signals using MATLAB and Python libraries • Signal operations including amplitude scaling, time shifting, time reversal, and signal addition using computational tools • Simulation and visualization of standard continuous-time and discrete-time signals including sinusoidal, exponential, ramp, and impulse signals • Implementation and graphical interpretation of continuous-time convolution using MATLAB/Python • Implementation and graphical interpretation of discrete-time convolution using MATLAB/Python • Simulation of Linear Time-Invariant (LTI) systems and visualization of impulse and step responses • Fourier Series analysis and spectrum visualization of periodic signals using computational tools • Continuous-Time Fourier Transform (CTFT) and frequency spectrum analysis of engineering signals • Discrete-Time Fourier Transform (DTFT) implementation and frequency response analysis using MATLAB/Python • Experimental verification of sampling theorem, aliasing effects, and reconstruction of sampled signals • Laplace Transform applications for poles and zeros visualization, transfer function analysis, and system stability analysis • Simulation and analysis of operational amplifier circuits including summing amplifier, difference amplifier, integrator, and differentiator circuits • Design and implementation of basic digital filters and signal conditioning systems for audio and sensor signals • Industrial visit to telecommunication or signal processing industry, followed by teamwork-based technical presentation and report writing on practical applications of signals and systems			

RECOMMENDED BOOKS

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

8.18 Pakistan Studies

COURSE TITLE		CREDITS HOURS:	PRE-REQUISITE
Pakistan Studies		(2+0)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:
SK7 (Communication and Society) SK8 (Critical Thinking and Literature) SK9 (Professional Practice)		SP2 (Range of Conflicting Requirements) SP4 (Familiarity of Issues)	TA2 (Level of Interactions) TA5 (Familiarity)
Sustainable Development Goals (SDGs):			Professional Competence Profile:
SDG13- Climate Action SDG16- Peace, Justice and Strong Institutions			TC-8 (Ethics) TC-10 (Communication and Collaboration)
Course Objective			
The objective of this course is to develop awareness of Pakistan's historical development, socio-cultural diversity, national identity, civic responsibilities, and contemporary national challenges.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Demonstrate awareness of Pakistan's historical evolution, geographical importance, socio-cultural diversity, constitutional development, and national identity.	A2 (Affective) Responding	PLO-6 / SA6 (The Engineering Technologist and the World)
CLO-2	Organize and practice responsible civic behavior, social harmony, ethical values, and positive participation in addressing national and global challenges.	A4 (Affective) Organization	PLO7 / SA7 (Ethics)
Course Outline for Theory			
- Introduction to Pakistan: Geographical location and significance, historical background, ancient civilizations, and factors leading to the creation of Pakistan. - Political History of Pakistan: Formative phase, democratic transitions, and military interventions.			

- Geography of Pakistan: Physiography including mountains, plains, plateaus, deserts, valleys, coastal areas, river systems, and climatic regions.
- Society and Culture of Pakistan: Socio-cultural diversity and social structure of Pakistan.
- Economic Development of Pakistan: Agriculture, industrial sectors, and economic challenges of Pakistan.
- Contemporary Issues: Foreign relations, terrorism, extremism, regional conflicts, environmental challenges, sustainable development, media, and social change.

Lab Work Outline for Practical

NA

RECOMMENDED BOOKS

1. Jinnah of Pakistan by Stanley Wolpert (Latest Edition)
2. The Sole Spokesman: Jinnah, the Muslim League, and the Demand for Pakistan by Ayesha Jalal(Latest Edition)
3. The Struggle for Pakistan by Ishtiaq Husain Qureshi(Latest Edition)
4. Pakistan: The Formative Phase, 1857-1948 by Khalid B. Sayeed(Latest Edition)
5. Pakistan Studies: A Book of Readings by Sikandar Hayat(Latest Edition)
6. Constitutional and Political History of Pakistan by Hamid Khan(Latest Edition)
7. Pakistan: A Modern History by Ian Talbot(Latest Edition)
8. Economic Development of Pakistan by Ishrat Husain(Latest Edition)
9. Issues in Pakistan's Economy by S. Akbar Zaidi(Latest Edition)

8.19 Ideology and Constitution of Pakistan

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
Ideology and Constitution of Pakistan		(2+0)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK1 (Natural Sciences/ Social sciences) SK8 (Engagement with current technological literature)			
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
SDG16- Peace, Justice and Strong Institutions		TC-6 (Protection of Society), TC-7 (Legal, Regulatory and Cultural), TC-11 (CPD and lifelong learning)	
Course Objective			
This course is designed to provide students with a fundamental exploration of the ideology and the constitution of Pakistan. The course focuses on the underlying principles, beliefs, and aspirations that have been instrumental in shaping the creation and development of Pakistan as a sovereign state. Moreover, the course will enable students to understand the core provisions of the Constitution of the Islamic Republic of Pakistan concerning the fundamental rights and responsibilities of Pakistani citizens to enable them function in a socially responsible manner			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Demonstrate enhanced knowledge of the basis of the ideology of Pakistan with special reference to the contributions of the founding fathers of Pakistan.	C2 (Cognitive) Understand	PLO-11/ SA 11 (Lifelong learning)
CLO-2	Demonstrate fundamental knowledge about the Constitution of Pakistan 1973 and its evolution with special reference to state structure.	C2 (Cognitive) Understand	PLO6 / SA6 (The Engineer technologist and the World)
CLO-3	Explain about the guiding principles on rights and responsibilities of Pakistani citizens as enshrined in the Constitution of Pakistan 1973.	C4 (Cognitive) Analyze	PLO6 / SA6 (The Engineer technologist and the World)
Course Outline for Theory			
1. Introduction to the Ideology of Pakistan • Definition and significance of ideology. • Historical context of the creation of Pakistan (with emphasis on socio-political, religious, and cultural dynamics of British India between 1857 till 1947).			

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

2. Two-Nation Theory

- Evolution of the Two-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress Ministries 1937, Lahore Resolution 1940).
- Role of communalism and religious differences.

3. Introduction to the Constitution of Pakistan

- Definition and importance of a constitution.
- Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949).
- Overview of constitutional developments in Pakistan.

4. Constitution and State Structure

- Structure of Government (executive, legislature, and judiciary).
- Distribution of powers between federal and provincial governments.
- 18th Amendment and its impact on federalism.

5. Fundamental Rights, Principles of Policy and Responsibilities:

- Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan 1973 (Articles 8–28).
- Overview of Principles of Policy (Articles 29–40).
- Responsibilities of the Pakistani citizens (Article 5).

6. Constitutional Amendments:

- Procedures for amending the Constitution.
- Notable constitutional amendments and their implications

RECOMMENDED BOOKS

8.20 Technical Drawing & CAD

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE	
Technical Drawing & CAD		(0+1)	None	
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING		RANGE OF BROADLY DEFINED ACTIVITIES
SK4 (Engineering Technology Specialized Knowledge)		SP1 (Depth of Knowledge Required) SP4 (Familiar Problems Solution)		
Sustainable Development Goals (SDGs):			Professional Competence Profile:	
SDG8- Decent Work and Economic Growth			TC-1 (Comprehend & apply universal knowledge), TC-10 (Communication & Collaboration)	
Course Objective				
After completion of this course students will be able to understand engineering drawing standards, graphical representation techniques, electrical schematics and Computer-Aided Design (CAD) tools for preparation, interpretation and documentation of engineering drawings used in Electrical Engineering Technology.				
Course Learning Outcomes	CLOs Statement		Taxonomy (Level)	Program Outcomes (PLO)
	After completion of this course students will be able to:			
CLO-1	Interpret engineering drawing standards, symbols, scales, dimensioning practices and graphical conventions.		C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Operate CAD software for drafting, editing and management of engineering drawings.		P2 (Psychomotor) Manipulation	PLO-5 / SA5 (Tool Usage)
CLO-3	Produce complete engineering drawings		P4 (Psychomotor) Articulation	PLO-4 / SA4 (Investigation)
CLO-4	Respond to professional standards, drawing ethics and documentation requirements.		A2 (Affective) Respond	PLO-7 / SA7 (Ethics)
Course Outline for Practical				
• Drawing instruments, standards and line practice • Geometrical constructions and dimensioning • Orthographic and isometric drawings • Sectional, auxiliary and surface development drawings • Electrical symbols, schematics and single-line diagrams • Introduction to AutoCAD and CAD interface • CAD drawing, editing and layer management • CAD dimensioning, annotation and plotting				



Curriculum for
Bachelor of Electrical Engineering Technology



- Electrical wiring layout drafting using CAD
- Semester Project

RECOMMENDED BOOKS

1. N. D. Bhatt, Engineering Drawing, Latest Edition.
2. Luzadder & Duff, Fundamentals of Engineering Drawing, Latest Edition.
3. Bertoline & Wiebe, Technical Graphics Communication, Latest Edition.
4. Sham Tickoo, AutoCAD for Engineers and Designers, Latest Edition.
5. Thomas E. French, Engineering Drawing and Graphic Technology, Latest Edition.

8.21 Electronic Devices & Circuits

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE	
Electronic Devices & Circuits		(2+1)	Linear Circuit Analysis	
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF BROADLY DEFINED ACTIVITIES	
SK4 (Engineering Technology Specialized Knowledge)		SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA3 (Innovation) TA5 (Familiarity)	
Sustainable Development Goals (SDGs):		Professional Competence Profile:		
SDG7- Affordable and Clean Energy		TC-1 (Comprehend & apply universal knowledge), TC-2 (Problem Analysis), TC-10 (Communication & Collaboration)		
Course Objective				
After completion of this course, students will be able to understand the operating principles, characteristics and applications of semiconductor devices including diodes, transistors, FETs and operational amplifiers. Students will analyze and construct basic electronic circuits used in modern electrical and electronic systems and validate theoretical concepts through laboratory experimentation and interpretation of results.				
Course Learning Outcomes	CLOs Statement		Taxonomy (Level)	Program Outcomes (PLO)
	After completion of this course students will be able to:			
CLO-1	Explain semiconductor fundamentals and operating principles of PN junction diodes and special purpose diodes		C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze diode circuits including rectifiers, filters, clipping and clamping circuits		C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Analyze the characteristics and applications of BJT and FET devices in amplifier and switching circuits		C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-4	Construct and test electronic circuits using laboratory instruments and semiconductor devices		P3 (Psychomotor) Precision	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-5	Demonstrate safe laboratory practices and professional conduct during electronic circuit experimentation		A2 (Affective) Respond	PLO-7 / SA7 (Ethics)
Course Outline for Theory				

- Semiconductor materials and atomic structure
- Intrinsic and extrinsic semiconductors
- PN junction diode characteristics
- Diode models and load-line analysis
- Zener, LED and photodiode applications
- Half-wave and full-wave rectifiers
- Bridge rectifiers and power supplies
- Filter circuits and voltage regulation
- Clipping and clamping circuits
- BJT construction and operating regions
- BJT biasing and amplifier configurations
- JFET and MOSFET characteristics
- Operational amplifier fundamentals and applications
- Electronic switching and industrial applications
- Industry 5.0: Electronic devices used in sensors and modern automation systems
- Semester Project

Lab Work Outline for Practical

- Identification of electronic components and instruments
- PN junction diode characteristics
- Zener diode voltage regulation
- LED and photodiode applications
- Half-wave rectifier implementation
- Full-wave bridge rectifier implementation
- Filter circuit analysis and ripple measurement
- Clipper circuit verification
- Clamper circuit verification
- BJT characteristics and switching applications
- FET characteristics and switching applications
- Op-amp circuits and semester project demonstration

RECOMMENDED BOOKS

1. Robert L. Boylestad & Louis Nashelsky, **Electronic Devices and Circuit Theory**, Pearson, Latest Edition.
2. Thomas L. Floyd, **Electronic Devices**, Pearson, Latest Edition.
3. Sedra & Smith, **Microelectronic Circuits**, Oxford University Press, Latest Edition.
4. Donald Neamen, **Electronic Circuit Analysis and Design**, McGraw-Hill, Latest Edition.
5. Millman & Halkias, **Integrated Electronics**, McGraw-Hill, Latest Edition.

8.22 Electrical Network Analysis

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Electrical Network Analysis		(2+1)	ELT 121 Linear Circuit Analysis
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING:		RANGE OF BROADLY DEFINED ACTIVITIES:
SK4 (Engineering Technology Specialized Knowledge)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiar Problems Solution)		TA1 (Range of Sources) TA4 (Consequences to society and the environment) TA5 (Familiarity)
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
SDG8- Decent Work and Economic Growth		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-10 (Communication & Collaboration)	
Course Objective			
Upon successful completion of this course, students will be able to analyze RL, RC, and RLC circuits under AC excitation, evaluate transient responses with switching and initial conditions, apply Laplace transform techniques to series and parallel circuits, and examine resonance, polyphase systems, filters, and frequency response characteristics.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Interpret and compare the behavior of various electrical components with their transient response	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Use frequency response, resonance, filters, coupled-inductor/transformer behavior, and network functions using phasor and Laplace methods	C3 (Cognitive) Apply	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-3	Analyze first-order and second-order linear networks in time and s domains, including initial conditions, transient response. Polyphase circuit analysis	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-4	Perform theoretical, simulated, and experimental results related to AC excitation circuits	P2 (Psychomotor) Manipulation	PLO-2 / SA2 (Problem Analysis)
CLO-5	Use simulation platforms and bench instruments to test RLC transients, resonance, filters, and network behavior against theoretical predictions	P3 (Psychomotor) Precision	PLO-5 / SA5 (Tool Usage)
CLO-6	Respond to rules regulations and safety measure of lab along with accepting the responsibility	A3 (Affective) Value	PLO-7 / SA7 (Ethics)



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Course Outline for Theory

- Review of RL, RC and RLC circuits with AC excitation
- Series and parallel circuits analysis
- Laplace transform basics
- Transient response and switching action of the circuits
- s-domain element models, initial conditions
- Nodal and mesh analysis in s-domain
- Introduction to impulse, step response
- Resonance circuits
- Passive filters
- Introduction to active filters
- Polyphase basics and power concepts

Lab Work Outline for Practical

- s-domain simulation of RC and RL networks
- First- and second-order transient comparison
- Series resonance experiment
- Parallel resonance experiment
- Passive low-pass and high-pass filters
- Active filter realization
- Polyphase simulation / power demonstration
- Semester Project

RECOMMENDED BOOKS

Electrical Workshop Practice

8.23 Entrepreneurship

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
		(2+0)	None
Entrepreneurship			
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:
SK7 (Communication and Society) SK8 (Critical Thinking and Literature) SK9 (Professional Practice)		SP2 (Range of Conflicting Requirements) SP4 (Familiarity of Issues) SP5 (Extent of Applicable Codes)	TA2 (Level of Interactions) TA5 (Familiarity)
Sustainable Development Goals (SDGs):			Professional Competence Profile:
SDG8- Decent Work and Economic Growth			TC-8 (Ethics) TC-10 (Communication and Collaboration)
Course Objective			
The objective of this course is to develop entrepreneurial mindset, leadership qualities, innovation, financial awareness, and business management skills for professional and social development.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Demonstrate awareness of entrepreneurial values, leadership qualities, innovation, teamwork, and ethical business practices in professional environments.	A2 (Affective) Responding	PLO-8 / SA8 (Individual and Collaborative Team Work)
CLO-2	Organize and practice entrepreneurial planning, communication, financial responsibility, and business management skills for startup and community development activities.	A4 (Affective) Organization	PLO-10 / SA10 (Project Management)
Course Outline for Theory			
- Introduction to Entrepreneurship: Definition and concept of entrepreneurship, entrepreneurial process, role of entrepreneurship in economic development, and reasons for becoming an entrepreneur. - Entrepreneurial Skills: Characteristics of successful entrepreneurs, creativity, innovation, critical thinking, risk-taking abilities, and opportunity identification techniques. - Marketing and Sales: Target market identification, market segmentation, Four P's of Marketing branding, and marketing strategy development. - Financial Literacy: Basic concepts of income, savings, investment, revenue, expenses, cash flows banking products, and Islamic financing modes. - Team Building for Startups: Characteristics and features of effective entrepreneurial teams and			

collaborative work environments. Regulatory Requirements in Pakistan: Types of enterprises, intellectual property rights, enterprise registration procedures, taxation, and financial reporting obligations.
Lab Work Outline for Practical
N/A
RECOMMENDED BOOKS
1. Entrepreneurship: Successfully Launching New Ventures by Bruce R. Barringer and R. Duane Ireland(Latest Edition) 2. Entrepreneurship: Theory, Process, and Practice by Donald F. Kuratko (Latest Edition) 3. New Venture Creation: Entrepreneurship for the 21st Century by Jeffry A. Timmons, Stephen Spinelli Jr., and Rob Adams (Latest Edition) 4. The Lean Startup by Eric Ries (Latest Edition) 5. Effectual Entrepreneurship by Stuart Read, Saras Sarasvathy, Nick Dew, Robert Wiltbank, and Anne-Valérie Ohlsson(Latest Edition)

8.24 Robotics and Autonomous System Technology

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Robotics and Autonomous System Technology		(2+1)	None
KNOWLEDGE & ATTITUDE PROFLE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK4 (Engineering Specialized Knowledge) SK5 (Engineering Design and Operations)		SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
SDG8- Decent Work and Economic Growth SDG12- Responsible Consumption and Production		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-5 (Evaluation)	
Course Objective			
After completion of this course students will be able to understand concepts of robotics and their design process and validation of these concepts in lab work for development of robotic prototypes.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcom es (PLO)
CLO-1	Understand fundamental concepts of robotics, sensors and actuators.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Identify mathematical principles, kinematics, inverse kinematics, dynamics, and DH parameter formulation to model and analyze robotic motion.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Apply path planning algorithms, and AI for real-world industrial automation.	C3 (Cognitive) Apply	PLO-6 / SA6 (The Engineering Technologist and the World)
CLO-4	Perform experiments in laboratory in order to interpret experimental data and observe its results using sensors, actuators or robotics lab equipment.	P3 (Psychomotor) Guided Response	PLO4 / SA4 (Investigation)

CLO-5	Mend various robotic concepts using ROS (Robot Operating System).	P5 (Psychomotor) Complex Overt Response	PLO5/ SA5 Tool Usage
Course Outline for Theory			
• Introduction to robotics, classification of robots (industrial, service, medical, mobile, underwater, UAV, humanoid, swarm, and soft robots), serial versus parallel mechanisms (open vs closed kinematic chains, Stewart platform, Delta robot), types of robotic joints (revolute, prismatic, spherical, universal, cylindrical, planar, screw), types of wheels (conventional, mecanum, omnidirectional, carter, tracks etc.). Application of robotics. • Robotic sensors (motor encoders, LiDAR, IMUs, cameras, tactile, force/torque, proximity) and actuators (DC motors, steppers, servos, linear actuators, pneumatic/hydraulic, artificial muscles) with selection criteria. • Basic mathematics for robotics. Kinematics, inverse kinematics and dynamics of robots. Coordinates and formation of Dh table. Mobile robots and their types. Velocity kinematics of mobile robots. Robotics trajectory generation. • Robotic path planning, including graph-based methods (A*, Dijkstra, visibility graph, Voronoi diagrams), potential fields (with local minima mitigation), velocity obstacles, bug algorithms (Bug 0,1,2) etc. • The course also introduces supervised and unsupervised machine learning for robotics (regression, classification, clustering, dimensionality reduction) along with reinforcement learning and imitation learning, followed by industrial automation, and industry 5.0.			
Lab Work Outline for Practical			
• Introduction to ROS (Robot Operating System) • Use basic velocity commands to make a robot move forward, turn using ROS • Use of Arduino, Arbotix or Raspberry Pi • Use of ultrasonic and infrared sensors for distance measurement • Controlling DC motors using H-bridge and PWM for speed control • Controlling servo motors and stepper motors • Implementing differential drive kinematics for wheeled robots • Odometry-based localization and position tracking • Reactive obstacle avoidance using sensor feedback • PID controller tuning for line following • Forward kinematics of a robotic arm (2-DOF or 3-DOF) • Use of robotics simulators or equipment available in HIE			
RECOMMENDED BOOKS			
• Introduction to Robotics. Mechanics and Control, by John J Craig. (latest edition). • Robotics, Vision and Control Fundamental by Peter Corke (latest edition).			

8.25 Applications of Artificial Intelligence (AI)

COURSE TITLE:		CREDIT HOURS	PRE-REQUISITE
Artificial Intelligence		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK2 (Technology Concepts and Operational Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirements) SP4 (Familiarity of Issues)	TA1 (Range of Resources) TA2 (Level of Interaction) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSSIONAL COMPETENCE PROFILE	
SDG9- Industry, Innovation and Infrastructure SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge) TC-3 (Problem Analysis) TC-8 (Ethics and Professional Responsibility) TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to introduce the fundamental concepts of Artificial Intelligence (AI), intelligent systems, and modern AI applications along with ethical, legal, and societal implications of AI technologies. The course develops understanding of responsible AI practices, data privacy, bias mitigation, cybersecurity awareness, and ethical decision-making while providing practical exposure to AI tools and applications relevant to engineering technology and society.			
CLO	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Explain the basic concepts of Artificial Intelligence, intelligent systems, and AI applications in engineering, business, healthcare, and society.	C2 (Understanding)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply AI tools, digital platforms, and data-driven techniques for solving basic engineering and real-world problems.	C3 (Apply)	PLO3 / SA3 (Design/Devel opment of Solutions)

CLO-3	Analyze ethical, legal, social, and cybersecurity challenges associated with AI technologies and intelligent systems.	C4 (Analysis)	PLO2 / SA2 (Problem Analysis)
CLO-4	Use AI-based software tools and platforms for data analysis, automation, communication, and intelligent decision-making tasks.	P3 (Guided Response)	PLO5 / SA5 (Tool Usage)
CLO-5	Develop simple AI-assisted solutions while incorporating responsible AI practices, fairness, transparency, and privacy considerations.	P5 (Mechanism)	PLO4 / SA4 (Investigation)
CLO-6	Demonstrate teamwork, ethical responsibility, professional conduct, and effective communication during AI-related activities and projects.	A3 (Valuing)	PLO7 / SA7 (Ethics)

Course Outline for Theory

- Introduction to Artificial Intelligence (AI), history, evolution, characteristics of intelligent systems, and scope of AI in modern society
- Types of AI systems including reactive systems, machine learning systems, expert systems, and autonomous intelligent systems
- Fundamentals of machine learning, neural networks, data-driven decision making, and intelligent automation concepts
- AI applications in engineering, healthcare, education, communication systems, smart cities, robotics, and industrial automation
- Introduction to data collection, data preprocessing, datasets, and data privacy concepts
- AI-powered tools and platforms including generative AI systems, virtual assistants, recommendation systems, and automation software
- Ethical foundations of AI including fairness, accountability, transparency, explainability, and responsible AI practices
- Bias in AI systems, discrimination risks, algorithmic fairness, and mitigation strategies
- AI governance, intellectual property rights, digital laws, cybersecurity, surveillance concerns, and privacy protection
- Social and economic impacts of AI including workforce transformation, future jobs, digital divide, and sustainability considerations
- Responsible use of generative AI tools in education, engineering, research, and professional environments
- Emerging trends in ethical AI, human-centered AI systems, Industry 5.0, and sustainable intelligent technologies

Lab Work Outline for Practical

- Introduction to AI-enabled software tools and cloud-based AI platforms for educational and engineering applications
- Hands-on practice with AI-assisted tools for document generation, presentations, communication, and data analysis
- Data collection, preprocessing, visualization, and analysis using spreadsheet tools and AI-enabled software
- Demonstration of simple machine learning models for classification, prediction, and intelligent decision-making tasks
- Practical exercises on responsible AI usage, prompt engineering, and verification of AI-generated content
- Cybersecurity awareness activities including secure password management, phishing identification, privacy protection, and safe AI usage practices
- Case study analysis of ethical AI issues including bias, misinformation, surveillance, and misuse of AI systems
- Development of simple AI-assisted solutions for engineering technology applications using no-code or low-code AI platforms
- Group discussions and presentations on ethical dilemmas in AI and responsible technology adoption
- Mini project involving ethical evaluation and implementation of an AI-based application for education, engineering, or industry
- Industrial or institutional visit to AI-enabled organizations, software houses, innovation labs, or technology centers followed by technical report writing and presentation

RECOMMENDED BOOKS

1. Artificial Intelligence: A Modern Approach by *Stuart Russell and Peter Norvig*, Pearson Education (Latest Edition)
2. Ethics of Artificial Intelligence and Robotics by *Vincent C. Müller*, Routledge (Latest Edition)
3. Human Compatible: Artificial Intelligence and the Problem of Control by *Stuart Russell*, Viking Publications (Latest Edition)
4. Artificial Intelligence Basics: A Non-Technical Introduction by *Tom Taulli*, Apress (Latest Edition)
5. Responsible Artificial Intelligence by *Virginia Dignum*, Springer (Latest Edition)

8.26 Digital Logic Circuits & Applications

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Digital Logic Circuits & Applications		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING:		RANGE OF BROADLY DEFINED ACTIVITIES
SK4 (Engineering Technology Specialized Knowledge)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiar Problems Solution)		TA1 (Range of Sources) TA4 (Consequences to society and the environment) TA5 (Familiarity)
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-10 (Communication & Collaboration) TC-4 (Design & Development)	
Course Objective			
After completing this course, students will be able to understand and apply the principles of digital logic circuits, including logic gates, arithmetic circuits, flip-flops, counters, and registers. The course emphasizes the analysis of digital systems used in modern electronic and computing applications.			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:		Taxonomy (Level)
CLO-1	Describe number systems, codes, Boolean algebra, and the behavior of basic logic gates used in digital systems.		C1 (Cognitive) Knowledge
CLO-2	Analyze combinational and sequential logic circuits using canonical forms, simplification methods, and flip-flops, counters, registers, and finite-state machines, for specified applications.		C4 (Cognitive) Analyze
CLO-3	Design of combinational and sequential circuits for different applications		C5 (Cognitive) Evaluate
CLO-4	Implement, simulate, and verify combinational and sequential circuits using TTL logic ICs,		P2 (Psychomotor) Manipulation
CLO-5	Digital simulators, or introductory HDL tools.		P3 (Psychomotor) Precision
CLO-6	Respond to rules regulations and safety measure of lab along with accepting the responsibility		A3 (Affective) Value
			PLO-7 / SA7 (Ethics)

Course Outline for Theory
• Digital systems overview and number system • Signed numbers, complements and arithmetic operations • Gates and Boolean algebra • K-maps and NAND/NOR realizations • Adders, decoders, encoders, MUX/DEMUX • Combinational design workflow, hazards • Latches and flip-flops • Registers and counters • Finite-state machines • Memory and programmable logic • HDL basics and simulation • Industry 5.0: Applications of digital logic circuits in smart manufacturing and control systems • Semester Project
Lab Work Outline for Practical
• Verification of basic logic gates using digital ICs. • Implementation of universal gates and verification of various theorems. • Simplification and implementation of Boolean expressions. • Design and testing of combinational logic circuits using K-Maps. • Implementation of half adder and full adder circuits. • Design and verification of half subtractor and full subtractor circuits. • Study and application of multiplexer and demultiplexer circuits. • Design and interfacing of encoder and decoder circuits. • Implementation of binary, Gray code, and BCD code converters. • Verification and analysis of SR, JK, D, and T flip-flops. • Design and operation of shift registers and storage registers. • Design and testing of synchronous and asynchronous counters.
RECOMMENDED BOOKS
• M. Morris Mano & Michael D. Ciletti, (Latest Edition) • C. K. Alexander and M. N. O. Sadiku, <i>Fundamentals of Electric Circuits</i>, latest edition • Digital Fundamental, Thomas L. Floyd & David Buchla, Latest Edition

Course Contents (Breadth)

8.27 Instrumentation and Measurements

COURSE TITLE		CREDITS HOURS:	PRE-REQUISITE
Instrumentation and Measurements		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING ACTIVITIES:
SK3 (Engineering Fundamentals) SK6 (Engineering Practice)		SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Resources) TA3 (Innovation)
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
SDG9- Industry, Innovation and Infrastructure		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem analysis) TC-4 (Design and development of solution) TC-5 (Evaluation) TC-8 (Individual and Collaborative Team work)	
Course Objective			
To provide students the understanding of sensors, transducers and DC/AC measuring instruments, concepts of accuracy/precision and familiarize them with many varieties of meters, scopes, transducers available, their operating principles, strengths and weaknesses.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
	After completion of this course students will be able to:		
CLO-1	Understand the theory of sensors/transducers and analogue DC and AC measuring instruments and associated errors.	C2 (Cognitive) Understand	PLO-1 / SA1 (Engineering Knowledge)
CLO-2	Analyze the integration of ADC and DAC with analog and digital system and use of electronic meters to achieve required output for measurement system	C3 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Performs the measurements from the sensors, transducers and instruments	P3 (Psychomotor) Guided Response	PLO-5 / SA5 (Tool Usage)
CLO-4	Demonstrate use of sensors, transducers, and electronic measuring instruments mismatch losses. and perform error analysis while following the international standards	P4 (Psychomotor) Mechanism	PLO3 / SA3 (Design/ Development of Solution)

CLO-5	Completes assigned tasks with active individual participation and effective contribution towards team assignment/projects.	A3 (Affective) Valuing	PLO8 / SA8 Individual and Collaborative team work
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Course Outline for Theory

- Transducers and Sensors: Basic principle of different sensor technologies. Temperature, Pressure, Resistance,, Linear variable differential transformer (LVDT), Capacitive, photoconductive, piezo-electric and thermo-electric transducers.
- Principles of Measurement, elements of a measurement system, Choosing appropriate measuring instruments, instrument types, smart and non-smart instruments,
- Static & dynamic characteristics of instruments (Accuracy, Precision and error etc), Necessity for calibration
- DC/AC Indicating Meters: The d'Arsonval movement, galvanometer application (ammeters, voltmeters and ohm measurements) and calibration. Half wave and full wave rectifier meters. Single phase wattmeter, Instrument transformers (CT and PT) and energy measurement meters (including AMI meters). Resistance, capacitance and inductance bridges
- Electronics/Digital Meters: Sampling, Quantization, Data Acquisition, A/D conversion. Transistor voltmeter circuits and operational amplifier voltmeter circuits, AC electronic voltmeters and current and resistance measurement.

Lab Work Outline for Practical

- Galvanometer, ammeter, voltmeter and ohm meter combinations
- Electronic Wattmeter & Energy Meters.
- Wheatstone bridge, Kelvin bridge, Maxwell Bridge, Hay Bridge, Schering Bridge, Wien Bridge
- LVDT, LDR, RTD, Pressure & Ultrasonic Sensor
- Bridge Measurements, Temperature Measurement, Light Sensors, Linear Position or Force Applications, Environmental Measurements, Rotational Speed or Position Measurements

RECOMMENDED BOOKS

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

**Course Contents
(Breadth)**

8.28 Electrical Machines

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Electrical Machines		(2+1)	Electrical Network Analysis
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK4 (Engineering Specialist Knowledge) SK6 (Engineering Practice)		SP1 (Depth of Knowledge Required) SK5 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG9- Industry, Innovation and Infrastructure		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis) TC (Evaluation), TC-8 (Individual and Collaborative Team work)	
Course Objective			
After completion of this course students will be able to understand and analyze the transformer circuits and describe their practical application in single-phase and three-phase systems, the principle of operation of AC and DC machines, the effect of machine parameters on the performance of a given AC or DC machine in terms of speed, torque, power, and efficiency			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand the concepts of magnetic fields to analyze magnetic circuits and principle of operation of a transformer and electrical machines.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Compute the various parameters of DC / AC generators and motors, their equivalent circuits, the relationships between speed, power, torque, and applications	C3 (Cognitive) Apply	PLO-2 / SA2 (Problem Analysis)

CLO-3	Perform different types of tests to calculate losses, efficiency, voltage regulation and selection of transformer, DC machines and AC machines.	P3 (Psychomotor) Guided Response	PLO4 / SA4 (Investigation)
CLO-4	Measure voltage-current characteristics, load characteristics, torque speed characteristics and speed regulation of DC-AC motors	P4 (Psychomotor) Mechanism	PLO5 / SA5 (Tool Usage)
CLO-5	Complete assigned tasks with active individual participation and affective contribution towards team assignments/projects while adhering to safety precautions.	A2 (Affective) Responding	PLO8/ SA8 (Individual and Collaborative Teamwork)

Course Outline for Theory

- The main focus of this course is to understand the magnetic field, the reluctance of magnetic materials, and air.
- Introduction of the theory and operation of transformer and DC/AC machines with an emphasis on the testing and measurement of machine characteristics and parameters.
- The voltage-current characteristics, voltage regulation of DC generators, torque-speed characteristics, speed regulation of DC motors, and the generalized concepts of electromechanical energy conversion are included mainly in this course.
- The AC machines fundamentals and the production of rotating magnetic fields, the working principles, construction, characteristics, and equivalent circuit of three-phase synchronous generators, synchronous motors and induction motors.

Lab Work Outline for Practical

- Working operations of transformers and Electrical Machines, transformer tests, the connection group of three phase transformer,
- Working operations of DC Machines (Motors and Generators), no load and load characteristics of DC Machines (Motors and Generators), speed control methods of dc motors
- Characteristics of single phase AC motors, working characteristics of three phase synchronous and asynchronous motors,
- Working characteristics of capacitive split-phase single-phase asynchronous motors, energy consumption
- Braking circuit of three-phase asynchronous motor and starting control circuits of three phase ac motors, speed control methods of three phase ac motors

RECOMMENDED BOOKS

1. Stephen J. Chapman, "Electric Machinery Fundamentals", McGraw-Hill. (Latest Edition)
2. Charles I. Hubert, Electrical Machines, Theory, Operation, Applications, Adjustment, and Control, (latest Edition).
3. Fitzgerald, Kingsley, and Umans, "Electric Machinery", McGraw-Hill. (Latest Edition)

8.29 Embedded Systems

COURSE TITLE:	CREDIT HOURS	PRE-REQUISITE	
Embedded Systems (Core)	(1+1)	DLD	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK2 (Procedural Knowledge) · SK4 (Specialist Knowledge)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) · SP4 (Familiarity of Issues)	TA1 (Range of Resources) TA2 (Level of Interactions) · TA4 (Innovation Extent)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSIONAL COMPETENCE PROFILE	
SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & Apply Universal Knowledge) TC-3 (Problem Analysis) TC-5 (Evaluation)	
Course Objective			
After completion of this course students will be able to understand embedded system architecture, interfacing techniques, programming methods, and hardware-software integration using microcontrollers and embedded development tools for industrial and real-time applications.			
CLO	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand embedded system architecture, microcontroller organization, and interfacing concepts for intelligent, human-centric, and sustainable embedded applications	C2 Understanding	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze embedded system operations, peripheral interfacing, real-time control applications, embedded solutions for Industrial IoT (IIoT), automation, and Industry 5.0 environments.	C4 Analyze	PLO2 / SA2 (Problem Analysis)
CLO-3	Perform programming, interfacing, and testing experiments using embedded development platforms and software tools.	P3 Guided Response	PLO5 / SA5 (Tool usage)
CLO-4	Present embedded system projects and experimental results effectively using professional communication practices for intelligent, human-centric, and sustainable embedded applications	A2 Responding	PLO9 / SA9 (Communication)
Course Outline for Theory			

- Introduction to embedded systems, applications, characteristics, and classification of embedded systems, evolution towards Industry 5.0 and human-centric embedded systems
- Architecture of microcontrollers and embedded processors, CPU organization, registers, and memory organization
- Embedded hardware components, system design considerations, and input/output interfacing techniques
- Instruction sets, addressing modes, and assembly language programming concepts
- Fundamentals of embedded C programming, program structure, variables, functions, and embedded development environments
- Timers, counters, and delay generation techniques in embedded systems
- Interrupt handling concepts, interrupt service routines, and real-time response mechanisms
- Serial communication concepts and UART communication protocol implementation
- SPI and I2C communication protocols, interfacing methods, and communication analysis
- Analog-to-Digital Conversion (ADC) and Digital-to-Analog Conversion (DAC) techniques and applications
- Sensor and actuator interfacing techniques including temperature sensors, motors, relays, and embedded control systems
- Real-Time Operating System (RTOS) concepts, task scheduling, synchronization, and multitasking in embedded systems
- Embedded system debugging, testing methods, troubleshooting techniques, and performance analysis
- Low power and energy efficient embedded system design techniques and optimization methods
- Embedded communication systems, Industrial Internet of Things (IIoT), Industrial automation (AI-enabled embedded systems), consumer electronics, smart devices, and security considerations edge computing
- Project demonstrations, presentation of embedded system applications, technical report writing, innovation and entrepreneurship in embedded systems, and communication of experimental results

Lab Work Outline for Practical

- Introduction to embedded systems laboratory, familiarization with microcontroller development boards, IDEs, and programming environments, and Industry 5.0 embedded development platforms (e.g., ESP32/STM32).
- LED interfacing and control programming using embedded C
- Push button and switch interfacing experiments with input/output control applications
- Timer and counter programming applications including delay generation and event counting
- Interrupt handling experiments and implementation of interrupt service routines including communication with Industrial IoT devices
- Serial communication using UART protocol for data transmission and reception SPI communication protocol implementation and interfacing experiments
- I2C communication protocol implementation and interfacing of peripheral devices
- LCD and display module interfacing for embedded system output applications
- Analog sensor interfacing and Analog-to-Digital Converter (ADC) experiments
- Motor, relay, and actuator interfacing applications for embedded control systems
- Embedded C programming for real-time monitoring and control applications
- Debugging and testing of embedded programs using software and hardware debugging tools
- Mini embedded system project implementation, preparation of technical laboratory report, and presentation of project results

RECOMMENDED BOOKS



Curriculum for Bachelor of Electrical Engineering Technology



1. Embedded Systems: Introduction to Arm Cortex-M Microcontrollers — Jonathan W. Valvano, (Latest Edition)
2. Embedded Systems Architecture — Tammy Noergaard, (Latest Edition)
3. The 8051 Microcontroller and Embedded Systems — Muhammad Ali Mazidi, Janice Mazidi & Rolin McKinlay (Latest Edition)
4. Embedded C Programming and the Microchip PIC — Richard Barnett, Larry O’Cull & Sarah Cox, (Latest Edition)

8.30 Control Technology (Depth)

COURSE TITLE:	CREDITS HOURS:	PRE-REQUISITE	
Control Technology	(2+1)	Electrical Network Analysis	
KNOWLEDGE & ATTITUDE PROFLE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Specialized Engineering Technology Knowledge) SK6 (Engineering Practice)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TC-3 (Innovation) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile:	
SDG9- Industry, Innovation and Infrastructure		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-5 (Evaluation)	
Course Objective			
After completion of this course students will be able to understand, analyze, and evaluate classical and industrial control systems using mathematical modeling, stability analysis, frequency response techniques, PID controllers, and modern engineering tools for practical industrial applications.			
Course Learning Outcomes	CLOs Statement: After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand mathematical models of electrical and mechanical systems using transfer functions, state-space modeling, block diagrams, and signal flow graphs.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze the principles of stability, root locus and its design response for open-loop and closed-loop control systems	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)

CLO-3	Execute simulations and laboratory experiments using MATLAB/Simulink and control trainers.	P4 (Psychomotor) Mechanism	PLO5 / SA5 (Tool Usage)
CLO-4	Affectively Present the experiments performed in laboratory with interpretation of experimental data and results.	A2 (Affective) Responding	PLO9/ SA9 Communication

Course Outline for Theory

- Introduction to control systems, applications of control systems, open-loop and closed-loop systems, feedback concepts, and functional block diagrams.
- Basic modeling and representation of control systems using transfer functions, block diagrams, RLC circuits, and MATLAB/Simulink-based industrial applications.
- Block diagram reduction techniques and rules for simplification of control systems.
- Signal Flow Graphs (SFGs) and Mason's Gain Formula.
- Introduction to time response analysis, poles and zeros, first-order system response, and transient response specifications.
- Second-order systems, transient response characteristics, damping ratio, natural frequency, and performance analysis.
- Steady-state error analysis, system types, static error constants, and error evaluation for unity and non-unity feedback systems.
- Stability analysis of Linear Time Invariant (LTI) systems using Routh-Hurwitz stability criterion.
- Root Locus technique, properties of root locus, angle and magnitude conditions, and stability analysis using root locus.
- Frequency response analysis, Bode plots, gain margin, phase margin, and stability analysis using Bode plots.
- Nyquist stability criterion and frequency-domain stability analysis.
- Introduction to P, PI, PD, and PID controllers and controller tuning concepts.
- Introduction to PLC, SCADA, and Industry 4.0 concepts and industrial process control applications.
- Introduction to MATLAB/Simulink environment and control system toolbox.
- Modeling and simulation of first-order and second-order systems.
- Transfer function implementation and block diagram simulation using MATLAB.
- Signal flow graph analysis and verification using simulation tools.
- Time response analysis of control systems.
- Stability analysis using Routh-Hurwitz criterion.
- Root locus plotting and analysis using MATLAB.
- Frequency response analysis using Bode and Nyquist plots.
- Implementation and tuning of PI, PD, and PID controllers.
- Servo motor speed and position control experiments.



Curriculum for Bachelor of Electrical Engineering Technology



- Sensors, transmitters, and actuator interfacing experiments.
- Industrial control trainer experimentation and troubleshooting of basic control problems.

RECOMMENDED BOOKS

- Norman S. Nise, Control Systems Engineering, Wiley, Latest Edition.
- Katsuhiko Ogata, Modern Control Engineering, Pearson, Latest Edition.
- Benjamin C. Kuo, Automatic Control Systems, Wiley, Latest Edition.
- S. K. Bhattacharya, Control Systems Engineering, Pearson, Latest Edition.
- Dorf & Bishop, Modern Control Systems, Pearson, Latest Edition.
- Chris T. Kilian, Modern Control Technology, Cengage Learning, Latest Edition.

8.31 Communication Systems

COURSE TITLE	CREDIT HOURS	PRE-REQUISITE	
Communication Systems (Core)	(2+1)	Signals and Systems	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK3 (Engineering Fundamentals)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSSIONAL COMPETENCE PROFILE	
SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis), TC-10 (Communication & Collaboration)	
Course Objective			
The objective of this course is to provide students with a comprehensive understanding of analog, digital, wireless, and cellular communication systems and their fundamental principles. The course aims to develop the ability to analyze and apply modulation, multiplexing, and signal processing techniques used in modern communication systems. It also enables students to evaluate system performance in terms of bandwidth, noise, Signal-to-Noise Ratio (SNR), and Bit Error Rate (BER). Furthermore, the course develops practical skills through MATLAB-based simulation and analysis of communication systems under different channel and noise conditions.			
CLO	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Explain the fundamental concepts, components, and operation of analog, digital, wireless, and cellular communication systems.	C2 (Understand)	PLO-1/SA1 (Engineering Knowledge)
CLO-2	Apply modulation, multiplexing, and signal processing techniques in analog and digital communication systems.	C3 (Apply)	PLO-2/SA2 (Problem Analysis)
CLO-3	Analyze the performance of communication systems in terms of bandwidth, noise, signal-to-noise ratio (SNR), Bit Error Rate (BER), and frequency spectrum utilization	C4 (Analyze)	PLO-4/SA4 (Investigation)
CLO-4	Implement and simulate analog and digital communication systems using MATLAB, including analog modulation schemes, digital modulation techniques, and noise effects analysis in communication channels.	P4 (Mechanism)	PLO-5/SA5 (Tool Usage)
CLO-5	Perform MATLAB-based simulation experiments to measure BER, SNR, and frequency spectrum of communication signals	P4 (Mechanism)	PLO-4/SA4 (Investigation)

	under different noise and channel conditions		
Course Outline for Theory			
• Introduction to Communication Systems, block diagram of communication systems, elements and functions of transmitter, channel, receiver, and noise sources, modes and methods of communication • Transmission media including guided and unguided media, bandwidth concepts, frequency spectrum, signal power, noise, and Signal-to-Noise Ratio (SNR) • Fundamentals of Analog Modulation, Amplitude Modulation (AM), modulation index, spectrum analysis, bandwidth requirements, and AM generation techniques • DSB-SC and DSB-LC modulation techniques, generation and demodulation methods, power efficiency, and bandwidth comparison • Single Sideband (SSB) and Vestigial Sideband (VSB) modulation, generation methods, spectrum analysis, bandwidth efficiency, and practical applications • Angle modulation techniques including Frequency Modulation (FM) and Phase Modulation (PM), modulation index, spectrum characteristics, bandwidth analysis, and demodulation techniques • Pulse communication concepts, sampling theorem, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), and Pulse Position Modulation (PPM) • Pulse Code Modulation (PCM), Differential PCM (DPCM), Delta Modulation (DM), quantization, companding techniques, and noise analysis • Line coding techniques, digital pulse transmission, synchronization, error detection concepts, and review of mid-semester topics • Multiplexing techniques including Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM), and Wavelength Division Multiplexing (WDM) • Introduction to Digital Communication Systems, ASK and FSK modulation techniques, coherent and non-coherent detection methods • PSK modulation schemes including BPSK, QPSK, DPSK, signal constellation, matched filters, and noise performance analysis • Quadrature Amplitude Modulation (QAM), bandwidth efficiency, spectral efficiency, BER analysis, and comparison of digital modulation schemes			
Lab Work Outline for Practical			
• Introduction to MATLAB environment for communication systems, generation and visualization of sinusoidal signals, frequency spectrum analysis using FFT, and basic signal operations • Simulation and analysis of Amplitude Modulation (AM), determination of modulation index, envelope detection, and spectrum analysis • Simulation of Double Sideband Suppressed Carrier (DSB-SC) and Double Sideband Large Carrier (DSB-LC) modulation and demodulation techniques • Simulation of Single Sideband (SSB) and Vestigial Sideband (VSB) modulation schemes with bandwidth comparison and spectrum analysis • Simulation of Frequency Modulation (FM) and Phase Modulation (PM), analysis of modulation index, bandwidth, and demodulation techniques • Verification of Sampling Theorem and implementation of Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), and Pulse Position Modulation (PPM) • Implementation of Pulse Code Modulation (PCM), quantization, encoding and decoding of digital signals • Simulation of Differential PCM (DPCM) and Delta Modulation (DM), analysis of quantization noise and slope overload distortion • Implementation and analysis of companding techniques and line coding schemes including			

NRZ, RZ, Manchester, and Bipolar coding

- Simulation of multiplexing techniques including Frequency Division Multiplexing (FDM) and Time Division Multiplexing
- Simulation of digital modulation techniques including Amplitude Shift Keying (ASK) and Frequency Shift Keying (FSK) with coherent and non-coherent detection
- Simulation and performance analysis of Phase Shift Keying (PSK) modulation schemes including BPSK and QPSK under noisy channel conditions
- Simulation of Quadrature Amplitude Modulation (QAM), analysis of constellation diagrams, bandwidth efficiency, and BER performance [
- MATLAB-based performance evaluation of communication systems by measuring Signal-to-Noise Ratio
- (SNR), Bit Error Rate (BER), and frequency spectrum under different channel noise conditions

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 Contents

8.32 Electrical Power Transmission (Breadth)

COURSE TITLE	CREDITS HOURS:	PRE-REQUISITE	
Electrical Power Transmission	(2+1)	None	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:	
SK3 (Engineering Fundamentals) SK4 (Engineering Specialist Knowledge) SK6 (Engineering Technology Knowledge)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues)	TA1 (Range of Resources) TA2 (Level of Interactions) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG7- Affordable and Clean Energy		TC-3 (Problem Analysis) TC-4 (Design and Development of Solutions) TC-5 (Evaluation) TC-10 (Communication and Collaboration)	
Course Objective			
After completion of this course students will be able to understand electrical power transmission systems, transmission line performance, design, and modern transmission technologies used in electrical power networks and validation of transmission system concepts in lab work with the interpretation of results.			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand electrical power systems, substations, AC/DC transmission systems, and transmission network structure.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze transmission lineparameters,corona effects, skin effects, and transmission line performance.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)

CLO-3	Analyze overhead transmission line components including conductors, insulators, sag, tension, and mechanical loading conditions.	C4 (Cognitive) Analyze	PLO-3 / SA3 (Design and Development of Solutions)
CLO-4	Perform experiments and simulations related to transmission lines and interpret the obtained results.	P3 (Psychomotor) Guided Response	PLO4 / SA4 (Investigation)
CLO-5	Present technical findings related to transmission systems using written reports and oral presentations.	A2 (Affective) Responding	PLO9/ SA9 Communication

Course Outline for Theory

- Electrical Power System: Overview of electrical power systems including generation, transmission, and distribution. AC and DC power systems. Important elements of AC and DC substations. Requirements for a satisfactory electrical supply system.
- Transmission Lines: Purpose of transmission systems. Advantages of AC and DC high-voltage transmission. Transmission system of Pakistan.
- Comparison of AC, HVDC, and smart transmission systems. Important elements of transmission systems. Corona effect and skin effect in transmission lines. Economics of electric power transmission.
- Parameters of overhead transmission lines, types and calculations of transmission lines.
- Mechanical Design of Overhead Transmission Lines: Conductor materials used in transmission lines. Line supports and tower structures. Insulators and their types.
- Voltage distribution over insulator strings, string efficiency and methods of improving string efficiency. Sag and tension calculations. Effect of wind pressure and ice loading. Ground clearance and safety standards.
- Renewable energy integration challenges, digital substations, AI and IoT applications in power transmission systems.

Lab Work Outline for Practical

- Power systems overview and familiarization with transmission system components.
- Determination of primary parameters of transmission lines.
- Steady-state analysis of transmission lines.
- Study of insulators used in overhead transmission lines.
- Transient analysis of transmission lines.
- Mechanical design analysis of overhead transmission lines.
- Simulation of AC and HVDC transmission systems using modern software tools.
- Technical report writing and presentation of laboratory investigations.
- Recommended Software / Tools: MATLAB / Simulink, ETAP, PSCAD, Power World Simulator etc.



Curriculum for
Bachelor of Electrical Engineering Technology



RECOMMENDED BOOKS

1. Electrical Transmission and Distribution Reference Book by Central Station Engineers, Westinghouse (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)

8.33 Power System Distribution & Utilization

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE	
Power System Distribution & Utilization		(2+1)	None	
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:	
SK3 (Engineering Fundamentals) SK6 (Engineering Technology Knowledge)		SP1 (Depth of Knowledge Required) SP4 (Familiarity of Issues)	TA4 (Innovation) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile		
SDG7- Affordable and Clean Energy		TC-3 (Problem Analysis) TC-4 (Design and Development of Solutions), TC-5 (Evaluation)		
Course Objective				
After completion of this course students will be able to understand power system distribution and the utilization in various applications and validation of concepts in lab work with the interpretation of results.				
Course Learning Outcomes	CLOs Statement		Taxonomy (Level)	Program Outcomes (PLO)
	After completion of this course students will be able to:			
CLO-1	Design and evaluate distribution systems, cables, and substations		C5 (Cognitive) Synthesis	PLO3 / SA3 (Design and Development of Solutions)
CLO-2	Understand various applications of electrical power for illumination, heating, and traction.		C2 (Cognitive) Comprehension	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-3	Perform experiments in laboratory in order to interpret experimental data using distribution simulators and utilization trainers.		P3 (Psychomotor) Guided Response	PLO4 / SA4 (Investigation)
CLO-4	Present and interpret lab data in written reports and presentation.		A2 (Affective) Responding	PLO8/ SA8 Individual and Collaborative Teamwork
Course Outline for Theory				

DC and AC Distributors:

Analysis of DC and AC distributors, covering pointed and uniform loading, distributors fed at one versus both ends, ring main and stepped main configurations, and the effects of unbalanced loading on three-phase AC distributors.

Underground Cables:

Underground cables in depth, including calculation of cable resistance, inductance, and capacitance, methods of cable installation (direct burial, duct, trough), voltage drop and power loss estimation, types of industrial cables (XLPE, PILC, EPR), and cable fault localization techniques such as Murray loop, Varley loop, and time-domain reflectometry (TDR), along with modern techniques.

Static Substations:

Substation location selection and layout criteria, classification of substations (indoor/outdoor, pole-mounted, grid, mobile, on base of voltage levels, function, and importance), bus bar arrangements (single, double, sectionalized, ring main, transfer), and grounding methods for the star neutral point including solid, resistance, and reactance grounding.

Utilization: The illumination engineering (luminous flux, efficacy, illumination levels, types of lamps including LED, fluorescent, and high-intensity discharge), electrical heating including resistive heating (direct and indirect), induction heating (coreless and core type), and dielectric heating with applications in electric furnaces (arc furnace, induction furnace), followed by electrical traction systems including classification (DC and AC traction), traction motor types (series motor, compound motor, linear induction motor), and typical layout of railway electrification systems.

Lab Work Outline for Practical

1. Introduction to distribution system
2. Study construction of various cables and nomenclature.
3. Calculation Cable size of for various loads.
4. Prepare a layout scheme for a substation.
5. Study of radial, ring main, and interconnected distribution systems using simulators
6. Visit of substation for familiarization with substation equipment.
7. Use of software for luminance arrangement and lay out design.
8. Demonstration of different tests of cables.
9. Fault localization in underground cables using Murray loop and Varley loop
10. Measurement of Earth resistance and insulation resistance.
11. Measurement of high voltage and current using PT and CT.
12. Demonstration of Resistance & Induction heating.
13. Demonstration of different types of welding methods.
14. Verification of laws of Illumination.
15. Demonstration on different types of lamps.

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)
3. Generation, distribution and utilization of electrical energy, C.L Wadhwa, Wiley Eastern Limited (Latest edition)
4. Turan Gönen, "Electric Power Distribution System Engineering" CRC Press(Latest edition)

Course Contents (Depth Core)

8.34 Power System Analysis

COURSE TITLE:		CREDITS HOURS	PRE-REQUISITE
Power System Analysis		(2+1)	Linear Circuit Analysis
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Engineering Specialist knowledge) SK6 (Engineering Practice)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required) TA1 (Range of Sources)	TA1 (Range of Resources) TA3 (Innovation)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG7- Affordable and Clean Energy		TC-1 (Comprehend & apply universal knowledge) TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis) TC-5 (Evaluation) TC-8 (Individual and Collaborative Team work)	
Course Objective			
After completion of this course students will be able to understand the principles of power flow analysis, fault analysis, stability analysis in interconnected power systems, modeling of transmission lines, generators/loads as well as advanced techniques like optimal power flow and dynamic simulation. The students should also be able to apply computational tools and software for analyzing complex power systems, addressing challenges such as grid integration.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Understand the concepts of per unit values, Y/Z Bus bus formations, load flow studies, symmetrical/asymmetrical fault calculations.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze the symmetrical faults and unsymmetrical faults conditions and the stability of the system.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)

CLO-3	Analysis of symmetrical and asymmetrical faults, power system stability and load management using available software.	P4 (Psychomotor) Mechanism	PLO5 / SA5 (Tool Usage)
CLO-4	Adapt the effect of dynamic load and power factor variations on three phase power systems using relevant software.	P6 (Psychomotor) Adaptation	PLO8 / SA8 (Individual and Collaborative Teamwork)
CLO-5	Invite the suggestions of others during group discussions and team assignments/projects	A3 (Affective) Valuing	PLO9/ SA9 (Communication)

Course Outline for Theory

- Three phase system and per phase representation
- Transmission and distribution networks with associated switching systems, transformer stations, lines/cables and other components
- Voltage drop, loss and compensation in point to point transfer
- Inductance / capacitance of cables and modelling of transmission lines
- Load and short circuit calculations
- Power transformer characteristics and equivalent diagram
- Per unit description and load flow calculations
- Symmetrical and asymmetrical grids

Lab Work Outline for Practical

- Analyse symmetrical and asymmetrical short- circuit and earth fault at the receiving end of the transmission line.
- Apply per unit models and admittance matrices
- Analyse the effect of dynamic load and dynamic power factor on three phase power systems.
- Analyse zero phase impedance, series reactive power and parallel reactive power compensation in three-phase transmission lines.
- Analyse power system maximum power demand and load management using SCADA software.

RECOMMENDED BOOKS

1. Power System Analysis by John J. Grainger and William D. Stevenson, Jr. (latest edition)
2. Electric Power Systems: A Conceptual Introduction by Alexandra von Meier (latest edition)
3. Power System Analysis and Design by J. Duncan Glover, Thomas J. Overbye, and Mulukutla S. Sarma. (latest edition)
4. Power System Analysis by Hadi Saadat,, McGraw-Hill International Editions (latest edition)



Curriculum for
Bachelor of Electrical Engineering Technology



8.35 Project Management

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
		(2+0)	None
Project Management			
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:
SK3 (Engineering Fundamentals) SK7 (Communication and Society) SK9 (Professional Practice)		SP2 (Range of Conflicting Requirements) SP3 (Depth of Analysis Required) SP5 (Extent of Applicable Codes)	TA2 (Level of Interactions) TA4 (Innovation) TA5 (Familiarity)
Sustainable Development Goals (SDGs):			Professional Competence Profile
SDG8- Decent Work and Economic Growth SDG12- Responsible Consumption and Production			TC-9 (Manage engineering activities) TC-10 (Communication and Collaboration)
Course Objective			
The objective of this course is to develop project planning, scheduling, management, teamwork, leadership, and decision-making skills for engineering and technology projects.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Understand the concepts, tools, scheduling methods, budgeting techniques, and risk management practices used in project management.	C2 (Cognitive) Understand	PLO-2 / SA2 (Problem Analysis)
CLO-2	Demonstrate awareness of teamwork, leadership, stakeholder coordination, and ethical responsibilities in managing engineering and technology projects.	A2 (Affective) Responding	PLO-8 / SA8 (Individual and Collaborative Team Work)
CLO-3	Organize and practice project planning, communication, resource management, and professional decision-making for successful project execution.	A4 (Affective) Organization	PLO-10 / SA10 (Project Management)
Course Outline for Theory			
Introduction to Management: History of management, functions and functional areas of management, levels of management, managerial skills, organizational structures, managerial			

control, and principles of management.

- Introduction to Project Management: Definition of project and project management, project life cycle, project characteristics, project constraints, project organization structures, and project knowledge areas.
- Project Quality Management: History of quality management, quality concepts, relationship between project management and quality management, and quality management frameworks.
- Project Stakeholder Management: Roles of project manager and sponsor, project team selection, competencies of project managers, team management, and stakeholder management.
- Project Cost Estimating and Budgeting: Cost estimation methods, budgeting, life cycle cost, cost scheduling, forecasting, resource allocation, earned value management, and cost control.
- Project Risk Management: Concepts of risk and uncertainty, business and project risk, probability and impact of risks, and risk management processes.
- Project Time Management: Project scheduling, Critical Path Method (CPM), network representation, Gantt charts, critical activities, and project timelines.

Lab Work Outline for Practical

NA

RECOMMENDED BOOKS

1. Project Management: A System Approach to Planning, Scheduling and Controlling by Harold Kerzner, latest Edition, John Wiley
2. Project Management: A Managerial Approach by Jack R. Meredith and Samuel J. Mantel Jr., latest Edition
3. Project Management for Engineering and Technology: Principles and Practice by John M. Nicholas and Herman Steyn latest Edition
4. Project Management: A Strategic Planning Approach by Paul Gardiner, latest Edition, Palgrave Macmillan, 2

8.36 Introduction to Foreign Language and Culture

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

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

The course objectives may include the following:

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

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

Course Contents (Depth Elective)

8.37 Renewable Energy Technology

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Renewable Energy Technology		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK3 (Engineering Fundamental) SK5 (Engineering Design)		SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP4 (Familiarity of issues)	TA1 (Range of Sources) TA3 (Innovation) TA4 (Consequences to society and the environment)
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG7- Affordable and Clean Energy		TC-1 (Comprehend & apply universal knowledge) TC-2 (Comprehend & apply local knowledge) TC-4 (Design and development of solution) TC-5 (Evaluation) TC-6 (Protection of Society) TC-10 (Communication & Collaboration)	
Course Objective			
After completion of this course students will be able to understand the physical principles, operating mechanisms, and design characteristics of major renewable energy technologies including Solar PV, Concentrating Solar Power, wind turbines, hydropower, and biomass and analyze the costs, lifecycle analyses, ecological consequences and financial benefits of renewable generation			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Demonstrate the fundamental characteristics of different renewable energy sources and mechanisms to harness these technologies.	C3 (Cognitive) Apply	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Compare the traditional energy sources and renewable energy sources to analyze their ecological/financial impacts on the environment.	C4 (Cognitive) Analyze	PLO-6 / SA6 (The Engineering Technologists and the World)
CLO-3	Operate equipment and practice the design of the characteristics of various renewable source configurations.	P3 (Psychomotor) Guided Response	PLO4 / SA4 (Investigation)

CLO-4	Design a standalone and grid connected photovoltaic system as per specified (consumer defined) parameters	P5 (Psychomotor) Complex Overt Response	PLO3 / SA3 (Design/development of Solutions)
CLO-5	Express the observations during a power plant visit and write a comprehensive report.	A3 (Affective) Responding	PLO9 / SA9 Communication
Course Outline for Theory			
• Introduction to Renewable Energy Systems: Worldwide Energy Scenario, Types of Renewable Energy Technologies, • Designing of Wind Energy systems: Classifications and best locations for wind Energy systems. • Designing Solar Energy systems: Designing 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. • Problems in energy sector: Review of present energy state of energy sector, Different sources of • energy, Components of power systems, Energy crises. 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 Work Outline for Practical			
• Learn the use of basic renewable energy gadgets. • Simulation to perform specialized alternate methods for generation/conversion energy efficiency, micro-grids, and smart grid integration of renewable energies systems with conventional grid • Evaluate the voltage and current curves of solar panels to determine maximum power points • Analyse the air parameters at different conditions, impact of installation height, wind power and average wind power. • Comparative analysis of different concentrating solar power systems • Design a stand alone and grid connected photovoltaic system • Visit a thermal/solar or Nuclear power plant			
RECOMMENDED BOOKS			
1. Renewable Energy: Power for a Sustainable Future by Godfrey Boyle (latest edition) 2. Renewable Energy Sources and Emerging Technologies by D.P. Kothari, Rakesh Ranjan, and K.C. Singal. (latest edition) 3. Solar Photovoltaics: Fundamental, technologies and applications, SOLANKI, CHETAN SINGH: Prentice Hall, (latest edition) 4. Wind and Solar Power Systems: Design, Analysis, and Operation by Mukund R. Patel, Omid Beik 5. (latest edition)			

Course Contents (Depth)

8.38 Electrical Safety

COURSE TITLE:		CREDITS HOURS	PRE-REQUISITE
Electrical Safety		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK4 (Specialized Knowledge)		SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources), TA2 (Level of Interactions), TA5 (Familiarity)
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-7 (Legal Regularity and Culture)	
Course Objective			
The objective of this electrical safety course is to equip students with the knowledge and skills to identify electrical hazards, understand Permit to Work procedures, selection of Personal Protective Equipment (PPE), and respond effectively to electrical emergencies.			
Course Learning Outcomes	CLOs Statement: After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand emerging electrical safety standards, technologies, and regulatory updates.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze safety protocols that protect public health, well-being, and infrastructure.	C4 (Cognitive) Analyze	PLO-6 / SA6 (The Engineering Technologist and the World)
CLO-3	Display the function, proper use, and inspection requirements of electrical safety equipment.	P3 (Psychomotor) Guided Response	PLO11 / SA11 (Lifelong Learning)
CLO-4	Identify the safety hazards in premises exhibit safety drills.	A2 (Affective) Responding	PLO8/ SA8 (Individual and The Collaborative Teamwork)

Course Outline for Theory

The electrical safety course will focus on electrical safety rules, Permit to Work (PTW) systems, Personal Protective Equipment (PPE), and emergency handling procedures. The course may include;

- Fundamentals of electrical hazards including electric shock, arc flash dangers. Study safety rules, including Lock Out Tag Out (LOTO) six-step procedure, approach boundary requirements from limited to prohibited, voltage-based safe distances ranging from 1 foot for low voltage to 4 feet for 121kV, and the test-before-touch protocol, along with detailed safety rules for daily practice.
- Complete Permit to Work (PTW) system including five permit types (electrical work, live work, LOTO, hot work, and excavation permits). PTW process flow from request through close-out, plus specific requirements for live work permits including justification criteria, multi-level approval, safety observer mandate, and Category 3-4 PPE requirements.
- Electrical PPE including head protection (Class E and G hard hats), eye and face protection (safety glasses to arc-rated hoods across Categories 0-4), rubber insulating gloves (Classes 00 through 4 with voltage ratings from 500V to 36kV, color codes, and pre-use inspection procedures including air testing), foot protection (EH rated), and complete Category 4 arc flash suit assembly.
- Emergency response protocols including the shock rescue procedure (do not touch, turn off power, remove victim with non-conductive tools, check responsiveness, call emergency, perform CPR using 30:2 compression-to-ventilation ratio, treat burns with cool water and sterile dressings), arc flash burn treatment, electrical fire response using CO₂ or dry chemical extinguishers with the PASS technique, downed power line protocol (minimum distance to be maintained, shuffle-walk if exiting is necessary), and required emergency equipment including AED (Automated External Defibrillator), eyewash stations, emergency showers, and burn kits with monthly inspection requirements.
- Electrical power generation, transmission and distribution safety. Wapda rules and regulations regarding electrical safety.

Lab Work Outline for Practical

Lock Out Tag Out (LOTO) Procedure Simulation – Demonstrate six-step LOTO process on a training panel including energy isolation, lock application, tag placement, and zero energy verification. **Understanding of Electrical Safety Equipment** – Demonstrate various PPEs used in electrical work on field.

Electrical Emergency Response Simulation – Respond to mock electric shock scenario including power isolation, victim removal using non-conductive materials, CPR application, and burn treatment. **Electrical Fire Extinguisher Selection and Use** – Identify correct extinguisher type (CO₂ or dry chemical) for different voltage levels and practice PASS technique on simulated electrical fire.

Downed Power Line Emergency Protocol – Practice safe evacuation including 35-foot distance maintenance, vehicle stay/exit decision, and shuffle-walk technique using mock power line setup.

RECOMMENDED BOOKS

Electrical Safety Handbook by John Cadick, Mary Capelli-Schellpfeffer, and Dennis K. Neitzel (Latest Edition)

8.39 High Voltage Technology

COURSE TITLE	CREDITS HOURS	PRE-REQUISITE	
High Voltage Technology	(2+1)	Power System Transmission	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Specialist knowledge) SK7 (Engineering in Society)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP6 (Extent of Stake holder involvement and Conflicting requirement)	TA1 (Innovation), TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG7- Affordable and Clean Energy SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge) TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis) TC-5 (Evaluation)	
Course Objective			
After completion of this course students will be able to acquire in-depth knowledge of electrical insulation systems, dielectric breakdown mechanisms, and high-voltage generation / measurement techniques used in power systems. Key objectives include analyzing electric fields, testing equipment reliability, and mastering insulation coordination to prevent system failures.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Comprehend the principles governing theory and topologies in high voltage technology	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze the effects of high voltages on its surrounding and protection measures, insulating materials and testing of high voltage equipment (cables and transformers).	C4 (Cognitive) Analyze	PLO6 / SA6 (The Engineering Technologist and the World)
CLO-3	Demonstrate the methods of high-voltage generation & measurement and the breakdown mechanisms in solid, liquid and gaseous dielectrics.	P3 (Psychomotor) Guided Response	PLO4 / SA4 (Investigation)
CLO-4	Perform Power frequency and Impulse Voltage Tests on Power Transformer	P4 (Psychomotor) Mechanism	PLO5 / SA5 (Tool Usage)

CLO-5	Present the experiments in laboratory with interpretation of experimental data and results in circuits.	A2 (Affective) Responding	PLO9/ SA9 Communication
Course Outline for Theory			
- Fundamental principles of high-voltage test techniques, - Generation and measurement of high AC voltages, impulse voltages and currents, - Construction elements for high voltage circuits and transformers - Shielding and earthing requirement of high-voltage circuits/systems, - Standards to test electrical equipment against BIL and BSL levels, - Introduction to insulation coordination, aging and analysis - Dimensions and technical equipment of the high voltage test setups, - Experiments with AC, DC and impulse high voltages,			
Lab Work Outline for Practical			
- Circuits for high-voltage experiments and fencing, shielding and earthing requirement of test setups. - Generation of AC high voltages and measurements. - Generation of DC high 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			
- High Voltage Engineering Fundamentals by E. Kuffel, W.S. Zaengl, and J. Kuffel (latest edition) - High Voltage Engineering: Fundamentals - Technology - Applications by Andreas Kuchler (latest edition) - High Voltage and Electrical Insulation Engineering by Ravindra Arora and Wolfgang Mosch (latest edition)			

Course Contents (Breadth)

8.40 Switchgear and Protective Devices Technology

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Switchgear and Protective Devices Technology		(2+1)	None
KNOWLEDGE & ATTITUDE PROFLE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:
SK3(Engineering Fundamental) SK4 (Engineering Specialist Knowledge) SK6(Engineering Technology Knowledge)		SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required)	TA1 (Innovation), TA5 (Familiarity)
Sustainable Development Goals (SDGs)		Professional Competence Profile:	
SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-6 (Protection of Society)	
Course Objective			
After completion of this course students will be able to understand power system distribution and the utilization in various applications and validation of concepts in lab work with the interpretation of results.			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand the basic knowledge of protection system attributes and the concepts of various protection schemes.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Evaluate the protection schemes design for power system protection.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Recognize safety protocols that protect public health, well-being, and infrastructure.	C1 (Cognitive) Knowledge	PLO-6 / SA6 (The Engineering Technologist and World)
CLO-4	Perform experiments in laboratory in order to interpret experimental data and observe its results in the electrical protection system.	P3 (Psychomotor) Guided Response	PLO4 / SA4 (Investigation)

CLO-5	Present the experiments in performed in laboratory with interpretation of experimental data and results in circuits.	A2 (Affective) Responding	PLO9/ SA9 Communication
Course Outline for Theory			
Protection Relays and Fuse: •Definition and basic operating principle of fuse. •Parts of a fuse, and their types: Rewirable (kit-kat), Cartridge, HRC/HBC, Diazed, NEOZED •HRC (High Rupturing Capacity) / HBC (High Breaking Capacity) fuse construction, operating principle, rating, breaking capacity and advantages of HRC. •Current-limiting phenomenon: interrupts fault before first peak •Principle of circuit interruption in circuit breakers, Circuit Breaker-Types and characteristics. Protection Relaying: •Need for protective relaying in power systems, principles and characteristics of protective relaying, theory and classification of relays •Relay attributes: Selectivity, Speed, Sensitivity, Reliability and Stability of relaying •Overcurrent, differential, distance, earth fault, directional, frequency relays •Electromagnetic, static, numerical relays •Instantaneous, definite time, inverse time, IDMT operation •Instrument Transformer: CTs and VTs, 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, Buchholz 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. Transmission Lines Protection: Drawbacks of overcurrent protection, Distance protection, Zones of protection.			
Lab Work Outline for Practical			
1. To study different types of switch gear equipment used in electrical power systems. 2. To identify the components of different types of circuit breakers. 3. To study the operation of over current relay and plot the performance characteristics. 4. To study the directional over current relay. 5. To study the magnetization of CT and its associated problems. 6. Plot the characteristics of fuse wire.			

7. To determine the transformation ratio of current transformers with different primary currents and load influence on the secondary, carryout the performance tests.
8. To determine the transformation ratio of a voltage transformer and load influence on the secondary. Carry out the performance tests.
9. Connection of the voltage transformers with open delta of 3-phase lines.
10. To study transformer differential protection.
11. To understand the protection schemes of alternators and sketch labelled schematic diagram of alternator, types of protection of alternators.
12. To understand types and specifications of neutral earthing and specification of earthing at different substations
13. To understand types and specifications of lightning assertors of different manufacturers through literature/brochures.
14. Visit to a local high voltage substation

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 Contents (Depth)
8.41 Electrification Technology

COURSE TITLE		CREDITS HOURS:	PRE-REQUISITE
Electrification Technology		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4(Specialized Engineering Knowledge) SK6(Engineering Technology Knowledge)	SP1 (Depth of Knowledge Required) SP4 (Familiarity of Issues)	TA1 (Range of Resources) TA4 (Innovation) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG11- Sustainable Cities and Communities		TC-3 (Problem Analysis) TC-4 (Design and Development of Solutions), TC-5 (Evaluation)	
Course Objective			
After completion of this course students will be able to understand use of renewable energy in place of fossil in transportation and buildings and validation of concepts in lab work with the interpretation of results.			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Explain renewable energy sources and distributed generation concepts	C2 (Cognitive) Comprehension	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze various concepts of microgrids, smart grids, vehicle to grid and building energy management system.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Apply economics and environmental aspects of renewable adoption for energy management to create sustainable cities (buildings and transport)	C3 (Cognitive) Application	PLO-6/ SA6 (Engineering Technologist and the World)
CLO-4	Perform experiments in laboratory in order to interpret experimental data using trainers and MATLAB simulators.	P3 (Psychomotor) Guided Response	PLO-4 / SA4 (Investigation)
CLO-5	Present and interpret lab data in written reports and presentation.	A2 (Affective) Responding	PLO-8/ SA8 Individual and Collaborative Teamwork

Course Outline for Theory

Renewable Energy & Distributed Generation:

Overview of global energy challenges, fossil fuel depletion, climate change impacts, and the need for decarbonization of transportation and building sectors. Principles of major renewable energy sources including solar PV, solar thermal, wind energy, biomass, bioenergy, geothermal, and hydrogen. The concept of **distributed generation (DG)**, benefits such as reduced transmission losses, improved reliability, and integration of small-scale generation at or near the point of consumption.

Microgrids, Smart Integration:

Microgrids – including AC, DC, and hybrid microgrid architectures, islanded and grid-connected operation modes, and control strategies for integrating distributed generation, storage, and loads at building or community scale. **Smart grids**, vehicle-to-grid (V2G) technology enabling EV batteries such as mobile storage, building energy management systems (BEMS), net-zero energy buildings (NZEB), demand response, and load shifting.

Building and Transportation:

Rooftop and building-integrated PV (BIPV), solar water heating, ground-source heat pumps, biomass heating systems, and hybrid renewable configurations. Renewable-powered EV charging stations, hydrogen fuel cell vehicles (FCVs), biofuels (biodiesel, bioethanol, biogas), and renewable energy applications in rail, marine, and aviation sectors. Energy storage technologies (lithium-ion batteries, thermal storage, hydrogen storage, flywheel, and second-life EV batteries) are covered to address intermittency of renewables. Technical, economic, and regulatory aspects of renewable adoption are examined including net metering, feed-in tariffs, levelized cost of energy (LCOE), payback period analysis, and barriers to implementation. Real-world **case studies** include zero-energy homes, solar-powered commercial buildings, renewable-powered EV charging networks, hydrogen bus fleets, and community microgrids. Upon completion, students will be able to analyze, evaluate, and design renewable energy integration solutions for transportation and building applications with a focus on distributed generation and microgrid systems.

Lab Work Outline for Practical

1. Study of solar PV module characteristics (I-V and P-V curves) under varying irradiance
2. Design and simulation of a rooftop solar PV system for a building
3. Performance analysis of a solar water heating system for buildings
4. Study of a small-scale wind turbine for building integration
5. Design and simulation of a solar-powered EV charging station
6. Performance analysis of battery energy storage system (lithium-ion) for building and EV applications
7. Simulation of a distributed generation (DG) system (solar + wind + storage) for a residential building using MATLAB Simulink.
8. Design and simulation of an AC microgrid using MATLAB Simulink.
9. Study of vehicle-to-grid (V2G) technology simulation of power flow between EV battery and building or grid.
10. Implementation of a building energy management system (BEMS) for load optimization
11. Measurement of solar irradiance using pyranometer and energy yield estimation
12. Study of power quality issues (voltage fluctuation, harmonics) in grid-connected renewable systems

RECOMMENDED BOOKS

1. *Principles of Sustainable Energy Systems (Latest Edition)* by Charles F. Kutscher, Jana B. Milford, and Frank Kreith, CRC Press
2. *Reinventing the Power Grid: Renewable Energy, Storage, and Grid Modernization, (Latest Edition)* by Nesimi Ertugrul, CRC Press

Course Contents (Depth)

8.42 Industrial Drives and PLC

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Industrial Drive and PLC		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK3 (Engineering Fundamentals) SK4 (Engineering Specialist Knowledge) SK5 (Engineering Design and Operation)		SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues)	TA4 (Innovation) TA5 (Familiarity)
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG8- Decent Work and Economic Growth: SDG12- Responsible Consumption and Production		TC-3 (Problem Analysis) TC-4 (Design and Development of Solutions),	
Course Objective			
After completion of this course students will be able to understand and analyze the industrial automation system (drive and PLC) and validation of concepts in lab work with the interpretation of results			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Analyze electrical drives (DC and AC drives, VFDs, and power converters) to select the appropriate drive for industrial applications.	C4 (Cognitive) Analyze	PLO2 / SA2 (Problem Analysis)
CLO-2	Apply sensor/actuator principles and PLC knowledge to develop solutions for modern industrial processes.	C3 (Cognitive) Apply	PLO-3 / SA3 (Design/ Development of Solutions)
CLO-3	Comprehend the knowledge of industrial drive and PLC in IR 5.0 application.	C2 (Cognitive) Understand	PLO-6 / SA6 (Engineering Technology and the World)
CLO-4	Perform experiments in laboratory in order to interpret experimental data using industrial sensors and motor drives.	P3 (Psychomot or) Guided Response	PLO4 / SA4 (Investigation)

CLO-5	Build PLC logic programs for various industrial processes using software and hardware simulators.	P4 (Psychomotor) Mechanism	PLO5/ SA5 (Tool Usage)
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: Concepts of electrical drives, including DC and AC motor classification, Types of drive, Trends in Drive Technology, construction, operating principles, and speed control techniques. power converters such as rectifiers, inverters, and choppers, DC motor operation modes, DC drives (armature and field control) Single Phase Drives, Three-Phase Drives, Stator voltage control, rotor voltage control, Stator current control, Stator voltage and frequency control, Variable frequency drives (VFD), Park transform and Field oriented control. Industrial Sensors and Actuators: Principles, selection, and applications of industrial sensors including flow, temperature, pressure, level, proximity, and chemical analyzers. Emphasis is placed on sensor interfacing with PLCs, signal conditioning, calibration, and practical use in automation and process control industries. Types, selection, and control of industrial actuators, including electric actuators, pneumatic actuators, and hydraulic actuators, Programmable Logic Controller: Introduction to PLC, types of PLC, PLC hardware architecture, I/O modules, memory organization, and communication protocols. Ladder logic diagram and programming of PLC, using timers, counters, compare instructions, and mathematical operations. Human machine Interface (HMI) of PLC, with sensors and actuators, and troubleshooting industrial control systems. Industrial Revolution 5.0 Application: To transform drives and PLC applications by embedding human-centric control/automation, environmental sustainability, and resilient manufacturing into traditional automation. The basic ladder logic and fixed-speed motor controls are enhanced to include collaborative robotics safety integration, real-time energy optimization through smart Variable Frequency Drives (VFDs), and predictive maintenance using edge-computed PLC data and intelligent human-machine interfaces (HMIs) that prioritize operator well-being.			
Lab Work Outline for Practical			
1. Perform speed control operation of DC motor. Shunt Motor. Series Motor. Compound motor. VFD. 2. Study Mechanical and Electrical Braking Systems. 3. Familiarize various industrial sensors. 4. Perform a simple ON-OFF operation on a standard PLC. 5. Perform AND, OR, AND-OR, OR-AND operation on a standard PLC. 6. Perform a Time Delay operation on a standard PLC. OFF-Time Delay. ON-Time Delay 7. Perform a Counter operation on a standard PLC. 8. Perform a Flip-Flop Operation on a standard PLC.			

9. 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. Power electronics: converters, applications, and design, by Ned Mohan (Latest Edition)
3. Electric Motors and Drives by Austin Hughes and Bill Drury (Latest edition)
4. Programmable Logic Controllers, Frank D. Petruzella, McGraw-Hill (Latest Edition)
5. PLC Manuals for Siemens and Mitsubishi. (Latest edition)

Course Contents (Depth Elective)

8.43 Power Generation Technology

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
Power Generation Technology		(2+1)	Electronic Devices & Circuits
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK4 (Specialized Engineering Technology Knowledge) SK6 (Engineering Practice)		SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA-4 (Consequences to society and the environment) TA5 (Familiarity)
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG9- Industry, Innovation and Infrastructure SDG7- Affordable and Clean Energy		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis),	
Course Objective			
After completion of this course students will be able to understand the operating principles, environmental impacts, and practical operation of conventional and renewable power generation technologies using modern engineering tools and industrial practices.			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Interpret the operating principles and major components of conventional and renewable power generation systems.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	List electricity generation technologies for a better environment.	C1 (Cognitive) Remembering	PLO6 / SA6 (Engineering Technologist and the World)
CLO-3	Analyze the operation and performance parameters of thermal, hydro, gas turbine, nuclear, and renewable energy power plants.	C4 (Cognitive) Analyze	PLO2 / SA2 (Problem Analysis)
CLO-4	Operate power generation equipment and practice various characteristics of operation.	P3 (Psychomotor) Precision	PLO4 / SA4 (Investigation)

CLO-5	Conduct experiments in a laboratory to observe various conditions of power generation considering electrical design parameters.	P4 (Psychomotor) Mechanize	PLO4 / SA5 (Tool Usage)
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Course Outline for Theory

Introduction of Electricity Generation Technologies: History and Evaluation, Electrical Networks, Renewable Energy and Distributed Generation, Environmental Impacts. 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 Reforming, Cost. Diesel Power Generation: Types of diesel generator, usage of diesel generator. 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 Work Outline for Practical

Introduction to laboratory safety and power plant equipment. 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, Latest Edition.
2. Wakil, Power Plant Technology, McGraw Hill, Latest Edition.
3. G.D. Rai, Introduction to Power Plant Technology, Khanna Publishers, Latest Edition.
4. M.U. Deshpande, Elements of Electrical Power Station Design, PHI Learning, Latest Edition.
5. P.K. Nag, Power Plant Engineering, McGraw Hill, Latest Edition.

Course Contents (Depth Elective)

8.44 Energy Conservation and Auditing

COURSE TITLE	CREDITS HOURS	PRE-REQUISITE	
Energy Conservation and Auditing	(1+1)	Electrical Power Systems	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES:	
SK4 (Engineering Specialist knowledge) SK6 (Knowledge of Engineering Technologies)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA-4 (Consequence to society and the environment) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG7- Affordable and Clean Energy SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-7 (Legal, Regulatory and Cultural)	
Course Objective			
After completing this course, students will be able to apply systematic energy conservation techniques, conduct energy audits, identify energy saving opportunities, evaluate economic feasibility of energy efficiency measures, and promote sustainable practices in electrical systems and industrial facilities using modern engineering tools and standards.			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand the principles of energy conservation, energy management systems, and regulatory frameworks.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze energy consumption patterns, load profiles, and energy performance indicators for industrial, commercial, and residential sectors.	C4 (Cognitive) Analyze)	PLO2 / SA2 (Problem Analysis)

CLO-3	Apply an appropriate energy conservation method to reduce the wastage of energy.	C3 (Cognitive) Apply	PLO4 / SA4 (Investigation)
CLO-4	Imitate energy conservation measures in electrical systems.	P3 (Psychomotor) Guided Response	PLO5 / SA5 (Tool Usage)
CLO-5	Conduct energy audit of an industry/organization	C3 (Cognitive) Apply	PLO8 / SA8 (Individual and Collaborative Teamwork)

Course Outline for Theory

Energy Conservation Approaches:

- 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,

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 Work Outline for Practical

- Introduction to energy audit instruments including power quality analyzer, lux meter, thermal imager, and tachometer.
- Load profiling and analysis of a 3-phase induction motor under various loading conditions using data logging techniques.
- Lighting audit includes lux measurement, comparison of existing lighting with LED retrofitting, and estimation of energy saving potential.
- Power factor correction including power factor measurement and capacitor bank sizing for target power factor improvement.
- Motor efficiency testing includes no-load and full-load tests, and efficiency estimation using IEEE standard methods.
- Industrial / institutional visit involving real-time energy audit exercise, data collection, and preparation of a preliminary audit report.
- Open Ended Lab (OEL) involves investment-grade energy audit for a selected facility such as college workshop, canteen, or hostel.
- Final energy audit report submission and team-based presentation.



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RECOMMENDED BOOKS

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

Course Contents (Depth Elective)

8.45 Power Electronics Technology

COURSE TITLE	CREDITS HOURS	PRE-REQUISITE	
Power Electronics Technology	(2+1)	Electronic Devices & Circuits	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Specialized Engineering Technology Knowledge) SK5 (Engineering Design)	SP1 (Depth of Knowledge Required) SK5 (Depth of Analysis Required)	TA3 (Innovation) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-5 (Evaluation)	
Course Objective			
After completion of this course students will be able to understand, analyze, and implement power electronic converter circuits using power semiconductor devices, modern control techniques, and simulation tools for industrial and renewable energy applications.			
Course Learning Outcomes	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Explain the construction, operation, switching characteristics, and applications of power semiconductor devices used in power electronic systems.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze power electronic converter circuits using mathematical modeling and performance evaluation techniques.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)

CLO-3	Design basic power electronic converter circuits for specified load and industrial application requirements.	C3 (Cognitive) Apply	PLO-3 / SA-3 (Design/Development of Solutions)
CLO-4	Perform simulations and laboratory experiments involving power electronic converters to evaluate converter performance and industrial applications.	P3 (Psychomotor) Guided Response	PLO4 / SA4 (Investigation)
CLO-5	Affectively present and communicate laboratory experiments, and simulation results	A2 (Affective) Responding	PLO9/ SA9 (Communication)

Course Outline for Theory

- Introduction to power electronics, applications, industrial importance, and comparison with linear electronics.
- Power semiconductor devices, switching characteristics, and applications of Power Diodes, Power BJT, MOSFET, IGBT, and Thyristors/SCRs.
- Steady-state and switching characteristics of semiconductor power devices and power computations.
- Single-phase uncontrolled rectifiers including half-wave and full-wave rectifiers, center-tapped and bridge configurations.
- Rectifiers with resistive, inductive, and R-E loads.
- Three-phase diode rectifiers including star and bridge type configurations.
- Single-phase controlled rectifiers, semi converters, full converters, and dual converters.
- Three-phase controlled rectifiers and performance analysis.
- DC-to-DC converters, continuous and discontinuous conduction modes (CCM/DCM), and chopper classifications.
- Buck converters, Boost converters, and Buck-Boost converters.
- Four-quadrant chopper and industrial applications such as DC motor drives and automotive
- Applications of power electronics in renewable energy systems, electric vehicles, motor drives, and industrial automation.
- Single-phase voltage source inverters (VSI), PWM techniques, and inverter performance analysis
- Three-phase inverters with R and RL loads.
- Harmonic analysis and FFT analysis of PWM inverters using MATLAB/Simulink.

Lab Work Outline for Practical

- Study of switching characteristics of SCR/Thyristor.
- Study of switching characteristics of Power BJT.
- Study of switching characteristics of Power MOSFET.
- Study of switching characteristics of Power IGBT.
- Implementation and analysis of single-phase uncontrolled rectifiers.
- Implementation and analysis of single-phase controlled rectifiers.
- Study and implementation of first-quadrant chopper circuits.
- Study and implementation of four-quadrant chopper circuits.

- Design and analysis of Buck regulator circuits.
- Design and analysis of Boost regulator circuits.
- Design and analysis of Buck-Boost regulator circuits.
- Implementation of single-phase full bridge square-wave inverter.
- FFT analysis and PWM inverter simulation using MATLAB/Simulink.
- Application of semiconductor devices in power converter systems.
- Mini project/Open Ended Lab (OEL) involving power converter applications.

RECOMMENDED BOOKS

1. Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, Pearson, Latest Edition.
2. Ned Mohan, Tore M. Undeland, and William P. Robbins, Power Electronics: Converters, Applications and Design, Wiley, Latest Edition.
3. P. S. Bimbhra, Power Electronics, Khanna Publishers, Latest Edition.
4. Daniel W. Hart, Power Electronics, McGraw-Hill, Latest Edition

8.46 Cloud Application Development and Operations

COURSE TITLE:	CREDIT HOURS	PRE-REQUISITE	
Cloud Application Development and Operations	(2+1)	Computer Programming	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Specialist Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSIONAL COMPETENCE PROFILE	
SDG9- Industry, Innovation and Infrastructure SDG8- Decent Work and Economic Growth		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis), TC-5 (Evaluation) TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to provide students with practical and theoretical knowledge of cloud application development and cloud operations used in modern computing environments. The course covers cloud computing architectures, virtualization, containerization, cloud deployment, DevOps practices, monitoring, and cloud security concepts. Students will develop skills in building, deploying, managing, and monitoring cloud-based applications using modern cloud platforms and automation tools. Practical exposure through cloud laboratories and projects enables students to implement scalable, reliable, and secure cloud solutions for industrial and enterprise applications.			
CLO	CLOs Statement	Taxonomy (Level)	Program Outcome s (PLO)
CLO-1	After completion of this course students will be able to: Explain the fundamental concepts of cloud computing, cloud service models, deployment models, and cloud application architectures.	C2 (Understand)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply cloud application development, deployment, virtualization, and containerization techniques using modern cloud platforms and tools.	C3 (Apply)	PLO3 / SA3 (Design/ Development of Solutions)
CLO-3	Analyze cloud system performance, scalability, security, reliability, and operational efficiency in cloud-based environments.	C4 (Analyze)	PLO2 / SA2 (Problem Analysis)

CLO-4	Perform cloud deployment, monitoring, automation, and DevOps-related experiments using cloud platforms, containers, and orchestration tools.	P4 (Mechanism)	PLO5 / SA5 (Tool Usage)
CLO-5	Prepare technical documentation and communicate cloud application development, deployment, and operational outcomes using professional engineering practices.	A3 (Valuing)	PLO9 / SA9 (Communication)

Course Outline for Theory

- Introduction to cloud computing, evolution of cloud technologies, and applications of cloud systems
- Cloud service models including IaaS, PaaS, and SaaS, and cloud deployment models including public, private, hybrid, and community clouds
- Cloud architecture, virtualization concepts, hypervisors, and virtual machine management
- Fundamentals of cloud application development and cloud-native application architectures
- Containerization concepts using Docker and lightweight virtualization techniques
- Container orchestration and management using Kubernetes and related orchestration tools
- Cloud storage systems, distributed file systems, and cloud databases
- Cloud networking concepts including virtual networks, load balancing, DNS, and cloud communication services
- DevOps fundamentals, CI/CD pipelines, and automation techniques for cloud operations
- Infrastructure as Code (IaC) concepts and automation using tools such as Terraform and Ansible
- Cloud monitoring, logging, resource management, and performance optimization techniques
- Cloud security concepts including identity management, encryption, access control, and secure cloud operations
- Scalability, reliability, fault tolerance, and disaster recovery in cloud environments
- Serverless computing, edge computing, and emerging trends in cloud technologies
- Cloud applications for IoT, big data, artificial intelligence, and enterprise systems

Lab Work Outline for Practical

- Introduction to cloud platforms, virtual machines, cloud dashboards, and cloud service management tools
- Introduction to cloud platforms, virtual machines, cloud dashboards, and cloud service management tools
- Creation and management of virtual machines in cloud environments
- Deployment and configuration of cloud storage and cloud networking services
- Development and deployment of basic cloud-based applications
- Container creation, image management, and application deployment using Docker
- Container orchestration and application scaling using Kubernetes
- Configuration of cloud databases and distributed storage systems
- Load balancing and virtual network configuration experiments in cloud environments
- Development of CI/CD pipelines using DevOps tools such as GitHub Actions or Jenkins
- Infrastructure automation using Terraform or Ansible for cloud resource provisioning
- Cloud monitoring, logging, and performance analysis using cloud monitoring tools
- Cloud security implementation including access control, encryption, and identity management
- Mini-project involving deployment and management of a scalable cloud-based application using cloud services and DevOps tools
- Final project presentation, teamwork evaluation, technical report preparation, and



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professional communication of cloud application deployment results

RECOMMENDED BOOKS

1. Thomas Erl and Eric Barceló Monroy, Cloud Computing: Concepts, Technology, Security & Architecture, Pearson, Latest Edition.
2. Michael J. Kavis, Architecting the Cloud, Wiley, Latest Edition.
3. Nigel Poulton, The Kubernetes Book, Leanpub, Latest Edition.
4. John Arundel and Justin Domingus, Cloud Native DevOps with Kubernetes, O'Reilly Media, Latest Edition.
5. Yevgeniy Brikman, Terraform: Up & Running, O'Reilly Media, Latest Edition.
6. Barrie Sosinsky, Cloud Computing Bible, Wiley, Latest Edition

8.47 Computer Vision for Technologists

COURSE TITLE:	CREDIT HOURS	PRE-REQUISITE	
Computer vision for Technologists	(2+1)	Applications of Artificial Intelligence (AI)	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Specialist Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Resources) TA3 (Innovation) TA4 (Consequences to society & the environment)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSIONAL COMPETENCE PROFILE	
SDG9- Industry, Innovation and Infrastructure SDG8- Decent Work and Economic Growth:		TC-1 (Comprehend & Apply Universal Knowledge), TC-2 (Comprehend & Apply Local Knowledge) TC-3(ProblemAnalysis), TC-5 (Evaluation) TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to provide students with fundamental and practical knowledge of computer vision and image processing technologies used in modern engineering and industrial applications. The course covers image acquisition, image enhancement, feature extraction, object recognition, machine vision, and intelligent visual systems. Students will develop skills in implementing computer vision algorithms using modern programming tools and vision libraries for automation, robotics, healthcare, surveillance, and smart systems. Practical laboratory activities and projects enable students to analyze and design real-world computer vision applications effectively.			
CLO	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Explain the fundamental concepts of computer vision, digital image processing, image representation, and vision system components used in modern engineering applications.	C2 (Understand)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply image processing, feature extraction, object detection, and computer vision techniques using modern computational tools and programming environments.	C3 (Apply)	PLO3 / SA3 (Design/Development of Solutions)

CLO-3	Analyze computer vision system performance including image enhancement, segmentation accuracy, pattern recognition, and object tracking techniques.	C4 (Analyze)	PLO2 / SA2 (Problem Analysis)
CLO-4	Perform experiments involving image acquisition, processing, computer vision model implementation, and real-time vision applications using modern software tools and hardware platforms.	P4 (Mechanism)	PLO5 / SA5 (Tool Usage)
CLO-5	Demonstrate teamwork, technical reporting, ethical responsibility, and professional communication skills during computer vision projects and application development.	A3 (Valuing)	PLO9 / SA9 (Communication)

Course Outline for Theory

- Introduction to computer vision laboratory tools, OpenCV environment, image acquisition devices, and programming platforms
- Image acquisition and basic image processing using OpenCV and Python/MATLAB
- Image enhancement experiments including filtering, smoothing, and contrast adjustment
- Edge detection and feature extraction using Sobel, Canny, and related operators
- Image segmentation experiments using thresholding and clustering techniques
- Morphological image processing and object shape analysis experiments
- Object detection and pattern recognition implementation using computer vision libraries
- Face detection and recognition experiments using machine learning-based methods
- Motion detection and object tracking in video sequences
- Camera calibration and depth estimation experiments using stereo vision techniques
- Implementation of image classification using Convolutional Neural Networks (CNNs)
- Development of real-time computer vision applications for industrial or robotic systems
- Mini-project involving design and implementation of a computer vision application such as smart surveillance, defect detection, or autonomous navigation

Lab Work Outline for Practical

- Introduction to computer vision laboratory tools, OpenCV environment, image acquisition devices, and programming platforms
- Image acquisition and basic image processing using OpenCV and Python/MATLAB
- Image enhancement experiments including filtering, smoothing, and contrast adjustment
- Edge detection and feature extraction using Sobel, Canny, and related operators
- Image segmentation experiments using thresholding and clustering techniques
- Morphological image processing and object shape analysis experiments
- Object detection and pattern recognition implementation using computer vision libraries
- Face detection and recognition experiments using machine learning-based methods
- Motion detection and object tracking in video sequences
- Camera calibration and depth estimation experiments using stereo vision techniques
- Implementation of image classification using Convolutional Neural Networks (CNNs)
- Development of real-time computer vision applications for industrial or robotic systems
- Mini-project involving design and implementation of a computer vision application such as smart

surveillance, defect detection, or autonomous navigation

- Final project presentation, teamwork evaluation, technical report preparation, and ethical discussion of computer vision applications

RECOMMENDED BOOKS

1. Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods, Latest Edition, Pearson Education.
2. Computer Vision: Algorithms and Applications by Richard Szeliski, Latest Edition, Springer.
3. Learning OpenCV 4 Computer Vision with Python by Joseph Howse and Joe Minichino Latest Edition, Packt Publishing.
4. Deep Learning for Computer Vision by Rajalingappaa Shanmugamani Latest Edition, Packt Publishing.

8.48 Cyber Security for Critical Infrastructures

COURSE TITLE:		CREDIT HOURS	PRE-REQUISITE
Cyber Security for Critical Infrastructures		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK2 (Procedural Knowledge) SK4 (Specialist Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirements) SP3 (Depth of Analysis Required)	TA1 (Range of Resources) TA2 (Level of Interactions) TA4 (Innovation Extent)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSIONAL COMPETENCE PROFILE	
SDG9- Industry, Innovation and Infrastructure SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & Apply Universal Knowledge) TC-3 (Problem Analysis) TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to provide students with comprehensive knowledge of cybersecurity principles and protection mechanisms for critical infrastructure systems. The course covers industrial control systems security, cyber threats, network protection, risk assessment, and security management techniques used in modern industrial environments. Students will develop practical skills in vulnerability analysis, network monitoring, incident response, and cybersecurity tool usage. The course also emphasizes ethical practices, secure industrial communication, and protection of critical infrastructure in Industry 5.0 and smart industrial systems.			
CLO	CLOs Statement	Taxonomy (Level)	Program Outcoms (PLO)
	After completion of this course students will be able to:		
CLO-1	Explain the fundamental concepts of cybersecurity, critical infrastructure protection, industrial control systems, and cyber threats in modern industrial environments.	C2 (Understand)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply cybersecurity techniques, risk assessment methods, and security policies to protect critical infrastructure and industrial communication systems.	C3 (Apply)	PLO3 / SA3 (Design/Developm ent of Solutions)
CLO-3	Analyze cyberattacks, vulnerabilities, network security incidents, and security performance of industrial and critical infrastructure systems.	C4 (Analyze)	PLO2 / SA2 (Problem Analysis)
CLO-4	Perform cybersecurity experiments including vulnerability assessment, network monitoring, penetration testing, and incident analysis using modern security tools and platforms.	P4 (Mechanism)	PLO5 / SA5 (Tool Usage)
CLO-5	Demonstrate ethical and professional responsibility in conducting cybersecurity assessments and protecting critical infrastructure systems in accordance with legal, ethical, and industry standards.	A3 (Valuing)	PLO7 / SA7 (Ethics)

Course Outline for Theory

- Introduction to cybersecurity concepts, cyber threats, and critical infrastructure protection
- Overview of critical infrastructures including power systems, industrial plants, transportation, healthcare, and communication systems
- Fundamentals of industrial control systems (ICS), SCADA systems, PLCs, and distributed control systems
- Cybersecurity principles including confidentiality, integrity, availability, authentication, and access control
- Common cyber threats and attacks including malware, ransomware, phishing, denial-of-service, and insider threats
- Network security fundamentals including firewalls, intrusion detection systems, VPNs, and secure communication protocols
- Industrial communication security and vulnerabilities in SCADA and industrial automation systems
- Risk assessment methodologies, threat modeling, and cybersecurity management frameworks
- Cryptography fundamentals including encryption, hashing, digital signatures, and secure authentication techniques
- Cybersecurity standards and policies including ISO 27001, NIST Cybersecurity Framework, and IEC 62443
- Vulnerability assessment and penetration testing techniques for industrial and enterprise systems
- Incident detection, monitoring, response, and disaster recovery planning for critical infrastructures
- Cloud security, IoT security, and cybersecurity challenges in Industry 5.0 environments
- Ethical hacking concepts, cyber forensics, and digital evidence analysis
- Emerging cybersecurity technologies including AI-based threat detection and zero-trust architectures

Lab Work Outline for Practical

- Introduction to cybersecurity laboratory tools, virtual machines, network analyzers, and security testing environments
- Network scanning and device identification using cybersecurity tools
- Packet analysis and network traffic monitoring using Wireshark
- Firewall configuration and implementation of network access control policies
- Intrusion detection and prevention system (IDS/IPS) configuration and analysis
- Vulnerability assessment and security scanning using cybersecurity assessment tools
- Password security analysis and implementation of secure authentication mechanisms
- Encryption and decryption experiments using symmetric and asymmetric cryptographic techniques
- Secure communication setup using VPN and secure shell (SSH) protocols
- SCADA and industrial control system security simulation and attack analysis
- Penetration testing and ethical hacking experiments in controlled cybersecurity environments
- Incident response and cybersecurity log analysis for attack detection and mitigation
- Mini-project involving cybersecurity protection of a simulated industrial or critical infrastructure network
- Final cybersecurity project presentation, teamwork evaluation, technical report preparation, and ethical discussion on cyber defense practices

RECOMMENDED BOOKS

1. Cybersecurity for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS by Tyson Macaulay and Bryan L. Singer Latest Edition,, CRC Press.
2. Industrial Network Security: Securing Critical Infrastructure Networks for Smart Grid, SCADA, and Other Industrial Control Systems by Eric D. Knapp and Joel Thomas Langill, Latest Edition,, Syngress/Elsevier.
3. Cybersecurity and Cyberwar: What Everyone Needs to Know by P. W. Singer and Allan



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Friedman, Latest Edition,, Oxford University Press.

4. Practical Industrial Cybersecurity: ICS, Industry 4.0, and IIoT by Dale Peterson, Latest Edition, Academic Press.

Baicun Wang, Pai Zheng, Lihui Wang, and Dimitris Mourtzis (Eds.), *Human-Centric Smart Manufacturing Towards Industry 5.0*,

8.49 Industrial Communication Systems

COURSE TITLE:	CREDIT HOURS	PRE-REQUISITE	
Industrial Communication Systems	(2+1)	Communication Systems	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Engineering Specialized Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSSIONAL COMPETENCE PROFILE	
SDG9- Industry, Innovation and Infrastructure SDG12- Responsible Consumption and Production		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-5 (Evaluation) TC-8 (Ethics) TC-10 (Communication & Collaboration)	
Course Objective			
The objective of this course is to provide students with comprehensive knowledge of industrial communication systems used in automation industries and Industry 5.0 environments. The course aims to develop understanding of industrial networking architectures, communication protocols, PLCs, SCADA systems, and real-time industrial communication techniques. It also enables students to analyze and troubleshoot industrial communication networks for reliable and efficient automation performance. Furthermore, the course develops practical skills in configuring industrial devices and communication systems while promoting teamwork, technical communication, and safe engineering practices in industrial environments.			
CLO	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Describe the architecture, operation, and applications of industrial communication systems used in modern automation industries and Industry 5.0 environments.	C2 Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze and troubleshoot industrial communication networks to improve reliability and real-time industrial automation performance	C4 Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Configure and establish communication between PLCs, sensors, actuators, HMIs, and SCADA systems using industrial protocols	P3 Guided Response	PLO4 / SA4 (Investigation)

CLO-4	Prepare technical reports and present the design, implementation, and troubleshooting outcomes of industrial communication systems using professional engineering communication practices.	A3(Valuing)	PLO9/ SA9 Communication
Course Outline for Theory			
• Introduction to industrial communication systems, industrial automation concepts, and Industry 5.0 environments • Architecture and components of industrial communication systems including PLCs, sensors, actuators, HMIs, and SCADA systems • Fundamentals of industrial networking, communication models, and industrial communication requirements • Industrial transmission media including wired and wireless industrial communication technologies Industrial communication protocols including Modbus, Profibus, CAN bus, and DeviceNet Ethernet-based industrial communication systems including Industrial Ethernet, Profinet, EtherCAT, and Ethernet/IP • PLC communication concepts and interfacing techniques for industrial automation systems Sensor and actuator communication methods in industrial control systems • Human Machine Interface (HMI) systems and SCADA communication architecture • Real-time industrial communication systems and deterministic communication requirements • Industrial wireless communication systems including ZigBee, WirelessHART, and industrial IoT communication • Network reliability, redundancy, fault tolerance, and industrial communication troubleshooting techniques • Industrial network security, cybersecurity threats, safety standards, and secure industrial communication practices • Data acquisition systems, industrial monitoring, cloud integration, and smart manufacturing concepts • Applications of industrial communication systems in manufacturing, process control, robotics, and smart factories • Industrial automation project presentations, teamwork activities, technical report writing, and communication of industrial networking solutions			
Lab Work Outline for Practical			
• Introduction to industrial communication laboratory equipment, PLC trainers, SCADA software, and industrial networking tools • PLC programming and establishment of basic communication between PLC and input/output devices • Interfacing of industrial sensors and actuators with PLC systems • Configuration and testing of Modbus communication protocol between industrial devices • Configuration and analysis of Profibus or CAN bus industrial communication networks • Industrial Ethernet configuration and communication setup using Ethernet/IP or Profinet • Establishment of communication between PLC and HMI systems for industrial monitoring applications • SCADA system configuration for industrial process monitoring and control • Real-time industrial data acquisition and communication experiments • Wireless industrial communication setup using ZigBee or WirelessHART modules			

- Troubleshooting industrial communication faults using diagnostic tools and testing techniques
- Industrial network reliability and redundancy analysis experiments
- Mini-project involving integration of PLCs, sensors, actuators, HMI, and SCADA systems for industrial automation applications
- Final project presentation, teamwork evaluation, technical report preparation, and implementation of industrial safety practices during communication system deployment

RECOMMENDED BOOKS

1. Industrial Communication Systems by Simatic, Siemens AG, Latest Edition, Siemens Technical Publications.
2. Industrial Data Communications: Fundamentals and Applications by Lawrence M. Thompson, ISA Publications, Latest Edition.
3. Industrial Communication Technology Handbook by Richard Zurawski, CRC Press, Latest Edition.
4. Practical Industrial Data Networks: Design, Installation and Troubleshooting by Steve Mackay, Edwin Wright, John Park, and Dean Reynders, Elsevier/Newnes, Latest Edition.

8.50 Smart Embedded and Automation System

COURSE TITLE:	CREDIT HOURS	PRE-REQUISITE	
Smart Embedded and Automation System	(2+1)	Embedded Systems	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK3 (Engineering Fundamentals)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSSIONAL COMPETENCE PROFILE	
SDG9- Industry, Innovation and Infrastructure SDG8- Decent Work and Economic Growth		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis), TC-4 (Design and Development of Solutions) TC-5 (Evaluation) TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to provide students with practical knowledge of smart embedded systems and industrial automation technologies used in modern engineering applications. The course covers microcontroller-based embedded systems, interfacing techniques, sensors and actuators, industrial automation concepts, real-time monitoring, programmable control systems, and IoT-enabled automation solutions. Practical exposure is provided through hardware interfacing, embedded programming, automation system implementation, and smart control applications.			
CLO	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Explain the architecture, operation, and applications of smart embedded systems, sensors, actuators, and automation technologies used in industrial environments.	C2 Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply embedded programming and interfacing techniques to develop smart automation solutions using microcontrollers and embedded platforms.	C3 Apply	PLO3 / SA3 (Design/Development of Solutions)
CLO-3	Analyze embedded and automation system performance including sensor integration, communication interfaces, timing behavior, and control operations.	C4 Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-4	Implement and test embedded automation systems involving sensors, actuators, communication modules, and real-time monitoring using modern development tools.	P4 Mechanism	PLO5 / SA5 (Tool Usage)

CLO-5	Prepare technical documentation and present the design, implementation, and performance of smart embedded and automation systems using professional engineering communication practices.	A3 Valuing	PLO9/ SA9 Communication
Course Outline for Theory			
• Introduction to smart embedded systems, industrial automation technologies, and applications in modern engineering systems • Architecture of embedded systems including microcontrollers, processors, memory units, and input/output interfaces • Sensors and transducers used in automation systems including temperature, pressure, motion, and proximity sensors • Actuators and control devices including motors, relays, solenoids, and industrial control mechanisms • Fundamentals of embedded programming using embedded C and development environments for microcontroller systems • Digital input/output interfacing techniques and hardware integration methods • Analog interfacing concepts including ADC, DAC, and sensor signal conditioning techniques • Timers, counters, interrupts, and real-time operation in embedded automation systems • Serial communication interfaces including UART, SPI, and I2C for embedded communication systems • Wireless communication modules and IoT-enabled automation concepts using Wi-Fi, Bluetooth, and wireless sensor interfaces • Real-time monitoring systems and embedded data acquisition techniques • Programmable control systems and automation logic implementation in industrial applications • Smart automation system integration including sensor-actuator coordination and intelligent control applications • Industrial automation applications including smart homes, smart agriculture, robotics, and process automation systems • Embedded system testing, debugging, troubleshooting, reliability, and performance optimization techniques			
Lab Work Outline for Practical			
• Introduction to embedded automation laboratory tools, microcontroller development boards, IDEs, and programming environments • LED interfacing and digital input/output control using embedded programming techniques • Interfacing of push buttons, switches, and digital sensors with embedded platforms • Analog sensor interfacing and data acquisition using ADC techniques • Motor and actuator interfacing experiments for automation control applications • Timer and counter programming for embedded automation and real-time control systems • Interrupt handling experiments and event-driven embedded control applications • Serial communication experiments using UART, SPI, and I2C communication protocols • LCD and display module interfacing for embedded monitoring and visualization systems • Wireless communication and IoT interfacing using Wi-Fi or Bluetooth modules for smart automation systems • Real-time monitoring and embedded data logging applications using sensor networks • Development and testing of programmable automation control systems using embedded platforms • Mini-project involving implementation of a smart embedded automation application such as smart home, smart irrigation, or industrial monitoring system • Final project presentation, technical report preparation, teamwork evaluation, and professional communication of automation system results			



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RECOMMENDED BOOKS

1. Embedded Systems: Introduction to ARM Cortex-M Microcontrollers by Jonathan W. Valvano Latest Edition, CreateSpace Independent Publishing Platform.
2. Embedded Systems Design: An Introduction to Processes, Tools, and Techniques by Arnold S. Berger, Latest Edition, CMP Books/Morgan Kaufmann.
3. Programmable Logic Controllers by Frank D. Petruzella, Latest Edition, McGraw-Hill Education.
4. B. I. Morshed, *Embedded Systems – A Hardware-Software Co-Design Approach (Arduino-Based Approach)*, Latest Edition,
5. C. Ünsalan, H. D. Gürhan, M. E. Yücel, *Embedded System Design with ARM Cortex-M Microcontrollers*, Latest Edition,

8.51 Sensor Networks and IoT

COURSE TITLE:		CREDIT HOURS	PRE-REQUISITE
Sensor Networks and IoT		(2+1)	Communication Systems
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK4 (Specialist Knowledge)		SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSIONAL COMPETENCE PROFILE	
SDG9- Industry, Innovation and Infrastructure SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis), TC-5 (Evaluation) TC-10 (Communication & Collaboration)	
Course Objective			
This course covers the fundamentals and applications of Wireless Sensor Networks (WSNs) and Internet of Things (IoT) systems. The WSN portion focuses on node architecture, network organization, communication protocols, MAC and routing mechanisms, localization, and energy-efficient design for distributed sensing environments. The IoT portion introduces smart connected systems, cloud integration, IoT architectures, communication protocols, industrial IoT applications, and real-time monitoring systems. The course emphasizes practical deployment in smart environments such as industrial automation, healthcare, smart cities, and energy systems.			
CLO	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Explain the fundamental concepts of Wireless Sensor Networks including node architecture, network organization, communication models, and protocol stack design.	C2 Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze wireless sensor network protocols including MAC protocols, routing mechanisms, localization techniques, and time synchronization in terms of performance and energy efficiency.	C4 Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Describe Internet of Things (IoT) systems including architecture, communication protocols, cloud integration, and real-world applications in smart environments.	C2 Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-4	Perform experiments and simulations involving wireless sensor networks and IoT systems, including node configuration, data transmission, and cloud-based monitoring applications.	P3 Guided Response	PLO4 / SA4 (Investigation)

CLO-5	Demonstrate professional responsibility by effectively presenting and communicating technical findings from sensor network and IoT-based experiments and projects.	A2 Responding	PLO9/ SA9 Communication
Course Outline for Theory			
• Introduction to Wireless Sensor Networks (WSN), vision, evolution, applications, and design challenges, Sensor node architecture including hardware components, sensing units, processors, transceivers, memory, and power management • Energy consumption models, operating systems for sensor nodes, and energy-efficient operation techniques • Network architecture, sensor deployment strategies, gateway concepts, and design objectives of WSNs • Wireless communication fundamentals including RF propagation, channel behavior, and transceiver design considerations • MAC layer protocols including contention-based, schedule-based, and low duty-cycle communication mechanisms • IEEE 802.15.4, Bluetooth, IEEE 802.11 standards, and wireless communication technologies for sensor networks • Link layer functions including framing, error detection, error control, and reliability mechanisms • Addressing and naming techniques in sensor networks including MAC addressing and distributed address allocation • Time synchronization techniques and synchronization protocols for wireless sensor networks • Localization and positioning methods in single-hop and multi-hop wireless sensor network environments • Routing protocols including energy-efficient routing, geographic routing, unicast, multicast, and mobile sensor network routing • Introduction to Internet of Things (IoT), IoT vision, characteristics, ecosystem, and evolution • IoT architecture including device, network, edge, and cloud layers along with IoT communication protocols such as MQTT, CoAP, HTTP, and LoRaWAN • Cloud integration, IoT data management, storage, processing, visualization, industrial IoT applications, and IoT security challenges			
Lab Work Outline for Practical			
• Simulation and configuration of wireless sensor networks to study node deployment, connectivity, and data flow behavior using network simulation tools • Practical implementation of sensor node configuration and wireless communication setup using sensor network platforms • Performance analysis of MAC layer protocols including contention-based and schedule-based communication techniques, Implementation and analysis of low duty-cycle communication mechanisms for energy-efficient wireless sensor networks • Measurement and optimization of energy consumption in wireless sensor nodes • Implementation of routing protocols in WSN including multi-hop communication and path selection techniques • Experiments on data forwarding strategies and performance analysis of wireless sensor network routing mechanisms • Localization and positioning experiments in single-hop and multi-hop sensor network environments • Time synchronization experiments and synchronization protocol analysis in wireless sensor networks • Sensor interfacing and data acquisition using Arduino, ESP32, or similar μC platforms • Development of IoT communication systems using MQTT, HTTP, and related IoT protocols for device-to-cloud connectivity			

- Integration of sensor data with cloud platforms for real-time monitoring, visualization, and dashboard development
- Design and implementation of IoT applications such as smart environment monitoring, smart agriculture, and remote sensing systems
- Mini-project integrating Wireless Sensor Networks and IoT cloud systems for end-to-end data collection, transmission, analysis, technical reporting, and project presentation

RECOMMENDED BOOKS

1. W. Dargie and C. Poellabauer, *Fundamentals of Wireless Sensor Networks: Theory and Practice*. Chichester, U.K.: Wiley Latest Edition,
2. A. F. Forster, *Introduction to Wireless Sensor Networks*. Hoboken, NJ, USA: Wiley-IEEE Press, Latest Edition,
3. D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, and J. Henry, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*. IN, USA: Cisco Press, Latest Edition, 2017.
4. H. M. A. Fahmy, *Concepts, Applications, Experimentation and Analysis of Wireless Sensor Networks*. Cham, Switzerland: Latest Edition,

8.52 Satellite and RADAR Communication

COURSE TITLE:		CREDIT HOURS	PRE-REQUISITE
Satellite and RADAR Communication		(2+1)	Communication Systems
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK3 (Engineering Fundamentals) SK4 (Specialist Knowledge) SK6 (Engineering Technologies)		SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirements) SP3 (Depth of Analysis Required)	TA1 (Range of Resources) TA2 (Level of Interactions) TA3 (Innovation) TA4 (Consequences to society and environment)
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSSIONAL COMPETENCE PROFILE	
SDG9- Industry, Innovation and Infrastructure SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis)	
Course Objective			
Understand the principles, architecture, and operation of satellite and radar communication systems, Analyze satellite and radar links and microwave communication systems using engineering methods, Perform calculations related to RADAR range, Doppler effect, and communication performance, Use modern engineering tools and laboratory instruments for communication system analysis.			
CLO	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Interpret orbital mechanics, satellite subsystems, and radar fundamentals.	C2 Understand	PLO1 / SA1 (Engineering Knowledge)
CLO-2	Apply satellite link budgets and radar range equations for specific scenarios.	C3 Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Implement and evaluate the architecture of satellite multiple access schemes and basic RADAR signal processing techniques using standard engineering tools.	C3 Apply	PLO-3 / SA3 (Design/ Development of Solutions)
CLO-4	Conduct experiments to measure RF parameters using hardware and software tools.	P4 Practice	PLO5/ SA5 Tool Usage
Course Outline for Theory			

- Overview of satellite communication systems, frequency bands, applications, and satellite communication architecture
- Fundamentals of orbital mechanics, Kepler's laws, satellite orbits, and orbital parameters
- Classification of satellites including Geostationary, LEO, and MEO satellites, launch concepts, and space segment analysis
- Satellite subsystems including transponders, power systems, telemetry, tracking, and control systems
- Earth station architecture, antenna systems, uplink and downlink operations in satellite communication systems
- Satellite link budget analysis including free space path loss and atmospheric attenuation calculations
- Carrier-to-noise ratio analysis and performance evaluation of satellite communication links
- Multiple access techniques including FDMA, TDMA, CDMA, and satellite resource allocation methods
- Introduction to RADAR systems, RADAR block diagram, principles of operation, and applications of RADAR systems
- RADAR range equation, signal-to-noise ratio, receiver noise, and Radar Cross Section (RCS) analysis
- Types of RADAR systems including pulse RADAR, continuous wave RADAR, tracking RADAR, and surveillance RADAR
- Pulse repetition frequency, range resolution, angular resolution, and performance parameters of RADAR systems
- Doppler effect, moving target indication (MTI), and RADAR signal processing techniques
- Tracking RADAR concepts, target detection techniques, and radar data processing methods
- IoT and satellite internet systems, satellite-enabled communication services, and emerging trends in satellite and RADAR technologies

Lab Work Outline for Practical

- Introduction to RF tools and satellite communication tools including GNU Radio, LabVIEW, Spectrum Analyzer, Network Analyzer, Satellite Tool Kit, and RADAR simulation software
- Antenna pattern measurement and plotting radiation patterns of a horn antenna
- Satellite tracking using Gpredict or Orbitron software for real-time satellite monitoring
- Satellite link budget simulation and development of a link margin calculator using Excel or Python Path loss analysis and measurement of signal attenuation over distance using RF communication kits
- LNB characterization and measurement of conversion gain of a satellite Low Noise Block (LNB) converter
- Observation and analysis of BPSK and QPSK modulation schemes using oscilloscopes and RF trainers
- Doppler shift measurement using a Doppler RADAR module to determine object velocity
- RADAR range simulation and implementation of the RADAR range equation using MATLAB/Simulink
- Pulse width and resolution analysis for studying the effect of pulse width on RADAR range resolution
- Clutter rejection experiment by implementing a simple Moving Target Indicator (MTI) filter in software

RECOMMENDED BOOKS

1. Timothy Pratt – Satellite Communications Latest Edition.
2. Merrill Skolnik – Introduction to RADAR Systems Latest Edition.
3. Simon Kingsley – RADAR Systems Latest Edition.
4. Anil K. Maini–Principles and Applications Latest Edition.

8.53 Predictive Maintenance Technologies

COURSE TITLE:		CREDIT HOURS	PRE-REQUISITE
Predictive Maintenance Technologies		(2+1)	Applications of Artificial Intelligence (AI)
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING		RANGE OF ENGINEERING ACTIVITIES
SK2 (Procedural Knowledge) SK4 (Specialist Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirements) SP3 (Depth of Analysis Required)		TA1 (Range of Resources) TA3 (Innovation Requirement) TA5 (Familiarity)
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSSIONAL COMPETENCE PROFILE	
SDG8- Decent Work and Economic Growth: SDG12- Responsible Consumption and Production		TC-1 (Comprehend & Apply Universal Knowledge) TC-3 (Problem Analysis) TC-5 (Evaluation)	
Course Objective			
This course aims to provide students with comprehensive knowledge of predictive maintenance technologies and condition monitoring techniques used in modern industrial systems. The course covers fault diagnosis, vibration analysis, thermal monitoring, sensor technologies, data acquisition, and reliability analysis for industrial equipment maintenance. Students will develop practical skills in monitoring machine health, analyzing operational data, and implementing predictive maintenance strategies using modern tools and software. The course also emphasizes industrial safety, reliability improvement, and Industry 4.0-based smart maintenance practices.			
CLO	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Explain the principles, techniques, and industrial applications of predictive maintenance technologies used in modern engineering systems.	C2 (Understand)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply condition monitoring, fault diagnosis, and data analysis techniques for predictive maintenance of industrial equipment and systems.	C3 (Apply)	PLO2 / SA2 (Problem Analysis)
CLO-3	Analyze machine performance data, maintenance trends, vibration signals, thermal behavior, and fault indicators to improve equipment reliability and operational efficiency.	C4 (Analyze)	PLO2 / SA2 (Problem Analysis)

CLO-4	Perform predictive maintenance experiments using sensors, data acquisition systems, monitoring instruments, and analysis software tools.	P4 (Mechanism)	PLO5 / SA5 (Tool Usage)
CLO-5	Demonstrate teamwork and adherence to safety procedures during predictive maintenance laboratory activities and industrial case studies.	A3 (Valuing)	PLO8 / SA8 (Individual and collaborative teamwork)

Course Outline for Theory

- Introduction to maintenance strategies including corrective, preventive, and predictive maintenance concepts
- Fundamentals of predictive maintenance technologies and industrial applications
- Reliability concepts, equipment failure mechanisms, and maintenance planning techniques
- Sensors and transducers used in predictive maintenance systems
- Data acquisition systems and signal conditioning techniques for industrial monitoring
- Vibration analysis fundamentals and machine condition monitoring techniques
- Frequency spectrum analysis, FFT concepts, and vibration-based fault diagnosis
- Thermal monitoring and infrared thermography techniques for predictive maintenance
- Lubrication analysis, oil condition monitoring, and wear particle analysis techniques
- Ultrasonic testing and acoustic emission techniques for fault detection
- Motor current signature analysis and electrical equipment condition monitoring
- Industrial IoT and smart sensor integration for predictive maintenance systems
- Artificial intelligence and machine learning applications in predictive maintenance
- Maintenance data analysis, fault prediction models, and reliability-centered maintenance techniques
- Industry 5.0 concepts, cloud-based monitoring systems, and smart factory maintenance applications

Lab Work Outline for Practical

- Introduction to predictive maintenance laboratory equipment, sensors, monitoring devices, and analysis software
- Vibration measurement and analysis using accelerometers and vibration analyzers
- Frequency spectrum analysis and FFT implementation for machine fault diagnosis
- Condition monitoring of rotating machinery using vibration monitoring techniques
- Thermal monitoring experiments using infrared thermography equipment
- Oil analysis and lubrication condition monitoring experiments
- Ultrasonic testing and acoustic signal analysis for fault detection
- Motor current signature analysis for electrical fault monitoring
- Sensor interfacing and industrial data acquisition using microcontrollers or DAQ systems
- Predictive maintenance data logging and visualization using MATLAB/Python or industrial monitoring software
- IoT-based machine health monitoring and cloud integration experiments
- Machine learning-based fault prediction and maintenance analysis applications
- Mini-project involving development of a predictive maintenance system for industrial equipment monitoring
- Final project presentation, technical report preparation, teamwork evaluation, and safety analysis for predictive maintenance applications



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RECOMMENDED BOOKS	
1.	R. Keith Mobley, <i>An Introduction to Predictive Maintenance</i> , latest Edition, Van Nostrand Reinhold, USA
2.	John Moubray, <i>Reliability-centered Maintenance</i> , latest Edition, Industrial Press Incorporated, USA
3.	John Steward Mitchell, <i>An Introduction to Machinery Analysis and Monitoring</i> , latest Edition, PennWell Publishing Company, USA

8.54 Optic Fiber Technology

COURSE TITLE:	CREDIT HOURS	PRE-REQUISITE	
Optic Fiber Technology	(2+1)	Applied Physics	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Specialist Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSIONAL COMPETENCE PROFILE	
SDG9- Industry, Innovation and Infrastructure SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis), TC-5 (Evaluation) TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to provide students with the fundamental knowledge of optical fiber communication systems, fiber optic transmission principles, and modern optical networking technologies. The course covers optical fibers, light propagation mechanisms, optical sources and detectors, fiber optic communication links, multiplexing techniques, and optical network components. Practical exposure is provided through laboratory experiments involving fiber optic devices, measurements, splicing, testing, and communication system analysis.			
CLO	CLOs Statement	Taxonomy (Level)	Program Outcome s (PLO)
CLO-1	After completion of this course students will be able to: Explain the principles of optical fiber communication, light propagation, fiber structures, and optical transmission characteristics.	C2 Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply optical communication principles to calculate attenuation, link power budget, and dispersion effects in fiber optic communication systems.	C3 Apply	PLO-2 / SA2 (Problem Analysis)
CLO-3	Analyze optical fiber communication links, multiplexing techniques, and network performance parameters used in modern communication systems.	C4 Analyze	PLO-2 / SA2 (Problem Analysis)

CLO-4	Perform laboratory experiments involving optical fiber handling, splicing, attenuation measurement, and optical communication system testing using modern tools and equipment.	P3 Guided Response	PLO4 / SA4 (Investigation)
CLO-5	Demonstrate professional responsibility by effectively presenting and communicating laboratory observations and optical communication system analysis results.	A2 (Affective) Responding	PLO9/ SA9 Communication

Course Outline for Theory

- Introduction to optical fiber communication systems, evolution, applications, and advantages of optical communication over conventional communication systems
- Electromagnetic spectrum, optical transmission windows, fundamentals of light propagation, reflection, refraction, and Snell's law
- Total internal reflection, numerical aperture, acceptance angle, and light guiding mechanisms in optical fibers
- Optical fiber structure and classification including step-index and graded-index fibers, single-mode and multimode fibers
- Optical fiber manufacturing techniques, cable structures, and fiber installation considerations
- Optical transmission characteristics including attenuation, absorption losses, scattering losses, and bending losses
- Dispersion mechanisms including modal dispersion, chromatic dispersion, and polarization mode dispersion
- Optical sources including LED and LASER diode characteristics, operation, and applications in communication systems
- Optical detectors including PIN photodiodes and avalanche photodiodes (APD), characteristics and performance analysis
- Optical communication link design including power budget analysis, rise time budget analysis, and system performance evaluation
- Optical connectors, couplers, splices, and optical amplifiers used in fiber optic communication systems
- Wavelength Division Multiplexing (WDM), optical switching, and optical networking concepts
- Passive Optical Networks (PON), Fiber-to-the-Home (FTTH) systems, and broadband optical access networks
- Optical measurement techniques including OTDR fundamentals, optical spectrum analysis, and link testing procedures
- Applications of optical fiber communication in telecommunication systems, industrial communication, medical systems, sensors, smart grids, and data centers

Lab Work Outline for Practical

- Identification and handling of optical fiber communication components, laboratory instruments, and safety precautions
- Measurement of numerical aperture and acceptance angle of optical fibers
- Study and measurement of attenuation and signal losses in optical fiber communication links
- Fiber optic cable splicing, connectorization, and bending loss analysis
- Performance analysis of LED optical sources and measurement of optical output characteristics
- Performance analysis of LASER diode optical sources and optical signal transmission experiments
- Characterization of optical detectors including PIN photodiodes and avalanche photodiodes (APD)

- Measurement of optical power using optical power meters and related optical communication instruments
- Analysis of dispersion effects and bandwidth limitations in optical fiber communication systems
- Demonstration and analysis of wavelength division multiplexing (WDM) concepts using optical communication trainers
- OTDR-based fault localization and optical link testing experiments
- Design and testing of simple optical communication links for analog signal transmission
- Design and testing of optical communication links for digital signal transmission and performance evaluation [Mini-project involving implementation or analysis of a fiber optic communication system along with technical presentation and laboratory report preparation]

RECOMMENDED BOOKS

4. G. Keiser, *Optical Fiber Communications*, latest Edition, New York, NY, USA: latest Edition,
5. J. M. Senior and M. Y. Jamro, *Optical Fiber Communications: Principles and Practice*, latest Edition, London, U.K.: Pearson Education,
6. B. E. A. Saleh and M. C. Teich, *Fundamentals of Photonics*, latest Edition,. Hoboken, NJ, USA: Wiley, G. P. Agrawal, *Fiber-Optic Communication Systems*, latest Edition,. Hoboken, NJ, USA: Wiley

8.55 Network Administration and Troubleshooting

COURSE TITLE:	CREDIT HOURS	PRE-REQUISITE	
Network Administration and Troubleshooting	(2+1)	None	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Specialist Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)		PROFRSSSIONAL COMPETENCE PROFILE	
SDG8- Decent Work and Economic Growth: SDG9- Industry, Innovation and Infrastructure		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-5 (Evaluation) TC-8 (Ethics) TC-10 (Communication & Collaboration)	
Course Objective			
After completion of this course students will be able to understand and analyze computer networking fundamentals, configure Cisco networking devices, troubleshoot communication problems and manage industrial and enterprise networks			
CLO	CLOs Statement After completion of this course students will be able to:	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Explain computer networking fundamentals including OSI/TCP-IP models, IP addressing, subnetting and Ethernet communication techniques used in industrial and enterprise networks.	C2 Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze, diagnose, and troubleshoot wired and wireless network communication problems using standard networking commands and testing techniques, considering cybersecurity, network resilience, AI-assisted monitoring, and fault diagnosis in Industry 5.0 networks.	C4 Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Configure and implement Cisco routers, switches, VLANs, wireless access points and basic network services using Cisco IOS and Packet Tracer tools.	P3 Guided Response	PLO5 / SA5 (Tool usage)
CLO-4	Prepare technical reports and present the design, configuration, and troubleshooting outcomes of industrial and enterprise networks using professional engineering communication practices.	A3 Valuing	PLO9/ SA9 Communication

Course Outline for Theory

- Introduction to computer networking concepts, types of networks including LAN, WAN, and WLAN, and applications of computer networks
- OSI reference model, functions of each layer, and layered communication architecture
- TCP/IP reference model, protocols, packet transmission mechanisms, and comparison with the OSI model
- IP addressing concepts including IPv4 addressing, subnet masks, classful and classless addressing techniques
- Subnetting methods, VLSM concepts, and IP address allocation techniques for enterprise and Industry 5.0 networks
- Ethernet technologies, MAC addressing, switching concepts, and Ethernet frame structure
- Cisco IOS fundamentals, command-line interface, and basic router configuration techniques Switch configuration, port management, MAC address table operation, and switch security basics
- VLAN concepts, VLAN configuration, trunking, and inter-VLAN communication techniques
- Static routing configuration and introduction to dynamic routing protocols in enterprise networks for enterprise and Industry 5.0 networks
- Network services including DHCP, DNS, and NAT configuration and implementation
- Wireless networking concepts, wireless standards, wireless access points, and WLAN security techniques
- Industrial networking concepts, network resilience, communication reliability, AI-assisted network monitoring, and network management in Industry 5.0 environments
- Network troubleshooting techniques, AI-assisted fault diagnosis, connectivity testing, and network performance analysis for Industry 5.0 networks
- Network security basics, secure communication techniques, cybersecurity practices, and maintenance of reliable Industry 5.0 communication networks

Lab Work Outline for Practical

- Introduction to Cisco Packet Tracer environment, network device identification, and basic network topology creation
- IP addressing configuration and subnetting implementation for small enterprise networks Basic router configuration using Cisco IOS commands and verification of network Switch configuration, port assignment, and MAC address table verification
- VLAN creation, VLAN assignment, and trunk configuration using Cisco switches
- Configuration and testing of inter-VLAN communication using router-on-a-stick techniques
- Static routing configuration and connectivity testing between multiple networks
- Basic dynamic routing configuration and routing table analysis for Industry 5.0-enabled enterprise and IIoT networks
- DHCP server configuration and automatic IP address assignment in enterprise networks
- DNS and NAT configuration for local and external network communication
- Wireless access point configuration, WLAN setup, and wireless client connectivity testing
- Network troubleshooting using ping, traceroute, ipconfig, and other network diagnostic commands
- Design, simulation, and performance evaluation of enterprise and Industry 5.0 network infrastructures using Cisco Packet Tracer.
- Final networking project involving network design, configuration, troubleshooting, technical report preparation, and professional presentation



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RECOMMENDED BOOKS

1. Wendell Odom, CCNA 200-301 Official Cert Guide, Cisco Press, Latest Edition.
2. Behrouz A. Forouzan, Data Communications and Networking, McGraw-Hill Education, Latest Edition.
3. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, Pearson Education, Latest Edition.
4. Cisco Networking Academy, Introduction to Networks Companion Guide, Cisco Press, Latest Edition.

8.56 Mobile Phone Assembly and Repair

COURSE TITLE:	CREDIT HOURS	PRE-REQUISITE	
Mobile Phone Assembly and Repair	(2+1)	Electrical Workshop Practice	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Specialist Knowledge) SK5 (Engineering Technology Practice)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirements) SP3 (Depth of Analysis Required)	TA1 (Range of Resources) TA2 (Level of Interactions) TA5 (Familiarity)	
SUSTAINABLE DEVELOPMENT GOALS (SDGs)	PROFRSSIONAL COMPETENCE PROFILE		
SDG11- Sustainable Cities and Communities	TC-1 (Comprehend & Apply Universal Knowledge) TC-3 (Problem Analysis) TC-10 (Communication & Collaboration)		
Course Objective			
This course aims to provide students with practical and theoretical knowledge of mobile phone assembly, maintenance, troubleshooting, and repair technologies used in modern smart devices. The course covers mobile phone architecture, communication modules, circuit analysis, software maintenance, and hardware repair techniques. Students will develop hands-on skills in disassembly, soldering, flashing, testing, and fault diagnosis using modern repair equipment and software tools. The course also emphasizes workplace safety, customer communication, and professional practices relevant to mobile servicing industries.			
CLO	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Explain the architecture, components, operating principles, and communication technologies used in modern mobile phones and smart devices.	C2 (Understand)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply troubleshooting, testing, assembly, and repair techniques for diagnosing hardware and software faults in mobile Phones using Industry 5.0 diagnostic practices.	C3 (Apply)	PLO3 / SA3 (Design/ Development of Solutions)
CLO-3	Analyze mobile phone circuit behavior, communication modules, power systems, and fault conditions to improve device performance and reliability.	C4 (Analyze)	PLO2 / SA2 (Problem Analysis)
CLO-4	Perform mobile phone disassembly, soldering, component replacement, flashing, and testing procedures using modern repair tools and diagnostic equipment.	P4 (Mechanism)	PLO5 / SA5 (Tool Usage)

CLO-5	Demonstrate teamwork, workplace safety, customer handling, technical reporting, and professional communication during mobile repair and maintenance activities.	A3 (Valuing)	PLO9 / SA9 (Communication)
Course Outline for Theory			
• Introduction to mobile phone technology, evolution of mobile communication systems, and smartphone applications • Mobile phone architecture including processors, memory, RF modules, sensors, and communication interfaces • GSM, 3G, 4G, and 5G mobile communication technologies and network fundamentals • Mobile phone hardware components including display systems, batteries, cameras, speakers, microphones, and charging circuits • Printed Circuit Boards (PCB), electronic components, and circuit layout used in mobile devices • Mobile phone power management systems and battery charging mechanisms and energy-efficient battery management for Industry 5.0 devices • Fundamentals of electronic troubleshooting AI-assisted fault diagnosis • Mobile phone assembly and disassembly procedures and safety practices • Soldering, desoldering, component replacement, and rework station operation • Software installation, flashing, firmware updating, unlocking, and operating system maintenance • Mobile phone testing equipment and diagnostic software tools • Troubleshooting of display faults, charging problems, network issues, and audio/video failures • Sensor systems, wireless communication modules, Bluetooth, Wi-Fi, GPS, and mobile connectivity troubleshooting • Preventive maintenance, device optimization, and data backup/recovery techniques • Customer support practices, workplace management, service center operations, and repair documentation			
Lab Work Outline for Practical			
• Introduction to mobile repair laboratory tools, multimeters, power supplies, soldering stations, and diagnostic equipment • Mobile phone identification, safe disassembly, and assembly procedures • Testing and identification of mobile phone electronic components on PCBs • Battery testing, charging circuit analysis, and power supply troubleshooting • Soldering and de-soldering practice for electronic component replacement • Display and touchscreen fault diagnosis and replacement procedures • Speaker, microphone, camera, and vibration motor troubleshooting experiments • Mobile software installation, firmware flashing, and operating system updating • Mobile unlocking, backup, and software troubleshooting using repair software tools • Wi-Fi, Bluetooth, GPS, and network signal troubleshooting experiments • PCB fault tracing and continuity testing using digital multi-meters and testing instruments • Complete troubleshooting and repair of common mobile phone faults • Mini-project involving assembly, maintenance, or repair of a smartphone device with complete fault analysis and testing • Final project presentation, technical report preparation, teamwork evaluation, and implementation of professional repair and customer handling practices			
RECOMMENDED BOOKS			
1. Mobile Phone Repairing by Shashi Bhushan Singh, latest Edition, BPB Publications. 2. Cell Phone Repair by David Carroll, latest Edition,, McGraw-Hill Education. 3. Smartphone Troubleshooting and Repair by Stephen J. Bigelow, latest Edition,, Cengage			



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| Learning. |
| 4. Practical Electronics for Technicians by John M. Hughes, latest Edition, McGraw-Hill Education. |

8.57 AI Driven Industrial Automation

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
AI DRIVEN INDUSTRIAL AUTOMATION		(2+1)	Fundamentals of Control Systems
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Engineering Specialized Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirements) SP3 (Depth of Analysis Required)	TA1 (Range of Resources) TA2 (Level of Interaction) TA4 (Innovation Level) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG9- Industry, Innovation and Infrastructure SDG12- Responsible Consumption and Production		TC-1 (Comprehend & Apply Universal Knowledge) TC-2 (Comprehend & Apply Local Knowledge) TC-3 (Problem Analysis) TC-4 (Design & Development of Solutions) TC-5 (Evaluation) TC-6 (Modern Tool Usage) TC-10 (Communication & Collaboration)	
Course Objective			
This course aims to provide students with a comprehensive understanding of how Artificial Intelligence transforms traditional industrial automation into "Smart Manufacturing based on Industry 4.0/5.0 principles." Students will learn to integrate machine learning, computer vision, and predictive analytics into PLC-based systems and robotic workflows to optimize production, reduce downtime, and enhance industrial safety.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO 1	Explain the fundamental transition from traditional automation hierarchies to AI-integrated Industry 4.0/5.0 frameworks, including the role of IoT and big data.	C2 (Understanding)	PLO 1 (Engineering Technology Knowledge:)
CLO 2	Apply machine learning algorithms and computer vision techniques to solve practical industrial problems such as defect detection, predictive maintenance, and robotic path planning.	C3 (Applying)	PLO 2 (Problem Analysis)
CLO 3	Analyze the performance and reliability of AI-driven adaptive control systems with respect to productivity, sustainability, resilience, cybersecurity, ethical AI, and human-machine collaboration in Industry 5.0 environments.	C4 (Analyzing)	PLO 3 (Design/ Development of solution)

CLO-4	Evaluate the effectiveness, sustainability, and reliability of AI-based industrial automation systems.	C5 (Cognitive) Evaluate	PLO6 / SA6 The Engineering Technologist and the World
CLO-5	Perform practical experiments related to AI-based industrial automation systems and interpret the obtained results.	P3 (Psychomotor) Guided Response	PLO4 / SA4 (Investigation)
Course Outline for Theory			
Unit 1: Industrial Automation in the Era of Industry 4.0/5.0 - The Automation Hierarchy: Review of PLC, SCADA, and DCS within the ISA-95 framework; limitations of traditional "Hard-Coded" logic. - AI Integration: Defining the "Brain" of the Smart Factory; how AI sits atop the automation pyramid. - Data in the Plant Floor: Industrial communication protocols (OPC-UA, MQTT) and the role of Big Data in manufacturing. Unit 2: Intelligent Process Control & Optimization - Beyond PID: Introduction to Model Predictive Control (MPC) and Reinforcement Learning for tuning control loops. - Machine Vision in Production: AI-driven defect detection, object sorting, and automated quality assurance using Computer Vision. - Soft Sensors: Using ML models to estimate unmeasurable process variables (e.g., internal temperature or chemical composition). Unit 3: AI for Asset Management & Reliability - Predictive Maintenance (PdM): Transitioning from reactive/preventative to predictive strategies using vibration and thermal data. - Anomaly Detection: Unsupervised learning for detecting "hidden" industrial faults in rotating machinery and production lines. - Remaining Useful Life (RUL): Estimating the lifespan of industrial components (bearings, motors) using Regression models. Unit 4: Robotics & Autonomous Systems - Collaborative Robots (Cobots): AI-enhanced safety protocols and human-robot interaction in shared workspaces. - Path Planning: AI algorithms for autonomous mobile robots (AMRs) and AGVs in warehouse automation. - Swarm Intelligence: Coordination of multiple automated units for optimized logistics. Unit 5: Edge AI, IIoT, and Ethical Governance - Edge Computing: Why "Latency Matters"—processing AI models locally on PLCs and Edge Gateways vs. the Cloud. - Cyber-Physical Systems (CPS): Securing AI-driven automation against adversarial attacks. - Ethics & Society: The impact of AI on the technical workforce; ensuring transparency and safety in autonomous decision-making.			
Lab Work Outline for Practical			
Introduction to AI and Industrial Automation Software Tools			

- Sensor Interfacing and Industrial Data Acquisition
- PLC and SCADA Demonstrations for Smart Automation
- IoT-Based Industrial Monitoring Systems
- Machine Learning Applications for Industrial Data Analysis
- AI-Based Fault Detection and Diagnosis Demonstrations
- Predictive Maintenance Simulations Using AI Models
- Industrial Robotics and Intelligent Control Simulations
- Computer Vision Applications in Industrial Automation
- Cloud-Based Industrial Monitoring Dashboards
- Smart Factory and Digital Twin Simulations
- Final Mini Project on AI-Driven Industrial Automation Systems

RECOMMENDED BOOKS

1. Artificial Intelligence: A Modern Approach - Stuart Russell & Peter Norvig, Pearson, Latest Edition.
2. Automation, Production Systems and Computer-Integrated Manufacturing - Mikell P. Groover, McGraw-Hill, Latest Edition.
3. Industry 4.0: The Industrial Internet of Things - Alasdair Gilchrist, Apress, Latest Edition.
4. Internet of Things: Principles and Paradigms - Rajkumar Buyya & Amir Vahid Dastjerdi, Elsevier, Latest Edition.
5. Machine Learning - Tom M. Mitchell, McGraw-Hill, Latest Edition.
6. Relevant IEEE journal papers, industrial case studies, and technical reports related to AI, smart manufacturing, robotics, and industrial automation systems.

8.58 AI Integrated Electrical Systems

COURSE TITLE	CREDITS HOURS	PRE-REQUISITE	
AI Integrated Electrical Systems	(2+1)	Linear Circuit Analysis, Programming Fundamentals	
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK3 (Engineering Fundamentals), SK8 (Engagement with Selected Knowledge)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)	
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
SDG9- Industry, Innovation and Infrastructure SDG11- Sustainable Cities and Communities		TC-1 (Universal Knowledge), TC-3 (Problem Analysis), TC-5 (Evaluation)	
Course Objective			
This course aims to enable students to design, simulate, and analyze intelligent electrical networks that utilize machine learning for predictive maintenance, autonomous load management, and enhanced grid resilience. By the end of the course, students will be proficient in using modern computational tools to solve complex electrical engineering technology problems while adhering to professional ethics and safety standards.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO 1	Apply machine learning algorithms and AI optimization techniques to solve problems related to load forecasting and energy management.	C3 (Applying)	PLO 1 (Engineering Technology Knowledge)
CLO 2	Analyze the performance of AI-integrated controllers compared to traditional PID/control systems for power electronics and motor drives.	C4 (Analyzing)	PLO 2 (Problem Analysis)
CLO 3	Construct and train predictive models using software tools (Python/MATLAB) to automate the monitoring and control of electrical hardware.	P3 (Guided Response)	PLO 5 (Tool Usage)
CLO 4	Investigate real-world electrical datasets to identify system anomalies and execute self-healing protocols in a simulated environment.	P4 (Mechanism)	PLO 4 (Investigation)
CLO 5	Demonstrate a commitment to electrical safety standards and ethical data handling practices while working in collaborative lab groups.	A3 (Valuing)	PLO 8 (Ethics)

Course Outline for Theory

Unit 1: Foundations of Intelligence in Electrical Systems

- **Evolution of Electrical Systems:** Transition from conventional grids to AI-enabled Smart Grids.
- **AI & ML Fundamentals:** Difference between Supervised, Unsupervised, and Reinforcement Learning in an electrical context.
- **Data Acquisition:** Principles of gathering electrical data via SCADA, PMUs, and smart sensors.
- **Ethical & Safety Standards:** Secure data handling and the impact of AI decision-making on public safety.

Unit 2: Computational Intelligence Techniques

- **Artificial Neural Networks (ANN):** Architectures and learning processes for system identification.
- **Fuzzy Logic Systems:** Handling uncertainty in electrical measurements and control.
- **Optimization Algorithms:** Genetic Algorithms (GA) and Particle Swarm Optimization (PSO) for power system efficiency.
- **Decision Support:** Expert systems for diagnosing complex electrical faults.

Unit 3: Intelligent Control of Machines & Power Electronics

- **Condition Monitoring:** Predictive maintenance of transformers and induction motors using AI-based diagnostics.
- **Intelligent Drives:** Adaptive AI control for VFDs (Variable Frequency Drives) and EV motor controllers.
- **Smart Power Converters:** AI applications in inverters and DC-DC converters for stable power output.

Unit 4: AI Applications in Power Systems & Grids

- **Load & Generation Forecasting:** Predicting electricity demand and renewable energy (Solar/Wind) availability.
- **Fault Detection & Isolation:** Automated anomaly detection and "self-healing" grid protocols.
- **Energy Management Systems (EMS):** AI-driven demand-side management and peak shaving.
- **Microgrid Stability:** Intelligent coordination of islanded and grid-tied renewable sources.

Unit 5: Edge AI and the Industrial Internet of Things (IIoT)

- **Smart Sensors:** Integration of intelligence at the sensor level for real-time monitoring.
- **Embedded AI:** Implementing lightweight AI models on microcontrollers for local automation.
- **Cybersecurity in Smart Grids:** AI-based intrusion detection systems for critical electrical infrastructure

Lab Work Outline for Practical

- **Intro to Data Tools:** Visualizing and cleaning real-time electrical sensor data using Python/Pandas.
- **Solar Power Forecasting:** Developing a Linear Regression model to predict PV output based on irradiance and temperature.
- **Fault Classification:** Using Decision Trees to classify fault types (L-G, L-L, L-L-G) in a 3-phase simulation.
- **Intelligent Motor Speed Control:** Implementing and comparing a Fuzzy Logic Controller vs. a traditional PID controller.
- **Non-Intrusive Load Monitoring (NILM):** Using K-Nearest Neighbors (KNN) to identify appliances by their current signatures.
- **Predictive Maintenance:** Developing an SVM model to predict motor bearing failure using vibration and thermal data.
- **Transformer Load Forecasting:** Using Artificial Neural Networks (ANN) to predict peak loading times.
- **Power Quality Analysis:** Utilizing K-Means Clustering to categorize power quality disturbances (sags, swells).
- **Smart Grid Demand Response:** Simulating Reinforcement Learning for battery storage optimization based on pricing.



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- **Microgrid Stability:** Using AI to manage transitions between grid-tied and islanded modes.
- **Edge AI Implementation:** Deploying a "TinyML" model onto a microcontroller to detect arcing in real-time.

RECOMMENDED BOOKS

1. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Latest Edition
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley, latest Edition
3. Ian Goodfellow, Deep Learning, MIT Press, Latest Edition

8.59 Data Analytics for Smart Energy Systems

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Data Analytics for Smart Energy Systems		(2+1)	Basic Programming / Introduction to Electrical Engineering
KNOWLEDGE & ATTITUDE PROFLE		RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES
SK4 (Engineering Specialized Knowledge)		SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirements) SP3 (Depth of Analysis Required)	TA1 (Range of Resources) TA2 (Level of Interaction) TA4 (Innovation Level) TA5 (Familiarity)
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
SDG8- Decent Work and Economic Growth: SDG9- Industry, Innovation and Infrastructure		TC-1 (Comprehend & Apply Universal Knowledge) TC-2 (Comprehend & Apply Local Knowledge) TC-3 (Problem Analysis) TC-5 (Evaluation) TC-6 (Tool Usage) TC-10 (Communication & Collaboration)	
Course Objective			
After completion of this course, students will be able to understand the concepts of smart energy systems, energy informatics, and data analytics techniques for analysis, forecasting, optimization, and intelligent decision-making in modern smart grids and energy management systems, while applying these concepts to Industry 5.0-enabled sustainable and human-centric energy solutions.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Explain the fundamentals of smart energy systems, smart grids, data analytics, and Industry 5.0 principles for sustainable energy infrastructures..	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze energy datasets using statistical and analytical tools for energy management applications.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Apply forecasting, predictive analytics, and AI techniques to optimize smart energy systems while improving efficiency, resilience, and sustainability	C3 (Cognitive) Apply	PLO5 / SA5 (Tool Usage)
CLO-4	Evaluate AI, IoT, big data, digital twins, and human-centric technologies for sustainable, secure, and resilient smart energy infrastructures..	C5 (Cognitive) Evaluate	PLO6/ SA6 (The Engineering Technologist and the World)
COURSE OUTLINE FOR THEORY			

- Introduction to Smart Energy Systems, Smart Grids, and Industry 5.0
- Fundamentals of Data Analytics and Energy Informatics
- Types and Sources of Energy Data
- Data Collection Techniques and IoT-Based Monitoring
- Data Cleaning, Preprocessing, and Visualization
- Statistical Analysis for Energy Applications
- Energy Consumption Pattern Analysis
- Forecasting Techniques for Load and Demand Prediction
- Machine Learning Basics for Smart Energy Systems
- Predictive Analytics for Energy Optimization
- Renewable Energy Data Analytics
- Big Data, Cloud Computing, and Digital Twin Applications in Smart Grids
- Cybersecurity, Data Privacy, and Ethical AI in Energy Systems
- AI Applications and Human-Centric Decision Support in Smart Energy Management
- Sustainable, Resilient, and Industry 5.0-Oriented Smart Grid Case Studies

LAB WORK OUTLINE FOR PRACTICAL

- Introduction to software tools for energy data analytics (MATLAB/Python/Google Colab or equivalent)
- Exploration and interpretation of real-world energy datasets
- Data preprocessing, cleaning, and visualization exercises
- Statistical analysis of energy consumption data
- Energy consumption pattern analysis using real datasets
- Load forecasting using regression and time-series techniques
- Machine learning implementation for energy demand prediction
- Renewable energy data analysis and performance evaluation
- Simulation of smart grid monitoring and energy management scenarios
- AI-assisted optimization of smart energy systems
- Case studies on Industry 5.0 applications in smart energy systems
- Mini-project involving data analysis, simulation, and presentation of results

RECOMMENDED BOOKS

1. G. Strbac, "Smart Grids: Infrastructure, Technology, and Solutions." (Latest Edition)
2. Steven Brunton & J. Nathan Kutz, "Data-Driven Science and Engineering." (Latest Edition)
3. Ali Keyhani, "Smart Power Grid." (Latest Edition)
4. Hwaiyu Geng, "Data Analytics for Smart Grids." (Latest Edition)
5. Relevant IEEE papers and industrial reports. (Latest Edition)

8.60 Electric Vehicle Technology

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Electric Vehicle Technology		(2+1)	Basic Electrical Engineering
KNOWLEDGE & ATTITUDE PROFLE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Engineering Specialist)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of issues) SP5 (Extend of applicable codes)	A2 (Range of Resources) TA3 (Level of Interaction) TA4 (Innovation Level) TA5 (Familiarity).	
Sustainable Development Goals (SDGs):		Professional Competence Profile:	
SDG9- Industry, Innovation and Infrastructure SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC- 2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis), TC-4 (Design and development of solutions) TC-7 (Legal, regulatory and cultural) TC-10 (Communication & Collaboration)	
Course Objective			
After completion of this course students will be able to have a comprehensive knowledge on the design, operation, and maintenance of EVs, equipping students with skills in electric powertrain design, battery management systems, power electronics, and high-voltage safety. They bridge theoretical knowledge with practical applications for careers in sustainable transport			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outco mes (PLO)
CLO-1	Apply the principles of electric vehicle architectures, propulsion systems, and energy storage technologies.	C3 (Cognitive) Apply	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze the performance and efficiency of electric powertrains, energy storage systems, and charging infrastructure.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Evaluate the environmental and economic impact of EV technology compared to conventional vehicles.	C5 (Cognitive) Evaluate	PLO6 / SA6 (The Engineer and the World)
CLO-4	Design electric drives, Battery Management Systems (BMS), and power electronic converters to enhance vehicle performance.	C6 (Cognitive) Create	PLO3/ SA3 Design of solutions
CLO-5	Perform basic electric vehicle component identification and safety procedures.	P3	PLO1 / SA1 (Engineering Technology Knowledge)

CLO-6	Analyze battery packs, BMS and motor drive performance through practical experiments.	P4	PLO-2 / SA2 (Problem Analysis)
CLO-7	Construct and test basic EV subsystems using simulation and laboratory equipment.	P5	PLO3/ SA3 Design of solutions
Course Outline for Theory			
• EV Fundamentals and Architecture: Introduction to EV types (BEV, HEV, PHEV), history, and architecture differences. • Battery Technology and Management: Lithium-ion battery packs, battery pack design, cell balancing, and Battery Management Systems (BMS). • Electric Powertrain and Motors: Selection and control of BLDC, PMSM, Induction, and SynRM motors; power electronics, inverters, and DC-DC converters. • EV Design and Dynamics: Vehicle modelling, performance simulation, powertrain sizing calculations, and aerodynamics. • Charging Infrastructure: AC/DC charging systems, fast charging technology, and smart grid integration. • Safety and Maintenance: High-voltage safety protocols, personal protective equipment (PPE), and high-voltage fault diagnosis. • Simulation Tools: Using software like MATLAB, Simulink, or LabVIEW for EV modelling			
LAB WORK OUTLINE FOR PRACTICAL			
• Laboratory safety and PPE for EV systems • Identification of EV components • Battery cell testing and pack measurements • Battery Management System (BMS) monitoring • BLDC/PMSM motor characteristics • Inverter and DC-DC converter demonstration • EV charging system (AC/DC) study • MATLAB/Simulink based EV modelling • Performance analysis of EV powertrain • Mini EV subsystem integration/demo			
RECOMMENDED BOOKS			
1. Electric Vehicle Technology Explained by James Larminie & John Lowry(Latest Edition) 2. Why read: Often considered the "bible" of EV technology, it provides comprehensive coverage of components, batteries, controllers, and design. (Latest Edition) 3. Modern Electric Vehicle Technology by C.C. Chan & K.T. Chau(Latest Edition) 4. Why read: Excellent for understanding the systemic view of EV tech, including electric machines, converters, and controller design. (Latest Edition) 5. Hybrid Electric Vehicles: Principles and Applications by Chris Mi & M. Abul Masrur(Latest Edition) 6. Why read: Focuses heavily on power electronics, motor drives, and energy management			



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strategies for both hybrid and pure EVs. (Latest Edition)

8.61 Green Sustainable Engineering Technology

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
Green Sustainable Engineering		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING TECHNOLOGY ACTIVITIES:	
SK4 (Engineering Technology Specialist Knowledge)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues) SP7 (Interdependence)	TA1 (Range of Sources) TA2 (Level of Interactions) TA3 (Innovation) TA4 (Consequences to society and the environment) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG9- Industry, Innovation and Infrastructure SDG11- Sustainable Cities and Communities		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis),	
Course Objective			
Green Sustainable Engineering Technology course aims to equip students with the ability to integrate environmental, social, and economic sustainability into engineering technology practices, and life-cycle assessments.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Explain green and sustainability concepts of engineering technology projects, including industrial ecology and waste management.	C3 (Cognitive) Understand	PLO6 / SA6 (The Engineering Technologist and the World)
CLO-2	Analyze the environmental impacts of products and systems from raw material extraction to end-of-life disposal.	C4 (Cognitive) Analyze	PLO2 / SA2 (Problem Analysis)
CLO-3	Design and optimize renewable energy systems (e.g., solar, wind, biomass) and improve energy efficiency in buildings and industry.	C6 (Cognitive) Evaluating	PLO3 / SA3 (Design/development of solutions

CLO-4	Operate specialized environmental monitoring instruments to measure carbon footprints, energy efficiency, and water quality criteria accurately.	P3 (Psychomotor) Precision	PLO5 / SA5 (Tool Usage)
CLO-5	Perform lifecycle assessment (LCA) simulations and material sorting procedures to isolate and minimize hazardous electronic or industrial waste.	P4 (Psychomotor) Articulation	PLO6 / SA6 (The Engineering Technologist and the World)
CLO-6	Work in teams to write clear technical lab reports and present sustainability recommendations.	A5 (Affective) Characterizing	PLO9 / SA9 (Individual and Collaborative Team Work)

Course Outline for Theory

- Introduction to Fundamentals of Green Engineering Technology
- Renewable Energy Technologies: Solar, wind, water, biomass, and geothermal
- Life Cycle Assessment (LCA): Goal and Scope, Life Cycle Inventory (LCI) Analysis, Life Cycle Impact Assessment (LCIA) and Interpretation.
- Sustainable Material Selection: Evaluating embodied energy, renewability, and toxicity,
- Circular Economy & Waste Management: Eco-design, sustainable consumption, resource recovery, and the "R" strategies (Reduce, Reuse, Recycle).
- Environmental Regulation & Policy: Pollution Control & Waste Management, Climate Change Mitigation, Natural Resource Management, Environmental Impact Assessment (EIA), Compliance and Enforcement, and Sustainability Planning.
- Sustainable Design & Development: Core Principles of Sustainable Design, Sustainable Building & Urban Development and Sustainable Product Development

Lab Work Outline for Practical

Renewable Energy Systems: Solar photovoltaic (PV) efficiency and I-V curve testing, Small-scale wind turbine output and wind speed correlation, Fuel cell and hydrogen storage performance evaluation.

Energy Efficiency and Green Building Tech: Building thermal insulation and heat-loss analysis, HVAC energy consumption monitoring and smart thermostat control, Lighting systems efficiency and lux-level mapping.

Water and Wastewater Treatment Tech: Advanced oxidation and filtration for pollutant removal, Water quality parameter testing (pH, turbidity, COD, BOD), Small-scale greywater recycling system setup.

Life Cycle Assessment (LCA) & Waste Upcycling: Software-based LCA modeling for manufactured products, Material recovery and waste characterization, Conversion of organic or plastic waste into value-added products.

RECOMMENDED BOOKS

- Sustainable Engineering: Principles and Practice by David T. Allen and David R. Shonnard (Latest Edition)
- Sustainable Energy - Without the Hot Air by David MacKay (Latest Edition)
- Environmental Engineering: Fundamentals, Sustainability, Design (Latest Edition) by James R. Mihelcic and Julie K. Zimmerman: (Latest Edition)



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- Zero Waste Engineering: A New Era of Sustainable Technology Development by M. M. Khan & M. R. Islam(Latest Edition)
- Sustainable and Resilient Engineering: Drivers, Metrics, Tools, and Applications by Krishna R. Reddy(Latest Edition)

8.62 Machine Learning Applications in Power Systems

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Machine Learning Applications in Power Systems		(2+1)	Power System Analysis, Basic Programming, Probability and Statistics
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK3 (Engineering Fundamentals) SK4 (Specialist Knowledge) SK6 (Engineering Practice and Technology Tools) SK7 (Society, Sustainability and Environment)	SP1 (Depth of Knowledge Required) SP2 (Range of Conflicting Requirement) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues)	TA1 (Range of Sources) TA2 (Level of Interactions) TA3 (Innovation) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG9- Industry, Innovation and Infrastructure SDG12- Responsible Consumption and Production		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis), TC-5 (Evaluation) TC-6 (Modern Tool Usage) TC-10 (Communication & Collaboration)	
Course Objective			
After completion of this course, students will be able to understand the role of machine learning in modern power systems and apply data-driven techniques for forecasting, monitoring, protection, stability assessment, renewable-energy integration and smart-grid operation. The course enables students to process power-system data, implement machine-learning models using modern software tools, evaluate model performance and interpret results for practical electrical power engineering applications.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Explain the fundamental concepts of machine learning and identify its applications in power systems, smart grids and renewable-energy systems.	C2 (Cognitive) Understand	PLO1 (Engineering Technology Knowledge)
CLO-2	Analyze power-system datasets by applying preprocessing, visualization, feature engineering and statistical interpretation techniques.	C4 (Cognitive) Analyze	PLO-2 (Problem Analysis)
CLO-3	Apply supervised and unsupervised machine-learning algorithms for load forecasting, renewable-energy forecasting, fault classification and anomaly detection.	C3 (Cognitive) Apply	PLO3 (Design/Development of Solutions)
CLO-4	Perform simulation-based laboratory tasks using Python or MATLAB to validate machine-learning models and present technical results effectively.	P3 (Psychomotor) Guided Response	PLO4 (Investigation)
CLO 5	Demonstrate a commitment to electrical safety standards and ethical data handling practices while working in collaborative lab groups.	A3 (Valuing)	PLO 7 (Ethics)

Course Outline for Theory	
Introduction to smart grids, renewable-rich power systems and the role of artificial intelligence and machine learning in electrical power engineering. Review of key power-system concepts: generation, transmission, distribution, load flow, stability, protection, voltage control and frequency control. Fundamentals of machine learning: supervised learning, unsupervised learning, reinforcement learning, training, validation, testing and model generalization. Power-system data sources and preprocessing: SCADA, PMU, smart meters, weather data, fault records, missing values, outliers, normalization and feature engineering. Supervised learning methods and applications: regression, decision trees, random forest, support vector machines and k-nearest neighbors for load forecasting, renewable forecasting and fault classification.	
Lab Work Outline for Practical	
• Introduction to Python/MATLAB environment and essential libraries for machine-learning applications in power systems. • Collection, cleaning and visualization of load, weather, renewable-generation, smart-meter or fault datasets. • Implementation of regression models for short-term load forecasting and renewable-energy forecasting. • Implementation of classification models for power-system fault detection and fault-type classification. • Application of clustering and anomaly-detection techniques for customer load-profile grouping and abnormal data identification. Mini-project using a real or simulated power-system dataset with model evaluation, graphs, interpretation and technical presentation.	
RECOMMENDED BOOKS	
1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, Latest Edition. 2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, Latest Edition. 3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, Latest Edition. John D. Kelleher, Brian Mac Namee and Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics", MIT Press, Latest Edition.	

8.63 Robotics And Autonomous System Technology

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Robotics and Autonomous System Technology		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF ENGINEERING ACTIVITIES	
SK4 (Engineering Specialized Knowledge) SK5 (Engineering Design and Operations)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required) SP4 (Familiarity of Issues)	TA1 (Range of Sources) TA2 (Level of Interactions) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-5 (Evaluation)	
Course Objective			
After completion of this course students will be able to understand concepts of robotics and their design process and validation of these concepts in lab work for development of robotic prototypes.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	Understand fundamental concepts of robotics, sensors and actuators.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Identify mathematical principles, kinematics, inverse kinematics, dynamics, and DH parameter formulation to model and analyze robotic motion.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-3	Apply path planning algorithms, and AI for real-world industrial automation.	C3 (Cognitive) Apply	PLO-6 / SA6 The Engineering Technologist and the World:
CLO-4	Perform experiments in laboratory in order to interpret experimental data and observe its results using sensors, actuators or robotics lab equipment.	P3 (Psychomotor) Guided Response	PLO4 / SA4 Investigation)
CLO-5	Mend various robotic concepts using ROS (Robot Operating System).	P5 (Psychomotor) Complex Overt Response	PLO5/ SA5 Tool Usage

Course Outline for Theory

- Introduction to robotics, classification of robots (industrial, service, medical, mobile, underwater, UAV, humanoid, swarm, and soft robots), serial versus parallel mechanisms (open vs closed kinematic chains, Stewart platform, Delta robot), types of robotic joints (revolute, prismatic, spherical, universal, cylindrical, planar, screw), types of wheels (conventional, mecanum, omnidirectional, carter, tracks etc.). Application of robotics.
- Robotic sensors (motor encoders, LiDAR, IMUs, cameras, tactile, force/torque, proximity) and actuators (DC motors, steppers, servos, linear actuators, pneumatic/hydraulic, artificial muscles) with selection criteria.
- Basic mathematics for robotics. Kinematics, inverse kinematics and dynamics of robots. Coordinates and formation of Dh table. Mobile robots and their types. Velocity kinematics of mobile robots. Robotics trajectory generation.
- Robotic path planning, including graph-based methods (A*, Dijkstra, visibility graph, Voronoi diagrams), potential fields (with local minima mitigation), velocity obstacles, bug algorithms (Bug 0,1,2) etc.
- The course also introduces supervised and unsupervised machine learning for robotics (regression, classification, clustering, dimensionality reduction) along with reinforcement learning and imitation learning, followed by industrial automation, and industry 4.0.

Lab Work Outline for Practical

- Introduction to ROS (Robot Operating System)
- Use basic velocity commands to make a robot move forward, turn using ROS
- Use of Arduino, Arbotix or Raspberry Pi
- Use of ultrasonic and infrared sensors for distance measurement
- Controlling DC motors using H-bridge and PWM for speed control
- Controlling servo motors and stepper motors
- Implementing differential drive kinematics for wheeled robots
- Odometry-based localization and position tracking
- Reactive obstacle avoidance using sensor feedback
- PID controller tuning for line following
- Forward kinematics of a robotic arm (2-DOF or 3-DOF)
- Use of robotics simulators or equipment available in HIE

RECOMMENDED BOOKS

- Introduction to Robotics. Mechanics and Control, latest edition by John J Craig.
- Robotics, Vision and Control Fundamental by Peter Corke (latest edition).

8.64 Smart Grid Technology

COURSE TITLE		CREDITS HOURS	PRE-REQUISITE
Smart Grid Technology		(2+1)	1. Power Generation OR Power Distribution
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING	RANGE OF ENGINEERING ACTIVITIES	
SK3 (Engineering Fundamentals)	SP1 (Depth of Knowledge Required) SP3 (Depth of analysis required) SP6 (Extend of stakeholder involvement and conflicting requirement)	TA1 (Range of Resources) TA2 (Level of Interaction) TA4 (Innovation Level) TA5 (Familiarity)	
Sustainable Development Goals (SDGs)		Professional Competence Profile	
SDG8- Decent Work and Economic Growth: SDG9- Industry, Innovation and Infrastructure		TC-1 (Comprehend & apply universal knowledge), TC-2 (Comprehend & apply local knowledge) TC-3 (Problem Analysis), TC-4 (Design and development of solution) TC-7 (Legal, regulatory and cultural)	
Course Objective			
After completion of this course, students will be able to understand the concepts of modern smart grid technologies, renewable energy integration, advanced communication systems, artificial intelligence, and data analytics for the analysis, operation, and optimization of reliable, resilient, sustainable, and Industry 5.0-enabled electrical power systems.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Describe the architecture, components, communication technologies, and operational principles of modern smart grid systems, including renewable energy integration and Industry 5.0 concept	C2 (Understand)	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Analyze smart grid operation, power quality, communication, monitoring, and protection using appropriate analytical methods	C4 (Analyze)	PLO2 / SA2 (Problem Analysis)
CLO-3	Perform modelling, simulation, and performance analysis of smart grid components and renewable energy systems using modern engineering software tools.	P3 (Guided Response)	PLO4 / SA4 (Investigation) / PLO5 / SA5 (Tool Usage)

CLO-4	Evaluate the application of artificial intelligence, IoT, data analytics, and Industry 5.0 technologies for improving the reliability, resilience, efficiency, and sustainability of smart grid systems.	C5 (Evaluate)	PLO6 / SA6 (Environment & Sustainability) / PLO5 / SA5 (Modern Tool Usage)
Course Outline for Theory			
Evolution of Electric Power Grid, introduction to smart Grid, Concept, definitions, architecture and functions of Smart Grid. Need of Smart Grid. Difference between conventional & smart grid. Opportunities & Challenges of Smart Grid, Introduction to Smart Meters, Real Time Pricing, Smart Appliances. Automatic Meter Reading (AMR). Outage Management System (OMS). Home & Building Automation, Substation Automation, Feeder Automation, Smart Sensors, Geographic Information System (GIS). Intelligent Electronic Devices (IED) & their application for Monitoring & Protection. Phasor Measurement Units (PMU), Wide Area Measurement System (WAMS), Wide-Area based Protection and Control, Micro-grid concepts, need and application, Issues of Interconnection. Protection & control systems for micro-grid. Storage systems including Battery, SMES, Pumped Hydro. Compressed Air Energy Storage. Variable speed wind generators, fuel-cells, micro-turbines. Integration of renewables and issues involved. Advantages and disadvantages of Distributed Generation. Power Quality & EMC in smart Grid. Power Quality issues of Grid connected Renewable Energy Sources. Power Quality Conditioners for micro-grid. Web based Power Quality monitoring, Power Quality Audit Data Analytics, Artificial Intelligence, and Machine Learning Applications in Smart Grids Cybersecurity, Data Privacy, and Communication Security in Smart Grid Systems Role and application of artificial intelligent of smart grid, self-healing, efficient, and adaptive systems, grand conductor. AI based forecasting and fault detection. Industry 5.0 Technologies for Smart Grids: Human-Centric Systems, Digital Twins, Intelligent Automation, and Sustainable Energy Management Industrial Applications and Case Studies of Smart Grid Technologies			
Lab Work Outline for Practical			
• Introduction to smart grid simulation software (MATLAB/Simulink, ETAP, DigSILENT PowerFactory, PSCAD, or equivalent) • Modelling and simulation of conventional and smart grid architectures • Simulation of Advanced Metering Infrastructure (AMI) and smart meter operation • Analysis of load profiles and demand response using real or simulated datasets • Modelling of distribution automation and feeder monitoring systems • Simulation of Phasor Measurement Units (PMUs) and Wide Area Measurement Systems (WAMS) • Modelling and analysis of microgrid operation under grid-connected and islanded modes • Simulation of renewable energy integration (solar PV and wind) into smart grids • Performance analysis of battery energy storage systems in smart grid applications • Power quality assessment and harmonic analysis in smart grid environments • AI-based load forecasting and fault detection using modern engineering tools • Cybersecurity and communication reliability analysis through smart grid case studies • Industry 5.0 applications in smart grids: digital twin concepts, intelligent automation, and human-centric energy management (simulation/case study) • Mini project involving modelling, simulation, performance analysis, and presentation of a smart grid application			



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RECOMMENDED BOOKS

- Smart Grid and Enabling Technologies: Shady S. Reffat et.al, Willey- IEEE Press, (Latest edition)
- Smart Grid Technology: A Cloud Computing Data Management Approach: Sudip Misra, Samaresh Bera, Cambridge University Press, (Latest edition)
- Smart Grid, Technology and Applications: Janaka Ekanayake, et.al, John Wiley, (Latest edition)
- Smart Grids Fundamental and Technologies in Electricity Networks: Bernd M. Buchholz, Zbigniw Styczynski, Springer, (Latest Edition).
- Ali Keyhani, "Design of Smart power grid renewable energy systems", Wiley.
- Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press,
- Stuart Borlase, " Smart Grid: Infrastructure, Technology and solutions " CRC Press.

8.65 Smart Unmanned Aerial Systems and Applications

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE
Smart Unmanned Aerial Systems and Applications		(2+1)	None
KNOWLEDGE & ATTITUDE PROFILE	RANGE OF PROBLEM IDENTIFICATION & SOLVING:	RANGE OF BROADLY DEFINED ACTIVITIES:	
SK3 (Engineering Technology Fundamentals)	SP1 (Depth of Knowledge Required) SP3 (Depth of Analysis Required)	TA3 TA5	
Sustainable Development Goals (SDGs):		Professional Competence Profile	
SDG8- Decent Work and Economic Growth: SDG9- Industry, Innovation and Infrastructure		TC-1 (Comprehend & apply universal knowledge), TC-3 (Problem Analysis), TC-10 (Communication & Collaboration)	
Course Objective			
After completion of this course, students will be able to understand the fundamentals of smart unmanned aerial systems, their components, communication and navigation technologies, operational procedures, and industrial applications. The course provides practical exposure to UAV mission planning, aerial data acquisition, monitoring systems, and safe operation practices through simulation and laboratory activities.			
Course Learning Outcomes	CLOs Statement	Taxonomy (Level)	Program Outcomes (PLO)
CLO-1	After completion of this course students will be able to: Describe the architecture, components, operating principles, and applications of smart unmanned aerial systems.	C2 (Cognitive) Understand	PLO1 / SA1 (Engineering Technology Knowledge)
CLO-2	Apply navigation, communication, sensing, and mission planning concepts in UAV operations.	C3 (Cognitive) Apply	PLO-1 / SA1 (Engineering Technology Knowledge)
CLO-3	Analyze UAV performance, communication links, sensor outputs, and mission requirements for technical applications.	C4 (Cognitive) Analyze	PLO-2 / SA2 (Problem Analysis)
CLO-4	Operate UAV simulation and mission planning tools for aerial monitoring and data acquisition tasks.	P3 (Psychomotor) Precision	PLO5 / SA5 (Tool Usage)
CLO-5	Perform UAV-based monitoring and inspection activities using simulation datasets and operational procedures.	P4 (Psychomotor) Mechanism	PLO-2 / SA2 (Problem Analysis)
CLO-6	Demonstrate awareness of safety regulations, ethical practices, and responsible operation of unmanned aerial systems.	A2 (Affective) Respond	PLO-7 / SA7 (Ethics)
Course Outline for Theory			



Introduction to Smart Unmanned Aerial Systems; Fundamentals of Flight; UAV Architecture and Components; Navigation and Positioning Systems; UAV Communication Systems; Sensors and Payload Systems; Mission Planning and Operations; Smart UAV Technologies; Industrial Applications of UAV Systems; UAV Safety, Ethics and Regulations.

Lab Work Outline for Practical

Introduction to UAV platforms and components; UAV flight simulation; Mission planning and waypoint navigation; GPS and telemetry monitoring; Sensor and payload identification; Aerial image acquisition; Power-line and solar inspection case studies; Deployment of UAVs in replacement to Conventional systems; Environmental monitoring; Autonomous mission simulation; Semester project and presentation.

RECOMMENDED BOOKS

1. Introduction to Unmanned Aircraft Systems
R. Kurt Barnhart, Douglas M. Marshall, Eric Shappee, CRC Press, Latest Edition. This is one of the most comprehensive introductory UAV textbooks and is available in electronic form through many university libraries.
2. Small Unmanned Aircraft: Theory and Practice
Wiley, Latest Edition. Widely used in undergraduate UAV courses and suitable for fundamentals of flight, navigation, and mission planning.
3. A First Course in Aerial Robots and Drones
CRC Press, Latest Edition. Written specifically as an introductory undergraduate text and easier for students than advanced aerospace books.

8.66 Applications of Industrial Revolution 5.0

COURSE TITLE:		CREDITS HOURS:	PRE-REQUISITE	
Industrial Revolution 5.0		(2+1)	Computer Programming, Basic Electrical Engineering	
KNOWLEDGE & ATTITUDE PROFILE		RANGE OF PROBLEM IDENTIFICATION & SOLVING:		RANGE OF ENGINEERING ACTIVITIES:
SK3 (Engineering Fundamentals)		SP1, SP3, SP6		TA1, TA2, TA4, TA5
Sustainable Development Goals (SDGs):		Professional Competence Profile:		
SDG9- Industry, Innovation and Infrastructure SDG11- Sustainable Cities and Communities		TC-Comprehend and apply universal knowledge TC-2 Comprehend and apply local knowledge TC-3 Problem analysis TC-5 Evaluation Evaluation		
Course Objective				
After completion of this course, students will be able to understand the evolution of industrial revolutions and the principles and applications of Industry 5.0. The course covers Artificial Intelligence, Industrial Internet of Things (IIoT), Digital Twins, Collaborative Robotics, Cyber-Physical Systems, Smart Manufacturing, Sustainability, and Human-Centric Engineering for intelligent industrial systems.				
Course Learning Outcomes	CLOs Statement		Taxonomy (Level)	Program Outcomes (PLO)
CLO1	Explain Industry 1.0–5.0 evolution and enabling technologies.		C2	PLO1/SA1 Engineering Technology Knowledge:
CLO2	Analyze AI, IIoT, Digital Twin and Smart Manufacturing applications.		C4	PLO2/SA2 Problem Analysis
CLO3	Perform simulation and implementation using modern engineering tools.		P3	PLO5/SA5 Tool Usage
CLO4	Apply sustainable, resilient and human-centric engineering solutions.		C5	PLO6/SA6 The Engineering Technologist and the World



Course Outline for Theory

- Evolution of Industrial Revolutions (1.0–5.0)
- Industry 4.0 vs Industry 5.0
- Human-Centric Engineering
- Artificial Intelligence and Machine Learning
- Industrial Internet of Things (IIoT)
- Cyber-Physical Systems
- Digital Twin Technology
- Cloud, Edge and Fog Computing
- Industrial Robotics and Cobots
- Smart Manufacturing
- PLC, SCADA and HMI
- Industrial Cybersecurity
- Renewable Energy and Smart Grids
- Sustainability and Circular Economy
- Industry 5.0 Applications in Electrical Engineering

Lab Work Outline for Practical

- PLC and HMI programming
- IoT-based industrial monitoring
- Digital Twin simulation
- AI-based predictive maintenance
- Industrial robot simulation
- SCADA monitoring
- Smart energy management
- Industrial cybersecurity assessment
- Mini project on Industry 5.0



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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 (7th and 8th), these credit hours and contact hours will be doubled.
- d. Students will maintain a daily Logbook, signed by the SIT supervisor at site, Training Administrator appointed by HEI, and the student.
- e. Students must observe safety 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

APPENDIX A: Sydney Accord Knowledge and Attitude Profile

As per [International Engineering Alliance \(IEA\) guidelines](#) following are the knowledge and Attitude Profile in Sydney Accord

Domain	Sydney Accord Knowledge and Attitude Profiles
Natural Sciences and relevant Social science	SK1: A systematic, theory-based understanding of the natural sciences applicable to the sub-discipline and awareness of relevant social sciences
Maths, Numerical Analysis, Statistics, Computer & Information Science	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
Engineering Fundamentals	SK3: A systematic, theory-based formulation of engineering fundamentals required in an accepted sub-discipline
Engineering Specialist Knowledge	SK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline
Engineering Design and Operations	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
Sub-discipline Engineering Technologies	SK6: Knowledge of engineering technologies applicable in the sub-discipline
Engineering Technology in Society	SK7: Knowledge of the role of technology in society and identified issues in applying engineering technology, such as public safety and sustainable development*
Research Literature	SK8: Engagement with the current technological literature of the discipline and awareness of the power of critical thinking
Ethics, inclusive behavior and conduct.	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
*Represented by the 17 UN Sustainable Development Goals (UN-SDG)	

APPENDIX B: Engineering Technologist Graduate Attribute Profile

As per [International Engineering Alliance \(IEA\) guidelines](#) following are the Graduate Attributes in Sydney Accord

Attributes	Sydney Accord Graduate Attributes Profiles
Engineering Technology Knowledge: Breadth, depth and type of knowledge, both theoretical and practical	SA1: Apply knowledge of mathematics, natural science, computing and engineering fundamentals and an engineering specialization as specified in SK1 to SK4 respectively to defined and applied engineering procedures, processes, systems or methodologies.
Problem Analysis Complexity of analysis	SA2: Identify, formulate, research literature and analyze broadly-defined engineering problems reaching substantiated conclusions using analytical tools as appropriate to the discipline or area of specialization. (SK1 to SK4)
Design/development of solutions: Breadth and uniqueness of engineering problems i.e., the extent to which problems are original and to which solutions have not previously been identified or codified	SA3: Design solutions for broadly-defined engineering technology problems and contribute to the design of systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required (SK5)
Investigation: Breadth and depth of investigation and experimentation	SA4: Conduct investigations of broadly-defined engineering problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions (SK8)
Tool Usage: Level of understanding of the appropriateness of technologies & tools	SA5: Select and apply, and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to broadly-defined engineering problems (SK2 and SK6)
The Engineering Technologist and the World: Level of knowledge and responsibility for sustainable development	SA6: When solving broadly-defined engineering problems, analyze and evaluate sustainable development impacts* to: society, the economy, sustainability, health and safety, legal frameworks, and the environment (SK1, SK5, and SK7)
Ethics: Understanding and level of practice	SA7: Understand and commit to professional ethics and norms of engineering technology practice including compliance with national and international laws. Demonstrate an understanding of the need for diversity and inclusion (SK9)
Individual and Collaborative Team work: Role in and diversity of team	SA8: Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (SK9)



Communication: Level of communication according to type of activities performed	SA9: Communicate effectively and inclusively on broadly-defined engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, taking into account cultural, language, and learning differences
Project Management: Level of management required for differing types of activity	SA10: Apply knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.
Lifelong learning: Duration and manner	SA11: Recognize the need for, and have the ability for i) independent and life-long learning and ii) critical thinking in the face of new specialized technologies (SK8)
<i>*Represented by the 17 UN Sustainable Development Goals (UN-SDG)</i>	

APPENDIX C: Engineering Technologist Professional Competence Profiles

As per [International Engineering Alliance \(IEA\) guidelines](#) following are the Engineering Technologist Professional Competence Profiles in Sydney Accord

Professional Competence	Sydney Accord Professional Competence Profiles
Comprehend and apply universal knowledge: Breadth and depth of education and type of knowledge	TC1: Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems or methodologies
Comprehend and apply local knowledge: Type of local knowledge	TC2: Comprehend and apply the knowledge embodied procedures, processes, systems or methodologies that is specific to the jurisdiction of practice
Problem analysis: Complexity of analysis	TC3: Identify, clarify, and analyze broadly-defined problems using the support of computing and information technologies where applicable
Design and development of solutions: Nature of the problem and uniqueness of the solution	TC4: Design or develop solutions to broadly-defined problems considering a variety of perspectives.
Evaluation: Type of activity	TC5: Evaluate the outcomes and impacts of broadly defined activities
Protection of society: Types of activity and responsibility to consider sustainable outcomes	TC6: Recognize the foreseeable economic, social, and environmental effects of broadly defined activities and seek to achieve sustainable outcomes*
Legal, regulatory, and cultural: No differentiation in this characteristic	TC7: Meet all legal, regulatory, and cultural requirements and protect public health and safety in the course of all activities
Ethics: No differentiation in this characteristic	TC8: Conduct activities ethically
Manage engineering activities: Types of activity	TC9: Manage part or all of one or more broadly-defined activities
Communication and Collaboration: Requirement for inclusive communications. No differentiation in this characteristic	TC10: Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders in the course of all activities.
Continuing Professional Development (CPD) and Lifelong learning: Preparation for and depth of continuing learning. No differentiation in this characteristic	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: Level of Developed knowledge, and ability and judgement in relation to type of activity	TC12: Choose appropriate technologies to deal with broadly defined problems. Exercise sound judgement in the course of all broadly-defined activities
Responsibility for decisions: Type of activity for which responsibility is taken	TC13: Be responsible for making decisions on part or all of one or more broadly defined activities

APPENDIX D: Proposed Correlation among Sydney Accord Profiles SKs, SAs and TCs

Program Learning Outcomes (PLOs)	Graduate Attribute Profiles (SAs)	Knowledge and Attitude Profiles (SKs)	Professional Competence Profiles (TCs)
PLO-1	SA1	SK-1,2,3,4	TC-1 & TC-2

Keeping in view of guidelines of [International Engineering Alliance \(IEA\) guidelines](#) following is the proposed correlation among profiles of Graduate Attributes, Knowledge & Attitude and Professional Competence the Engineering Technologist in Sydney Accord



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PLO-2	SA2	SK-1,2,3,4	TC-3
PLO-3	SA3	SK-5	TC-4
PLO-4	SA4	SK-8	TC-5
PLO-5	SA5	SK-2,5	TC-3 & TC-5
PLO-6	SA6	SK-1,5,7	TC-6 & TC-7
PLO-7	SA7	SK-9	TC-8
PLO-8	SA8	SK-9	TC-10
PLO-9	SA9	SK-1,9	TC-10
PLO-10	SA10	SK-2,5	TC-9
PLO-11	SA11	SK-8	TC-11 to TC-13

APPENDIX E: Broadly-defined Engineering Problems (BDP) & Broadly-defined Activities with a sample problem, template for assessment and its solution.

As per [International Engineering Alliance \(IEA\) guidelines](#), the range of Problem identification and Solving in Sydney Accord can be addressed by mandatory incorporation of the Broadly-defined Engineering problems in various courses of curriculum. In this context, **Broadly-defined Engineering Problems** are the problems having characteristic SP1 and some or all of SP2 to SP7 characteristics

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

As per [International Engineering Alliance \(IEA\) guidelines](#), the range of Engineering activities in Sydney Accord can be addressed by mandatory incorporation of the Broadly-defined activities in various courses of curriculum as defined in Preamble of following Table

Attribute	Broadly-defined Activities
Preamble	As Broadly defined activities means (engineering) activities or projects that have some or all of the following characteristics:
Range of resources	TA1: Involve a variety of resources including people, data and information, natural, financial and physical resources and appropriate technologies including analytical and/or design software
Level of interactions	TA2: Require the best possible resolution of occasional interactions between technical, non-technical, and engineering issues, of which few are conflicting
Innovation	TA3: Involve the use of new materials, techniques or processes in non-standard ways

Consequences to society and the environment	TA4: Have reasonably predictable consequences that are most important locally, but may extend more widely
Familiarity	TA5: Require a knowledge of normal operating procedures and processes

Sample of Broadly-defined Engineering Problem (BDP):

Following is a sample BDP Task and it can be revised as per requirements,

“Keeping in view of the scenario of Traffic Jam as shown in picture, submit a feasible Solution by Designing and Implementing a Porotype of Smart Digital Traffic Light Controller for a signal in your city which is effected with serious traffic jammed issue. In this regard, students are advised to submit the requirements details solution as per Deliverables



Sample Deliverables for BDP (it can be revised as per requirements)

1. Problem interpretation and design assumptions.
2. Functional block diagram.
3. Flowchart and four-state FSM diagram.
4. State assignment and transition table.
5. Output truth table and simplified Boolean equations.
6. Component list with reasons for selection.
7. Complete simulation schematic and results.
8. Breadboard prototype and live demonstration.
9. Testing record with pass/fail observations.
10. Short discussion of limitations and possible future extensions.
11. Individual reflection describing the student's own contribution.



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Sample Assessment Rubric for BDP

This is Sample Rubrics Template for Assessment and criterion can be revised as per requirement of assigned Task as BDP. This sample template covers the task related learning outcomes (CLOs/PLOs), Characteristics (SP/TA) and with their level of attainment.

Criterion	CLO	PLOs	Excellent	Good	Satisfactory	Poor	Total Marks	Obtained Marks
Problem analysis and state identification							10	
State diagram and transition table							15	
Logic equations and output decoding							15	
Component selection and design							15	
Complete circuit and simulation							15	
Hardware implementation							15	
Testing and troubleshooting							10	
Report and demonstration							5	
Total							100	

Over view of Solution of BDP Solution

This document presents a complete classroom and laboratory solution for a sequential traffic light controller. The design is deliberately based on the core topics normally taught in Digital Logic Circuits and Application: number representation, combinational logic, flip-flops, counters, finite-state machines, output decoding, and simulation and hardware verification. The language and design steps are suitable for undergraduate engineering technology students and can be used as a project brief, model solution, laboratory manual or assessment guide.

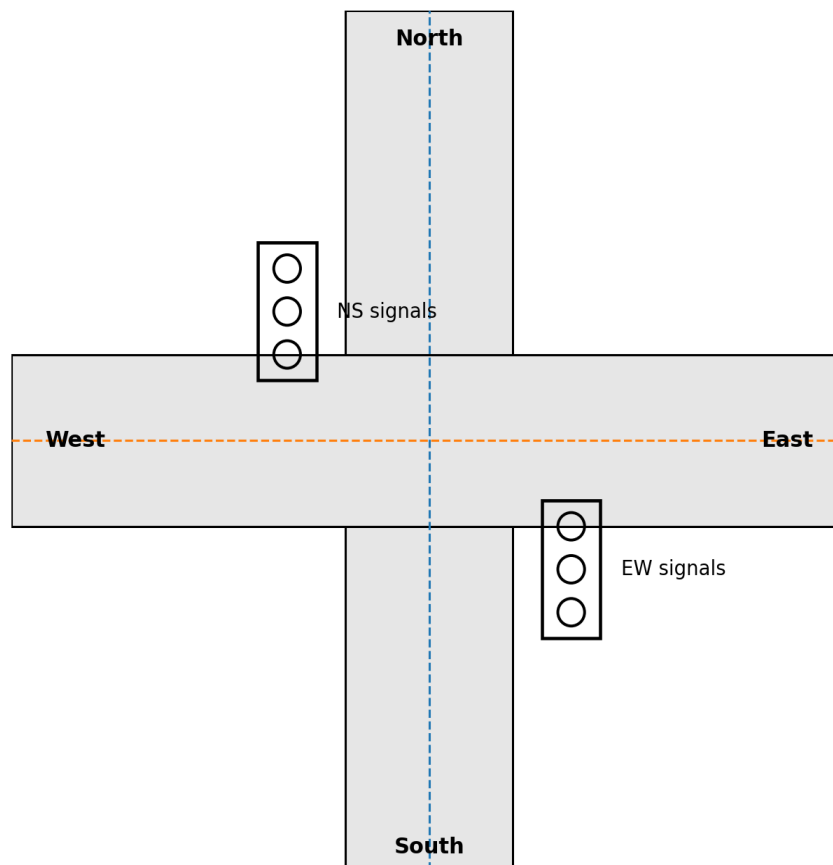
1. Problem context and scope
2. Learning outcomes and OBE mapping
3. Functional requirements and assumptions
4. System-level design
5. Finite-state-machine design
6. State table and output equations
7. Timing circuit
8. Component selection and explanation
9. Hardware interconnection
10. Simulation and implementation procedure
11. Testing and troubleshooting
12. Assessment rubric and viva questions
13. Any other details in support of BDP

1. Problem Context

A traffic signal is a familiar example of a sequential digital system. The output at any moment depends not only on the present inputs but also on the current operating state and the time already spent in that state. This makes the problem suitable for teaching how a practical requirement is converted into a finite-state machine and then implemented with standard digital logic components.

The project considers a simple intersection formed by two roads: a North–South road and an East–West road. Each road has red, yellow and green lights. The controller must allow traffic to move safely in one direction while stopping the traffic in the other direction.

Two-Road Intersection Used for the Prototype



1.1 Broadly Defined Problem Statement

Design, simulate and implement a sequential digital controller for a two-road traffic intersection using flip-flops, counters, combinational logic and finite-state-machine concepts. The controller must operate the red, yellow and green signals in a safe and repeating sequence, provide suitable timing for each state and include a reset facility that returns the system to a known starting condition.

Broadly-defined Engineering Problem Characteristics Mapping with Problem

SP1	Depth of knowledge required	The controller requires knowledge of digital electronics, sequential circuits, FSMs, counters, flip-flops, timing circuits and implementation using digital technology
SP3	Depth of analysis required.	FSM modeling, state-transition tables, Boolean logic, timing analysis, counter design and simulation are established engineering techniques
SP4	Familiarity of issues	Traffic-light controllers and FSM-based sequential controllers are established engineering applications.
SP7	Interdependence.	The clock, frequency divider, timing counter, FSM state register, next-state logic and output decoder are interdependent subsystems

1.2 Scope of the Prototype

Control of one North–South and one East–West traffic direction.

Four operating states: North–South green, North–South yellow, East–West green and East–West yellow.

Fixed timing for green and yellow intervals.

Implementation using commonly available digital logic ICs and LEDs.

Simulation before physical construction.

Use as an educational prototype only; it is not intended for installation on a public road.

2. Learning Outcomes and OBE Alignment

The project supports the following course learning outcomes. Students should be assessed on their ability to analyze the sequence, design the controller and verify its operation rather than merely copying a completed circuit.

CLO	Learning outcome	Student evidence	Bloom / domain
CLO-2	Analyze combinational and sequential logic circuits.	State identification, state diagram, transition table, timing analysis and logic equations.	C4 – Analyze
CLO-3	Design combinational and sequential circuits for practical applications.	Selection of states, counters, flip-flops, decoding method and complete circuit design.	C5 – Evaluate / Design
CLO-4	Implement, simulate and verify digital circuits using suitable ICs or simulation tools.	Simulation, breadboard implementation, measurement, fault finding and demonstration.	P3 – Precision

2.1 Project Learning Outcome

Analyze, design, simulate, implement and test a sequential traffic light controller using flip-flops, counters, finite-state-machine concepts and combinational logic, while maintaining the correct timing sequence and preventing conflicting green signals.

3. Functional Requirements and Design Assumptions

3.1 Functional Requirements

Only one road may have a green signal at any time.

The road changing from green to red must first receive a yellow warning signal.

The controller must move through the states automatically and repeat the sequence continuously.

The reset input must return the system to North–South green and East–West red.

The timing unit must provide a longer interval for green and a shorter interval for yellow.

The six lamp outputs must be clearly observable through LEDs in the laboratory prototype.

3.2 Design Assumptions

The North–South and East–West roads are treated as having equal priority.

No pedestrian crossing, emergency vehicle input or traffic-density sensor is included.

The demonstration timing is 10 seconds for green and 3 seconds for yellow.

A one-hertz clock is used so that one clock pulse represents approximately one second.

The controller operates from a regulated 5 V DC supply when 74HC-series logic is used.

4. System-Level Design

The controller is divided into five simple sections. Each section has a clear role, which makes the design easier to understand, test and troubleshoot.

Functional Block Diagram of the Traffic Light Controller

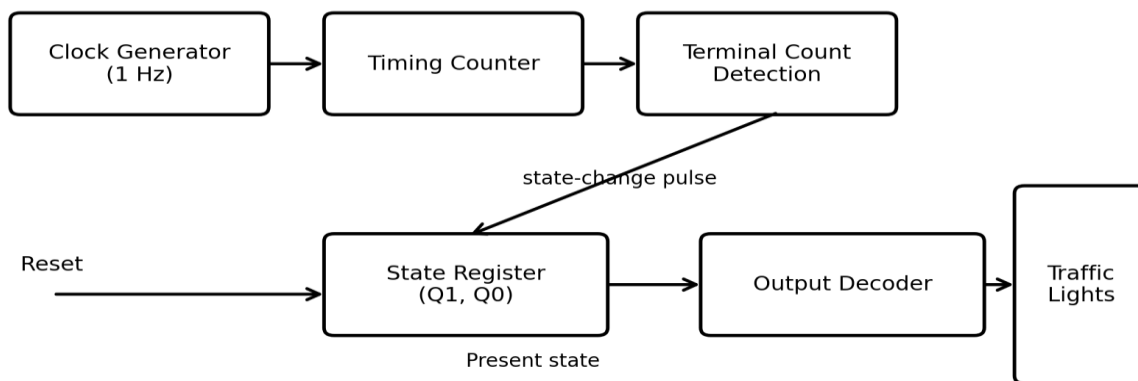


Figure 1. Functional block diagram of the controller.

Clock generator: Produces a regular stream of pulses. With a one-hertz clock, each pulse represents about one second.

Timing counter: Counts the clock pulses while the controller remains in a state.

Terminal-count detector: Checks whether the selected time has completed. It produces a state-change pulse at count 10 for green states and count 3 for yellow states.

State register: Uses two flip-flops to remember the present state of the traffic controller.

Output decoder: Converts the state bits into the six lamp-control signals for the two roads.

5. Traffic Sequence and State Design

The complete traffic cycle is divided into four states. A Moore-type finite-state machine is used because the lamp outputs depend only on the present state.

State	North–South	East–West	Duration	Purpose
S0	Green	Red	10 s	Allows North–South traffic to move.
S1	Yellow	Red	3 s	Warns North–South traffic that the signal is changing.
S2	Red	Green	10 s	Allows East–West traffic to move.
S3	Red	Yellow	3 s	Warns East–West traffic that the signal is changing.

Finite-State Machine (Moore Model)

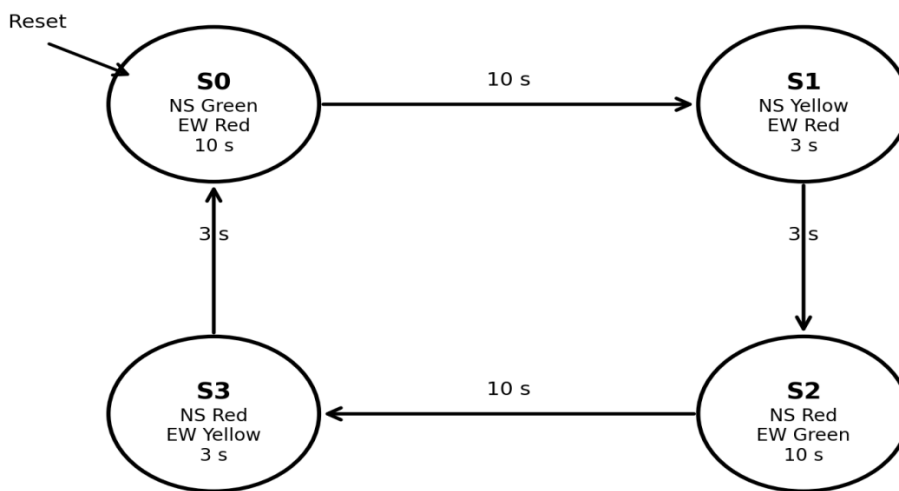


Figure 2. State diagram for the four-state controller.

5.1 Step-by-Step Operation

After reset, the controller enters S0. North–South green and East–West red are switched on. The counter counts ten one-second pulses. At the end of the count, the controller moves to S1. In S1, North–South yellow and East–West red are on for three seconds. After three pulses, the controller moves to S2. North–South red and East–West green are switched on. After ten seconds, the controller moves to S3. North–South remains red while East–West changes to yellow. After three seconds, the controller returns to S0 and the cycle starts again.

Operational Flowchart

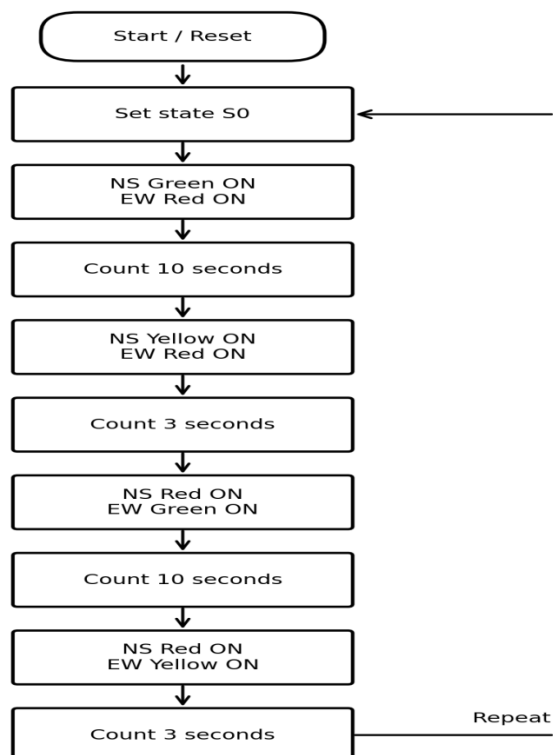


Figure 3. Operational flowchart.

6. State Assignment and Transition Table

Four states require two binary state variables because two flip-flops can represent four combinations. The flip-flop outputs are called Q1 and Q0.

State	Q1	Q0	Traffic condition
S0	0	0	NS Green, EW Red
S1	0	1	NS Yellow, EW Red
S2	1	0	NS Red, EW Green
S3	1	1	NS Red, EW Yellow

6.1 Complete State-Transition Table

Present state	Q1Q0	Timer complete (T)	Next state	Next Q1Q0
S0	00	0	S0	00
S0	00	1	S1	01
S1	01	0	S1	01
S1	01	1	S2	10
S2	10	0	S2	10
S2	10	1	S3	11
S3	11	0	S3	11

Present state	Q1Q0	Timer complete (T)	Next state	Next Q1Q0
S3	11	1	S0	00

When $T = 0$, the selected time has not finished, so the controller remains in the same state. When $T = 1$, the controller advances to the next state.

6.2 Next-State Equations

For the repeating sequence $00 \rightarrow 01 \rightarrow 10 \rightarrow 11 \rightarrow 00$, the two D-flip-flop inputs can be written as:

$$D0 = Q0'$$

$$D1 = Q1 \oplus Q0$$

These equations describe the state sequence when a valid state-change pulse is applied. In a careful synchronous implementation, the clock remains common to all flip-flops and the timer-complete signal is used as an enable condition.

7. Output Truth Table and Logic Equations

Q1	Q0	NS-R	NS-Y	NS-G	EW-R	EW-Y	EW-G
0	0	0	0	1	1	0	0
0	1	0	1	0	1	0	0
1	0	1	0	0	0	0	1
1	1	1	0	0	0	1	0

The simplified output equations are:

$$\text{NS Green: } NS_G = Q1' Q0'$$

$$\text{NS Yellow: } NS_Y = Q1' Q0$$

$$\text{NS Red: } NS_R = Q1$$

$$\text{EW Green: } EW_G = Q1 Q0'$$

$$\text{EW Yellow: } EW_Y = Q1 Q0$$

$$\text{EW Red: } EW_R = Q1'$$

An important safety check follows directly from these equations: NS_G is active only in state 00 and EW_G is active only in state 10. Therefore, the two green outputs cannot be active in the same valid state.

8. Timing Design

A one-hertz clock produces one pulse each second. The timing counter counts these pulses. The terminal-count circuit selects the required limit according to the current state.

State type	Q0	Required duration	Terminal count
Green state	0	10 seconds	10 pulses
Yellow state	1	3 seconds	3 pulses

Because $Q0$ is 0 in the two green states and 1 in the two yellow states, $Q0$ can be used as the timing-selection signal. When $Q0 = 0$, the circuit waits for count 10. When $Q0 = 1$, it waits for count 3.

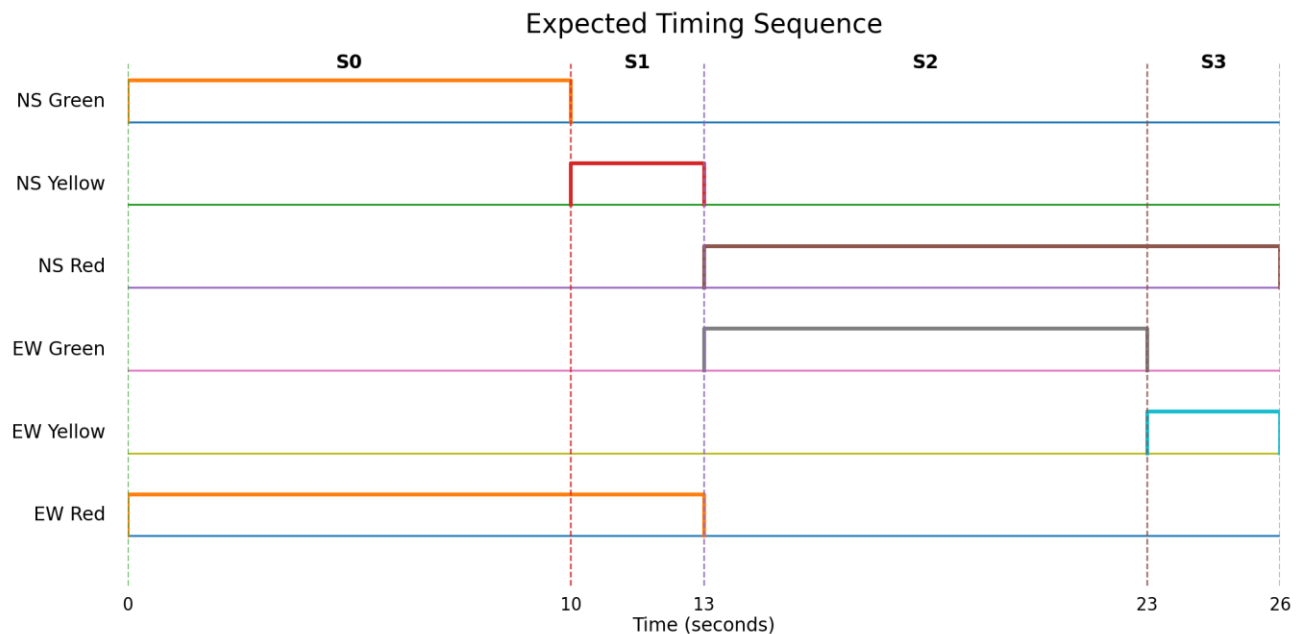


Figure 4. Expected timing diagram for one complete 26-second cycle.

9. Component Selection and Explanation

The following components are suitable for a breadboard prototype. Equivalent devices may be used depending on what is available in the laboratory.

Component	Example device	Quantity	Purpose
Clock generator	NE555 timer	1	Produces a slow clock signal.
Four-bit counter	74HC163 / CD4029	1	Counts the one-second pulses.
State flip-flops	74HC74	1 IC	Stores Q1 and Q0.
Comparator / count decoder	74HC85 or gates	1	Detects count 3 or count 10.
NOT gates	74HC04	1	Generates complemented signals.
AND gates	74HC08	1–2	Forms decoded output conditions.
OR gates	74HC32	1 if required	Combines intermediate logic terms.
XOR gates	74HC86	1	Generates the D1 next-state term.
LEDs	2 red, 2 yellow, 2 green	6	Represent traffic lights.
LED resistors	330 ohm	6	Limit LED current.
Reset push button	Normally open	1	Initializes the controller.

Component	Example device	Quantity	Purpose
Decoupling capacitors	0.1 microfarad	One per IC	Reduce supply noise.
Power supply	Regulated 5 V DC	1	Powers the circuit.

9.1 NE555 Clock Generator

The NE555 can be connected in astable mode so that it continuously produces clock pulses. For classroom use, a frequency close to one hertz is convenient because students can count the pulses and observe each state change.

The timing frequency is set by two resistors and one capacitor. A small variable resistor may be included so that the instructor can speed up or slow down the demonstration.

9.2 Four-Bit Timing Counter

A four-bit counter is sufficient because it can represent values from 0 to 15. The counter receives one pulse per second and provides a binary output that represents the elapsed time.

When the required count is reached, the terminal-count logic produces a short pulse, clears the timing counter and advances the state machine.

9.3 D-Type Flip-Flops

Two D flip-flops store the state bits Q1 and Q0. The 74HC74 contains two D flip-flops in one package and is therefore suitable for this design.

The asynchronous clear input can be connected to the reset push button so that both state bits return to zero. This places the system in S0.

9.4 Logic Gates and Decoder

The logic gates perform two tasks: they generate the next state and decode the current state into lamp outputs. A 2-to-4 decoder may be used instead of several individual gates. Its four outputs can represent S0, S1, S2 and S3.

Using a decoder makes the circuit easier to wire and reduces the number of separate Boolean expressions that students must implement physically.

9.5 LEDs and Current-Limiting Resistors

Six LEDs are used as the traffic lamps. Each LED must be connected through its own current-limiting resistor. A value of 330 ohms is appropriate for a typical 5 V laboratory circuit.

The LEDs should be arranged in two vertical groups so that the operation resembles a real traffic signal.

9.6 Reset and Power-Supply Practice

The reset input should never be left floating. A pull-up or pull-down resistor is required, depending on whether the selected IC uses an active-high or active-low reset.

A 0.1 microfarad decoupling capacitor should be placed close to the supply pins of each IC. This is a good laboratory habit and helps prevent unwanted state changes caused by switching noise.

10. Proposed Hardware Architecture

Proposed Hardware Architecture

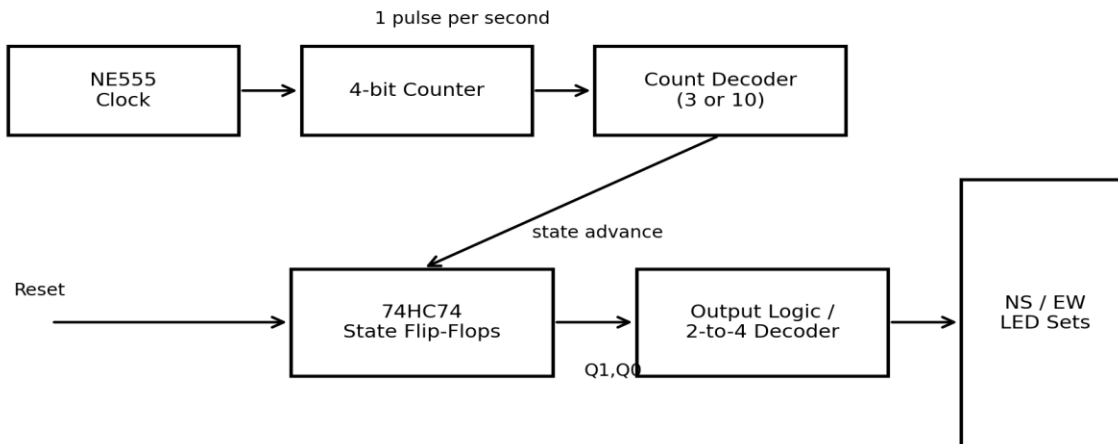


Figure 5. Hardware architecture using a clock, counter, state register and output decoder.

10.1 Recommended Interconnection Sequence

Build and test the 5 V power rails before inserting any IC.
 Construct the NE555 clock circuit and verify its output using an LED or oscilloscope.
 Connect the clock to the timing counter and confirm that the binary count advances correctly.
 Build the terminal-count detector for count 3 and count 10.
 Connect the timer-complete output to the state-control section.
 Wire the two D flip-flops and verify the state sequence 00, 01, 10, 11, 00.
 Build the output decoder and first test it with manually selected Q1 and Q0 values.
 Connect the six traffic-light LEDs through 330-ohm resistors.
 Connect the complete timing and state sections, apply reset and observe several complete cycles.

11. Simulation Procedure

The circuit should be simulated before it is built on a breadboard. Proteus, Multisim, Logisim Evolution or another suitable digital simulator may be used.
 Create a new project and place the clock source, counter, flip-flops, logic gates, LEDs and reset switch.
 Set the clock to one hertz, or use a faster frequency during initial testing.
 Connect Q1 and Q0 to logic indicators so that the state sequence can be observed directly.
 Run the simulation and press reset. Confirm that Q1Q0 = 00.
 Check that the states advance in the order 00, 01, 10, 11 and then return to 00.
 Observe the six lamp outputs and compare them with the truth table.
 Use a logic analyser or virtual oscilloscope to capture the state and lamp timing waveforms.

Introduce one wiring fault deliberately and record how it affects the outputs. Correct the fault and repeat the test.

11.1 Simulation Evidence to Include in the Report

Complete circuit schematic.

Screenshot of the reset condition.

Screenshot or waveform showing the four-state sequence.

Timing waveform for all six lamp outputs.

Observation table comparing expected and simulated results.

Brief explanation of any fault found during simulation.

12. Hardware Implementation

Students should construct the system in stages rather than wiring the whole circuit at once. Stage-by-stage testing reduces mistakes and makes fault finding much easier.

Stage	Circuit section	Test method	Expected result
1	Power supply	Measure supply rails with a multimeter.	Approximately 5 V at every IC.
2	Clock generator	Observe output LED or oscilloscope.	Regular pulses.
3	Timing counter	Check binary outputs.	Count increases correctly.
4	State register	Apply manual state-change pulses.	00 → 01 → 10 → 11 → 00.
5	Output decoder	Set Q1Q0 manually.	Correct pair of lamps for each state.
6	Complete controller	Run for several cycles.	Correct automatic sequence with no conflicting green lights.

13. Testing and Verification

Test	Procedure	Expected result	Pass criterion
Reset test	Press and release reset.	NS green and EW red are ON.	Q1Q0 = 00 and no other lamp is active.
Green timing	Count the clock pulses in S0 and S2.	Each green state lasts 10 pulses.	State changes only after pulse 10.
Yellow timing	Count pulses in S1 and S3.	Each yellow state lasts 3 pulses.	State changes only after pulse 3.
Sequence test	Observe one complete cycle.	S0 → S1 → S2 → S3 → S0.	No skipped or repeated state.
Safety test	Observe both green LEDs continuously.	They never turn on together.	Mutual exclusion maintained.
Repeatability	Run for at least five cycles.	Identical operation each cycle.	No false transition or lock-up.
Power-cycle test	Switch supply off and on, then reset.	Controller returns to S0.	Safe start after reset.

14. Troubleshooting Guide

Observed problem	Likely cause	Suggested check
No LEDs turn on	Missing supply or incorrect LED polarity.	Measure 5 V rail and check LED orientation.
Clock does not pulse	Incorrect 555 wiring or timing component values.	Check pins 2, 6 and 7; verify resistor and capacitor connections.
Counter does not advance	Clock not reaching counter or reset held active.	Probe clock input and reset pin.
Wrong state sequence	D-input wiring error or floating input.	Compare D0 and D1 wiring with the equations.
Two green LEDs turn on together	Incorrect output decoding.	Check Q1 and Q0 connections to green-output gates.
State changes too early	Terminal count decoded incorrectly.	Verify binary values for decimal 3 and decimal 10.
Random state changes	Supply noise, bouncing reset switch or floating inputs.	Add decoupling capacitors and proper pull resistors.
LED is very dim	Resistor too large or weak logic output drive.	Check resistor value and logic-family compatibility.

15. Possible Extensions

Once the basic controller is working, stronger students may extend the project. These extensions should be treated as optional work because they require additional states or input conditions.

All-red safety interval between the two traffic directions.

Pedestrian push button and walk indicator.

Night-time flashing-yellow mode.

Variable green time selected through switches.

Seven-segment countdown display.

Vehicle sensor input for traffic-responsive timing.

Implementation using a programmable logic device after the discrete-logic version has been understood.

16. Safety and Practical Limitations

The proposed design is a low-voltage educational prototype. A controller intended for a public road requires certified hardware, redundant safety circuits, approved timing standards, protected power supplies, emergency operating modes, pedestrian facilities and formal testing by the responsible authorities. The classroom design should therefore be presented as a learning exercise and not as a road-ready product.

17. Conclusion

This broadly defined problem gives students a complete path from a familiar real-life requirement to a working sequential digital system. It brings together state modelling, flip-flops, counters, Boolean logic, timing, simulation, hardware construction and troubleshooting. More importantly, it asks students to make and justify design decisions instead of carrying out a routine verification experiment. For this reason, it is well suited to the Digital Systems or Digital Logic Circuits and Applications course in a BS Electrical Engineering Technology program.

APPENDIX F: Guidelines for Incorporation of Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are a collection of 17 global goals [set by the United Nations in 2015](#). Designed as a shared blueprint to achieve a better and more sustainable future by 2030, they address global challenges including poverty, inequality, climate change, environmental degradation, peace, and justice as follows.

SDGs	Description
 UP2DATESKILLS ENGLISH SUPPORTS THE SDGs	SDG1- No Poverty: End poverty in all its forms everywhere. SDG2- Zero Hunger: End hunger, achieve food security, and promote sustainable agriculture. SDG3- Good Health and Well-being: Ensure healthy lives and promote well-being for all ages. SDG4- Quality Education: Ensure inclusive and equitable quality education and lifelong learning. SDG5- Gender Equality: Achieve gender equality and empower all women and girls. SDG6- Clean Water and Sanitation: Ensure availability and sustainable management of water and sanitation for all. SDG7- Affordable and Clean Energy: Ensure access to affordable, reliable, sustainable, and modern energy. SDG8- Decent Work and Economic Growth: Promote sustained, inclusive, and sustainable economic growth. SDG9- Industry, Innovation and Infrastructure: Build resilient infrastructure and foster innovation. SDG10- Reduced Inequalities: Reduce inequality within and among countries. SDG11- Sustainable Cities and Communities: Make cities inclusive, safe, resilient, and sustainable. SDG12- Responsible Consumption and Production: Ensure sustainable consumption and production patterns. SDG13- Climate Action: Take urgent action to combat climate change and its impacts. SDG14- Life Below Water: Conserve and sustainably use the oceans, seas, and marine resources. SDG15- Life on Land: Protect, restore, and promote sustainable use of terrestrial ecosystems. SDG16- Peace, Justice and Strong Institutions: Promote peaceful and inclusive societies for sustainable development. SDG17- Partnerships for the Goals: Strengthen global partnerships for sustainable development.



To promote sustainable engineering education and align engineering curricula with the United Nations Sustainable Development Goals (UN SDGs), Higher Education Institutions (HEIs) may integrate sustainability principles, where appropriate, into Broadly-defined Engineering Problems (BDPs), Broadly-defined Engineering Activities (BDAs), laboratory work, semester projects, capstone projects, and other curricular, co-curricular, and extra-curricular activities.

HEIs map only those UN SDGs that are directly addressed through BDPs, BDAs, laboratory exercises, semester projects, capstone projects, or co- and extra-curricular activities, as mapping all 17 SDGs is neither required nor expected. Students may be encouraged to develop engineering solutions that enhance resource efficiency, minimize environmental impacts, and contribute to sustainable industrial and societal development. Furthermore, interdisciplinary collaboration among students from different engineering and technology disciplines may be promoted to develop integrated solutions for addressing complex and interconnected sustainability challenges.



APPENDIX G: Guidelines for Inclusion of Massive Open Online Courses (MOOCs) in the Curriculum

Massive Open Online Courses (MOOCs) provide students with access to high-quality educational resources offered by internationally recognized universities, industries, and professional organizations. Integrating MOOCs into the curriculum enhances learning through flexible and self-paced education while supplementing classroom instruction with contemporary, industry-oriented knowledge.

The University may approve and periodically endorse eligible MOOCs through its relevant statutory bodies, enabling students to earn academic credit as prescribed by the concerned department. The recognition and award of credits for MOOCs shall be in accordance with the Higher Education Commission (HEC) **Undergraduate Education Policy 2023 (Version 1.1)** and the University's applicable academic regulations.

MOOCs offered by recognized national and international platforms, such as Coursera, edX, FutureLearn, NPTEL, MIT OpenCourseWare etc can be considered for academic credit. These platforms provide students to develop new knowledge and professional skills beyond the traditional classroom environment.



APPENDIX H: Guidelines for Implementing Mandatory Certifications in the Curriculum

To enhance graduates' employability and industry readiness, students shall complete mandatory industry-recognized certifications aligned with the program learning outcomes and current market needs. Certifications shall complement the curriculum by providing practical, job-ready skills and exposure to emerging technologies.

The Department may maintain and periodically update a list of approved certifications offered by recognized national and international certification bodies. Certifications may be integrated within relevant courses or recognized for academic credit through course mapping, subject to approval by the University's statutory bodies and the detailed guidelines in accordance with HEC letter no. **HEC/CURR/GEN/2025/8036 dated September 15, 2025.**

Industry-recognized certifications such as electrical safety, PLC programming, industrial automation, SCADA systems, electrical machine drives, renewable energy and solar PV systems, embedded systems, industrial instrumentation, IoT, machine learning and computer-aided electrical design (AutoCAD Electrical/EPLAN). These certifications shall be obtained from recognized certification providers, including Siemens, Schneider Electric, ABB, Rockwell Automation (Allen-Bradley), Phoenix Contact, Mitsubishi Electric, Autodesk, MathWorks, Coursera, EdX and other equivalent national or international organizations approved by the HEI, to strengthen students' practical skills, industry readiness, and professional competence.



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APPENDIX I: Guidelines for Reviewing and transformation of Curriculum in the Context of IR 5.0

The rapid advancement of Artificial Intelligence (AI), automation, digitalization, advanced manufacturing, intelligent systems, sustainability technologies, and other emerging technologies under Industrial Revolution 5.0 (IR 5.0) is transforming industry, employment, and societal needs. In view of these developments and HEC guidelines in accordance with HEC letter no. **HEC/CURR/IR/26/01 dated July 15, 2026**, HEIs are advised to review and update curricula regularly to ensure that graduates acquire relevant, future-oriented, and industry-responsive competencies.

In this context, HEIs can upgrade the contents of relevant existing courses to incorporate emerging technologies, AI and digital competencies, intelligent systems, critical thinking, real-life problem-solving, innovation, sustainability, communication, and entrepreneurship, while remaining within the approved program structure and credit framework.

To provide students with a broader and structured understanding of these developments, universities may also consider offering a dedicated course on Emerging Technologies and Industrial Revolution 5.0, where appropriate within the approved curriculum. Such curriculum enhancement, supported through practical projects, industry case studies, and experiential learning, will help ensure that graduates remain future-ready, employable, innovative, and capable of responding to evolving technological and industrial requirements, in line with the general directions of HEC and relevant NCRC curriculum frameworks.

APPENDIX J: Minutes of Preliminary Meeting of NCRC

The preliminary meeting of National Curriculum Review Committee (NCRC) for the Electrical Engineering Technology for Bachelor's Degree program was held during 3 days from 11-05-2026 to 13-05-2026 at the National University of Technology (NUTECH), Islamabad and following is the the list of participants

S N	Name	Designation and Affiliation
1.	Prof. Dr. Muhammad Kamran	Vice Chancellor, The Islamia University of Bahawalpur (IUB), Bahawalpur
2.	Prof. Dr. Muhammad Inayatullah Khan	Vice Chancellor, University of Engineering & Technology (UET), Taxila
3.	Prof. Dr. Saad Rehman	Pro-Rector Academics, Imperial College of Business Studies (ICBS), Lahore
4.	Prof. Dr. Gulistan Raja	Dean, University of Engineering & Technology (UET), Taxila
5.	Prof. Dr. Ahmed Muddassir Khan	Dean FEST, Indus University (IU), Karachi
6.	Dr. Nauman Razzaq	HoD, National University of Technology (NUTECH), Islamabad
7.	Dr. Muhammad Shahid Iqbal	Associate Professor, National University of Technology (NUTECH), Islamabad
8.	Dr. Ayesha Abbasi	Lecturer, International Islamic University (IIU), Islamabad
9.	Dr. Rooha Masroor	Assistant Professor, MNS UET, Multan
10.	Prof. Dr. Marium Jalal	Professor, National University of Technology (NUTECH), Islamabad
11.	Prof. Dr. Aamer Saleem	Campus Director & Dean, Hamdard University (HU), Islamabad Campus
12.	Prof. Dr. Zahoor Ahmed Baloch	Dean, Balochistan University of Engineering & Technology (BUET), Khuzdar
13.	Dr. Waqar Ishaq	HoD, Hazara University, Mansehra
14.	Dr. Bakhtiar Khan	HoD, Karakoram International University (KIU), Gilgit Baltistan
15.	Prof. Dr. Sajjad Manzoor	Director Mirpur Institute of Technology (MIT), Mirpur University of Sciences & Technology (MUST), AJK
16.	Dr. Adnan Yousaf	Associate Dean, Superior University (SU), Lahore
17.	Prof. Dr. Syed Waqar Shah	Dean, University of Engineering & Technology (UET), Peshawar



S N	Name	Designation and Affiliation
18.	Prof. Dr. Mehr Gul	Dean, Mirchakar Khan Rind University of Technology (MCUT), DG Khan
19.	Prof. Dr. Sajjad Hussain (Online Mode)	Professor, University of Glasgow
20.	Mr. Muhammad Munir Akhtar (Technologist)	GM Utility Operations, Naveena Exports Ltd Lahore
21.	Engr. Zakaullah Khan Gandapur (Industrial Rep)	EX-CEO & GM Power Distribution Companies PESCO, TESCO and WAPDA
22.	Mr. Hidayatullah Kasi (HEC Rep)	Deputy Director, Academics Division HEC, Islamabad
23.	Hafiz Ghulam Muhammad (NTC Rep)	Deputy Director, NTC, Islamabad

Day 1 Proceedings: Opening Session

The preliminary meeting commenced with recitation of Holy Quran and it was chaired by honorable Prof. Dr. Wasim Khaliq, after welcoming the participants, he highlighted the objectives and significance of the meeting in the context of outcome-based education and international accreditation requirements. Then he further explicitly elaborated the Curriculum requirements for BS Engineering Technology programs through more practical work engagement along with the futuristic approach, market demands and societal needs as per the scope NTC under the guidelines of Sydney accord. Then, the house was invited for nominations of Convener, Co-Convener and Secretary for the NCRC, after discussion with members following members nominated for further proceedings

Sr#	Nominations	Name and Affiliation
1	Convener	Prof. Dr. Gulistan Raja, Dean, Faculty of Electrical & Electrical Engineering, University of Engineering & Technology (UET), Taxila
2	Co-convener	Prof. Dr. Muhammad Kamran, Vice Chancellor, The Islamia University of Bahawalpur (IUB), Bahawalpur
3	Secretary	Prof. Dr. Ahmed Muddassir Khan, Dean Faculty of Engineering, Science and Technology, Indus University, Karachi

Addressed By Chairman NTC:

Meanwhile, Lt. Gen. Moazzam Ejaz, HI (M) (Retd.), Chairman NTC graced the house with his valuable presence and enlighten the objectives for the NCRCs and important initiatives for the promoting the Engineering Technology educations such as

- Strengthening industry-academia linkages through NTC (centralized) and institutional platforms (decentralized). Decentralized approach is prevailing the today's world.
- Expansion of teacher training and professional development initiatives in next phase.
- Encouragement for HEIs to establish stronger industrial collaborations for internships and SIT.
- Promotion of job fairs and technologist databases to improve graduate employability.
- HEC supports launching MS and PhD programs in Engineering Technology disciplines.
- Encouragement for HEIs to offer international language courses to improve global employability.
- HEC's facilitation of funding support for laboratories in the HEIs with technology infrastructure.
- Continuation of efforts toward international recognition and Sydney Accord alignment.

Suggestions and Queries by NCRC members:

After the comprehensive speech, Chairman NTC permitted to open the house for the suggestions and queries. Therefore, following members contributed with their important feedback individually

- Prof. Dr. Gulistan Raja briefed importance of the process of curriculum revision,
- Prof. Dr. Muhammad Kamran emphasized on inculcation of Sydney Accord standards,
- Prof. Dr. Muhammad Inayatullah Khan suggested to include the emerging technologies in curriculum,
- Engr. Zakaullah Khan proposed the alignment of curriculum with Industry demands,
- Mr. Munir Akhtar highlighted the importance of medium of curriculum & intake policy in technical boards,
- Prof. Dr. Saad Rehman emphasized on provision of certification in curriculum
- Mr. Hidayatullah emphasized on compliance of HEC guidelines of General education courses,
- Prof. Dr. Mehr Gul also suggested the difference of standard for technical boards,
- Prof. Dr. Sajjad (via online link) highlighted the challenges of AI in academia & future Jobs,
- Dr. Muhammad Shahid Iqbal emphasized on competency & scenario based assessment with Professor by practice,
- Dr. Rooha proposed the initiatives for female students in technology programs as NTC Ambassadors,
- Dr. Maryam shared her international experience and suggested for Co-option system at national level,
- Dr. Ayesha informed that more female students enrolled in her HEI, however need SIT opportunities,
- A few other honorable members also shared their views for improvement in technology education,



- Prof. Dr. Ahmed Muddassir as a secretary shown commitment to address the guidelines of Sydney accord.

In the end, vote of Thanks to all members by Chairman NTC was presented and he also appreciated the suggestions by honorable members and he shown his interest to address all the issues gradually

Day 1 Proceedings: Technical Proceedings

Following are the further proceedings of Day-1 and all NCRC members contributed with their active participations

Mr. Hidayatullah Kasi, Deputy Director, Academics Division, HEC Islamabad, delivered a presentation on curriculum development guidelines and the HEC curriculum template. He also suggested that if NCRC need to propose any other additional general education courses as per NTC framework or guidelines by mentor report of Sydney accord then it can be accommodated in inter disciplinary elective categories.

- Prof. Dr. Gulistan Raja, (Convener) started discussion with the HEC general education courses requirements and semester wise distribution in the Electrical Engineering Technology curriculum. He further discussed the other requirements of framework on distribution of core courses, inter-disciplinary courses, senior design project, supervised industrial training and certification.
- Prof. Dr. Muhammad Kamran (Co-convener) recommended to incorporate the Sydney accord guidelines in International Engineering Alliance (IEA) for Graduate Attributes (SAs), Professional Competencies (TCs), and UN Sustainable Development Goals (SDGs) in the curriculum.
- Prof. Dr. Muhammad Inayatullah Khan proposed to constitute sub-groups for General Education, Foundation, and Breadth, Depth and Interdisciplinary Subjects (IDS) domains and he further suggested to further distribute the subgroup on the basis specialization such as Electrical Power, Computing, Telecom and Emerging Technologies. The details of sub-groups are as follows

**Sub-groups of NCRC Electrical Engineering Technology**

Following sub-groups are constituted with their separate Sub-group Lead for distribution of courses as per discipline

NCRC Electrical Engineering Technology			
Sr#	Name	Designation and Affiliation	Role
1	Prof. Dr. Gulistan Raja	Professor and Dean, Faculty of Electrical & Electrical Engineering, University of Engineering & Technology (UET), Taxila	Convener
2	Prof. Dr. Muhammad Kamran,	Professor and Vice Chancellor, The Islamia University of Bahawalpur (IUB), Bahawalpur	Co-convener
3	Prof. Dr. Ahmed Muddassir Khan,	Professor and Dean Faculty of Engineering, Science and Technology, Indus University, Karachi	Secretary

Sub-Group: General Education			
Sr#	Name	Designation	Role
1	Mr. Hidayatullah Kasi	HEC Representative	Sub-group Lead
2	Prof. Dr Mehr Gul	Professor and Dean	Member
3	Dr Adnan Yousuf	Associate Dean and HoD	Member
4	Engr. Zakaullah Khan	Industrial Representative	Member
Sub-Group: Foundation and Core Courses			
Sr#	Name	Designation	Role
1	Prof. Dr. Muhammad Kamran	Professor and VC	Sub-group Lead
2	Prof. Dr. Saad Rehman	Pro-Rector Academics,	Member
3	Prof. Dr. Gulistan Raja	Professor and Dean	Member
4	Mr. Muhammad Munir Akhtar	Technologist	Member



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Sub-Group: Power and Renewable Energy			
Sr#	Name	Designation	Role
1	Prof. Dr. Nauman Razzaq	Associate Professor and HoD	Sub-group Lead
2	Prof. Dr. Mehr Gul	Professor and Dean	Member
3	Prof. Dr. Sajjad Manzoor	Professor and Director	Member
4	Dr Ayesha Abbasi	Lecturer	Member
5	Engr. Zakaullah Khan	Industrial Representative	Member
6	Dr Bakhtiar Khan	HoD	Member
Sub-Group: Telecom and Computing			
Sr#	Name	Designation	Role
1	Prof. Dr Syed Waqar Shah	Professor and Dean	Sub-group Lead
2	Dr Rooha Masroor	Assistant Professor	Member
3	Dr Waqar Ishaq	HoD	Member
4	Dr Muhammad Shahid Iqbal	Associate Professor	Member
5	Prof. Dr Aamer Saleem	Dean and Director Campus	Member
6	Prof. Dr Sajjad (Uni of Glasgow)	Professor	Member
Sub-Group: Emerging Technologies			
Sr#	Name	Designation	Role
1	Dr Adnan Yousuf	Associate Dean and HoD	Sub-group Lead
2	Prof. Dr. Muhammad Inayatullah Khan	Professor and VC	Member
3	Mr. Muhammad Munir Akhtar	Technologist	Member



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4	Prof. Dr. Zahoor Ahmed	Professor	Member
5	Prof. Dr. Marium Jalal	Professor	Member
6	Dr. Rooha Masroor	Assistant Professor	Member
Sub-Group: SIT, Internship, Industrial Certifications, Capstone Project			
Sr#	Name	Designation	Role
1	Mr. Muhammad Munir Akhtar	Technologist	Sub-group Lead
2	Prof. Dr Mehr Gul	Professor and Dean	Member
3	Engr. Zakaullah Khan	Industrial Representative	Member

- Prof. Dr. Ahmed Muddassir (Secretary) started discussion for semester wise courses allocation in accordance with HEC curriculum template and as per the proposed framework of Electrical Engineering Technology. Moreover, curriculum related important points also discussed regarding observations in Mentor Report of Sydney Accord visit. After discussion with members, proposed a course scheme of Electrical Engineering Technology as well as its comparison with NTC framework.
- Meanwhile, Industry Experts Mr Munir Akhtar and Engr. Zakaullah Khan also highlighted the industry demands for addressing in curriculum, particularly it was proposed to incorporate the Certification in Curriculum as per HEC guidelines.
- Similarly, International Expert Prof. Dr Sajjad Hussain (online from University of Glasgow), shared his experience in terms of international trends of inclusion of Artificial Intelligence (AI) in the curricula of all program. In this context, recommendation and guidelines of Artificial Intelligence (2+1) course is already under consideration as per HEC guidelines.
- Then after discussion, the Courses were distributed among the subgroups to develop the detailed course profiles.
- At the end of the day, the Secretary presented the progress achieved and outlined the tasks for Day 1.

Day 2 Proceedings:



Following are the proceedings of Day-2 and all the NCRC members contributed with their active participations

- The Convener shared the guidelines of Graduate Attributes (SAs), Professional Competencies (TCs), and UN Sustainable Development Goals (SDGs) aligned with international engineering technology standards. In this context, details of Attributes and Profiles are adopted from International Engineering Alliance (IEA).
- The secretary along with convener proposed a sample Course Profile Template for incorporating the Sydney accord guidelines in International Engineering Alliance (IEA) for the Knowledge & Attitude Profiles (SKs), Technologist Competencies (TCs), Range of Problem Identification and Solving (SPs), Range of Engineering Activities (TAs) CLOs, Bloom's Taxonomy levels, course contents, lab contents recommended books, and PLO mappings. In this regard, sample course profile.
- The committee discussed and finalized recommendations regarding elective courses, subject nomenclature, and domain-wise distribution. All subgroups continued working on their assigned domains to develop detailed theory and lab course profiles.
- The Secretary presented a summary of the work completed during Day 2.

Day 3 Proceedings

Following are the proceedings of Day-3 and all the NCRC members contributed with their active participations

- The Secretary presented a consolidated summary of the work completed by all subgroups.
- Peer review of the developed course profiles was conducted to ensure consistency and alignment with outcome-based education principles.
- Participants visited laboratories, innovation facilities, and the National Incubation Center (NIC) at NUTECH.

Closing Session

Following are the closing remarks by the core committee members:

- Prof. Dr. Wasim Khaliq (Focal Person of NTC NCRCs) discussed the major outcomes of the preliminary meeting and emphasized alignment with international accreditation requirements and Sydney Accord considerations.
- Prof. Dr. Gulistan Raja (Convener) presented the summary of proceedings and informed members regarding follow-up online meetings for further discussion towards finalization of the curriculum.
- Prof. Dr. Muhammad Kamran (Co-convener) appreciated the collaborative contributions and expert input of the all NCRC members.



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- Prof. Dr. Ahmed Muddassir Khan (Secretary) highlighted the responsibilities of subcommittees and further process of submission and review of course profiles through G-Drive folders.

Conclusion

The meeting concluded with a vote of thanks by the Prof. Dr. Wasim Khaliq (Focal Person of NTC NCRCs) who appreciated the active participation and valuable contributions of all members. Commemorative shields were distributed among the participants in recognition of their contributions. In the end, NCRC members of Electrical Engineering Technology also present their gratitude with acknowledgement of hospitality and continuous support from the staff and management of NUTECH, GIZ and NTC Team.

APPENDIX K: Minutes of the Final Meeting of NCRC

The Final meeting of National Curriculum Review Committee (NCRC) for the Electrical Engineering Technology for Bachelor's Degree program was held during 3 days from 05-08-2026 to 07-08-2026 at the National University of Technology (NUTECH), Islamabad and following is the list of participants

SN	Name	Designation and Affiliation
1.	Prof. Dr. Gulistan Raja	Convener NCRC, Dean, University of Engineering & Technology (UET), Taxila
2.	Prof. Dr. Muhammad Kamran	Co-convener NCRC, Vice Chancellor, The Islamia University of Bahawalpur (IUB), Bahawalpur
3.	Prof. Dr. Ahmed Muddassir Khan	Secretary NCRC, Dean, Indus University (IU), Karachi
4.	Prof. Dr. Muhammad Inayatullah Khan	Vice Chancellor, University of Engineering & Technology (UET), Taxila
5.	Prof. Dr. Saad Rehman	Pro-Rector Academics, Imperial College of Business Studies (ICBS), Lahore
6.	Dr. Nauman Razzaq	HoD, National University of Technology (NUTECH), Islamabad
7.	Dr. Muhammad Shahid Iqbal	Associate Professor, National University of Technology (NUTECH), Islamabad
8.	Dr. Rooha Masroor	Assistant Professor, MNS UET, Multan
9.	Prof. Dr. Marium Jalal	Professor, National University of Technology (NUTECH), Islamabad
10.	Prof. Dr. Aamer Saleem	Campus Director & Dean, Hamdard University (HU), Islamabad Campus
11.	Dr. Waqar Ishaq	HoD,, Hazara University, Mansehra
12.	Dr. Bakhtiar Khan	HoD, Karakoram International University (KIU), Gilgit Baltistan
13.	Prof. Dr. Sajjad Manzoor	Director Mirpur Institute of Technology (MIT), Mirpur University of Sciences & Technology (MUST), AJK
14.	Dr. Adnan Yousaf	Associate Dean, Superior University (SU), Lahore
15.	Prof. Dr. Syed Waqar Shah	Dean, University of Engineering & Technology (UET), Peshawar
16.	Prof. Dr. Sajjad Hussain (Online Mode)	Professor, University of Glasgow
17.	Mr. Muhammad Munir Akhtar (Technologist)	GM Utility Operations, Naveena Exports Ltd Lahore
18.	Engr. Zakaullah Khan Gandapur (Industrial Rep)	EX-CEO & GM Power Distribution Companies PESCO, TESCO & WAPDA
19.	Hafiz Ghulam Muhammad (NTC Rep)	Deputy Director, NTC, Islamabad



Leaves of absence is granted to members who couldn't attend meeting due to their official responsibilities. After the introductory session, deliberations on the agenda of the final meeting formally commenced and headed by Convener Prof. Dr. Gulistan Raja, Co-convener Prof. Dr. Muhammad Kamran, Secretary Prof. Dr. Ahmed Muddassir Khan

1. The inauguration session was started with recitation of Holy Quran, and chaired by Convener Prof. Dr. Gulistan Raja. The Chair also extended his gratitude to the entire team and briefed the objectives and arrangements for the second NCRC.
2. Various issues were thoroughly deliberated during three (03) days 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.
 - Finalized the various Appendices to provide guidelines as per IEA for Sydney Accord related Knowledge & Attitude Profiles, Graduates Attributes, Professional Competence, Correlation among Profiles, Characteristics of Broadly-defined Engineering Problem and Activities with sample problem, rubrics of assessment and its solution.
 - Furthermore, guidelines are also provided to incorporate of Sustainable Development Goals (SDGs), Massive Open Online Courses (MOOCs), Mandatory Certification and emerging technologies (such as IR 5.0) in the curriculum for compliance the HEC Pakistan directives.
3. Chairman NTC Lt. Gen. Moazzam Ejaz, HI (M) (Retd.), Chairman NTC graced the house with his valuable presence and 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 final draft was compiled by Secretary Engr. Prof. Dr. Ahmed Muddassir Khan with the help of Team lead of of each sub-group of NCRC,
5. After review by Members and with the approval of Convener Prof. Dr. Gulistan Raja, Co-Convener Prof. Dr. Muhammad Kamran for submission to NTC.

Conclusion

The NCRC meeting for Electrical Engineering Technology at NUTECH Islamabad marked a significant milestone in the development of the program's curriculum. With the scheme of studies,



course contents, CLOs, PLOs, suggested Program Mission Statement and program objectives (PEOS). The curriculum conforms with the essential attributes proved in IEA document and is in consonance with the essence of Sydney Accord related Knowledge & Attitude Profiles, Graduates Attributes, Professional Competence, Correlation among Profiles, Characteristics of Broadly-defined Engineering Problem and Activities (See Appendix A to E). Furthermore, to incorporation of Sustainable Development Goals (SDGs), Massive Open Online Courses (MOOCs), Mandatory Certification and emerging technologies (such as IR 5.0) in the curriculum for compliance the HEC Pakistan directives, guidelines are also provided (See Appendix F to I). In the end, Convener Prof. Dr. Gulistan Raja, Co-convener Prof. Dr. Muhammad Kamran, Secretary Prof. Dr. Ahmed Muddassir Khan and NCRC members of Electrical Engineering Technology also present their gratitude with acknowledgement of hospitality and continuous support from the staff and management of NUTECH, GIZ Team and NTC team.



Curriculum for Bachelor of Electrical Engineering Technology



APPENDIX L: 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 M: 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.

Chapter 01	Background of Training Organization	XX
Chapter 02	Schedule of Training and Duties as Trainee	XX
	2.1 Sub-heading	XX
	2.2 Sub-heading	XX
	2.3 Sub-heading	XX
	...	
Chapter 03	Working Experience	XX
	3.1 Projects carried out (as assigned by the on-the-job trainer)	XX
	3.2 Hands-on skills acquired	XX
	3.3 Problems and challenges encountered	XX
	3.4 Problem solving process/approach	XX
	3.5 Supervisory tasks	XX
	3.6 Suggestions for enhancing productivity	XX
	3.7 Quality management systems in place	XX
	3.8 Safety features at workplace	XX
	3.9 Additional sub-headings	XX
	...	XX
Chapter 04	Conclusion	XX
	References	XX
	Appendices	XX