Curriculum

for

Bachelor of Industrial Engineering Technology Degree

(2023)

Higher Education Commission
Islamabad
Curriculum Division

Acronyms, Abbreviations & Definitions

Acronym/Abbreviation	Definition
NTC	National Technology Council
NCRC	National Curriculum Review Committee
IDEE	Integration of Data in Engineering Environment.
MATLAB	Matrix Laboratory
HEI	Higher Education Institution
SMEs	Small and Medium Enterprises
PLC	Programmable Logic Controller
Th	Theory
Lab	Laboratory
Cr. Hrs.	Credit Hours
PEC	Pakistan Engineering Council
WA	Washington Accords
PLO	Program Learning Outcomes
CLO	Course Learning Outcomes
SA	Sydney Accords
SK	Sydney Knowledge Profile
WK	Washington Knowledge Profile
TC	Technologist Competency Profile
EC	Engineers Competency Profile

Contents

1. Introduction

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

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

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

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

2. Curriculum Development Methodology

2.1 Benchmarking

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

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

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

2.2 Curriculum Development Cycle

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

- Nominations are requested from academic circles and relevant industry forums to constitute a National Curriculum Review Committee (NCRC) comprising of leading national experts.
- From the nominations received, NCRC is finalized and notified by NTC/HEC.

- A preliminary Meeting of the NCRC, spanning three days, is held to establish framework and benchmarking issues, and assign different facets of curriculum development to smaller teams within the NCRC.
- NCRC Members elect a Convenor, a co-Convenor, and a Secretary amongst themselves for the proceedings of NCRC, after mutual consultations.
- A draft of program curriculum is prepared by NCRC at the end of the Preliminary Meeting and sent to relevant foreign experts for review and feedback.
- After the foreign expert's review and feedback is received, a Final NCRC Meeting, lasting up to three days, is held to finalize the NCRC Members recommendations, and prepare a final curriculum document.
- The entire cycle of curriculum development is completed in two months.

2.3 Historical Timeline of Meetings

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

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

3. Curriculum Details

Bachelor of Industrial Engineering Technology Program			
Parameter	**HEC Framework**	**Framework - A (SIT in 7th & 8th Semesters)**	**Framework - B (SIT in 8th Semester Only)**
Program Type	Semester System	Semester System	Semester System
Program Duration	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years
Semester Duration	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams
Total Number of Courses	41	41	46**
Engineering Technology Domain Courses	28	28	33**
Non-Engineering Technology Domain Courses	13	13	13
Total Credit Hours	130 – 140	136	136
Engineering Technology Domain Credit Hours	85	101	97
Percentage of Engineering Technology Domain Courses	70-74.42%	71.6%	71.3%
Non-Engineering Technology Domain Credit Hours	39	39	39
Percentage of Non-Engineering Technology Domain Courses	25-31.45%	28.4%	28.7%
No. of Credit Hours per Semester	15 – 18	15 – 18	15 – 18
** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)			
1 credit hour: (1) For theory: 1 contact hour per week for a minimum of 16 weeks for theory. (2) For practical's: 3 contact hours per week for a minimum of 16 weeks for practical's.			

Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework							
Knowledge Area	**Name of Course**	**Credit Hours** (Th+Lab)	**Weekly Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
				As per Scheme	**As per Framework**	**As per Scheme of Studies**	**As per Framework**
Computing	Computer Fundamentals	1+1=2	1+3=4	6	6	3	2-3
	Computer Programming	1+1=2	1+3=4				
	Management Information System (MIS)	1+1=2	1+3=4				
Industrial Engineering Technology (Foundation)	Workshop Practice-I	0+1=1	0+3=3	19	19	9	7-10
	Workshop Practice-II	0+1=1	0+3 =3				
	Engineering Drawing	0+2=2	0+6=6				
	Basic Electric and Electronics	2+1=3	2+3=5				
	Fundamentals of Materials	2+1=3	2+3=5				
	Computer Aided Drafting (CAD)	0+1=1	0+3=3				
	Health and Safety	2+0=2	2+0=2				
	Quality Engineering	2+1=3	2+3=5				
	Work Study and Methods	2+1=3	2+3=5				
Industrial Engineering Technology (Breadth)	Operations of Manufacturing Systems (OMS)	2+1=3	2+1=5	20	20	7	7-10
	Operations Research	2+0=2	2+0=2				
	Project Management	2+1=3	2+3=5				
	Manufacturing Processes	2+1=3	2+3=5				
	Ergonomics	2+1=3	1+3 =5				
	Industrial Repair and Maintenance	2+1=3	2+3=5				
	Production Planning and Control (PPC)	2+1=3	2+3=5				
	Breadth Elective-I	2+1=3	2+3=5				
	Breadth Elective-II	2+1=3	2+3=5				
	Breadth Elective-III	2+1=3	2+3=5				
Industrial Engineering Technology (Depth)	Computer Aided Manufacturing (CAM)	2+1=3	2+3=5	12	14	5	5-7
	Manufacturing Systems	2+1=3	2+3=5				
	Total Quality Management	2+0=2	2+0=2				

	Supply Chain Management	2+0=2	2+0=2				
	Entrepreneurship	2+0=2	2+0=2				
	Depth Elective-I	2+1=3	2+3=5				
	Depth Elective-II	2+1=3	2+3=5				
IDEE	Mechanical Technology	2+1=3	2+3=5	6	5	2	2
	Instrumentation and Measurement	2+1=3	2+3=5				
Senior Design Project	Project Part-I	0+3=3	0+9=9	6	6	2	2
	Project Part-II	0+3=3	0+9=9				
Training	Supervised Industrial Training-(Opt.)	0+16=16	0+16=16	16**		0	
	Supervised Industrial Training	0+16=16	0+16=16	16		0	
Total Credit Hours and Courses (For Engineering Technology Domain Courses)		40+59=99	40+177=217	98 - 110		27 - 31	

** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)

Non-Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework								
Knowledge Area	**Sub Area**	**Name of Course**	**Credit Hours** (Th+Lab)	**Weekly Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
					As per Scheme of Studies	**As per Framework**	**As per Scheme of Studies**	**As per Framework**
General Education	Expository Writing	Functional English-I	3+0=3	3+0=3	9	9	3	3
		Functional English-II	3+0=3	3+0=3				
		Technical Report Writing	3+0=3	3+0=3				
	Civilization	Islamic Studies / Ethics	3+0=3	3+0=3	6	6	2	2
		Pakistan Studies	3+0=3	3+0=3				
	Social Sciences	Organizational Behavior	3+0=3	3+0=3	6	6	2	2
		Economics	3+0=3	3+0=3				
	Natural Sciences	Applied Physics	2+1=3	2+3=5	6	6	2	2
		Applied Mathematics	3+0=3	3+0=3				
	Quantitative Reasoning	Logical and Critical Thinking	3+0=3	3+0=3	6	6	2	2
		Probability and Statistics	3+0=3	3+0=3				
	Arts and Humanities	Professional Ethics	3+0=3	3+0=3	6	6	2	2
		Environment and Sustainability	3+0=3	3+0=3				
Total Credit Hours and Courses ** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)					Cr. Hrs. **39-39**		Courses **13 -13**	

List of Elective Topics	
Breadth Electives*	**Depth Electives***
➢ Operations Management ➢ Design of Experiment ➢ Industrial System Simulation ➢ Special Topic ➢ Elective Courses by HEI*	➢ Automation and Control ➢ Metal Forming and Cutting Operations ➢ Reliability Analysis ➢ Industrial Facilities ➢ Data Analytics ➢ Industry 4.0 ➢ Special Topic ➢ Elective Courses by HEI*
*Other related course can be included, with approval of the HEI's Statutory Bodies (maximum: 3 courses per elective knowledge area) Note: In General Education Courses, the HEI, after approving it from statutory bodies, can replace the subject as per the requirement and need, provided the credit-hours limit, and essence of the respective general education subject is not changed.	

4. Admission Criteria

Criteria for admission in Bachelor of Industrial 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 features for eligibility for admission are:

(1) At least 50% marks in DAE/FSc (Pre-engineering)
or other equivalent qualifications such as A-level/ICS/B.Sc. (sports and Hafiz-e-Quran marks are not included) and

(2) Entrance Test

(3) Weightage:

- 70% for academics (DAE/FSc etc.)
- 30% for Entrance Test

5. Semester-wise Scheme of Studies

Semester-wise scheme of studies for the Bachelor of Industrial Engineering Technology program spanning 4 years, spread over 8 semesters, and totaling 129 credit hours is presented below, along with weekly contact hours for each course.

SEMESTER-I				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
IEV-115	Islamic Studies / Social Ethics	Civilization-I	3+0	3+0
IEE-116	Functional English-I	Expository Writing-I	3+0	3+0
IEQ-111	Logical and Critical Thinking	Quantitative Reasoning-I	3+0	3+0
IEN-117	Applied Mathematics	Natural Sciences-I	3+0	3+0
IEC-112	Computer Fundamentals	Computing-I	1+1	1+3
IET-113	Workshop Practice-I	Engineering Foundation-I	0+1	0+3
IET-114	Engineering Drawing	Engineering Foundation-II	0+2	0+6
Subtotal			**13+4 =17**	**13+12 =25**
SEMESTER-II				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
IEV-123	Pakistan Studies	Civilization-II	3+0	3+0
IEH-124	Professional Ethics	Arts and Humanities-I	3+0	2+0
IEN-125	Applied Physics	Natural Sciences-II	2+1	2+3
IEE-126	Functional English-II	Expository Writing-II	3+0	3+0
IEC-121	Computer Programming	Computing-II	1+1	1+3
IET-122	Workshop Practice-II	Engineering Foundation-III	0+1	1+3
IET-123	Basic Electric and Electronics	Engineering Foundation-IV	2+1	2+3
	Subtotal		**15+3 =18**	**15+12 =27**

SEMESTER-III				Weekly Contact Hrs. (Th+Lab)
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
IEH-217	Environment and Sustainability	Arts and Humanities-II	3+0	3+0
IES-218	Organizational Behavior	Social Sciences-I	3+0	3+0
IEQ-219	Probability and Statistics	Quantitative Reasoning-II	3+0	3+0
IET-213	Fundamentals of Materials	Engineering Foundation-V	2+1	2+3
IET-214	Health and Safety	Engineering Foundation-VI	2+0	2+0
IET-215	Computer Aided Drafting	Engineering Foundation-VII	0+1	0+3
IEI-216	Mechanical Technology	Interdisciplinary-I	2+1	2+3
	Subtotal		**15+3 =18**	**15+9 =24**
SEMESTER-IV				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
IEE-228	Technical Writing	Expository Writing-II	3+0	3+0
IEC-221	Management Information System (MIS)	Computing-III	1+1	1+3
IES-227	Economics	Social Sciences-II	3+0	3+0
IET-223	Quality Engineering	Engineering Foundation-VIII	2+1	2+3
IET-224	Work Study Methods	Engineering Foundation-IX	2+1	2+3
IET-225	Operations of Manufacturing Systems	Breadth-I	2+0	2+0
IET-226	Operations Research	Breath-II	2+0	2+0
	Subtotal		**14+4 =16**	**15+09 =24**

SEMESTER-V				Weekly Contact Hrs. (Th+Lab)
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
IET-311	Production Planning and Control	Breadth-III	2+1	2+3
IET-312	Manufacturing Processes	Breadth-IV	2+1	2+3
IET-313	Ergonomics	Breadth-V	1+1	1+3
IET-315	Total Quality Management	Depth-I	2+0	2+0
IEI-316	Instrumentation and Measurement	Interdisciplinary-II	2+1	2+3
IET-317	Project Part-I	Project-I	0+3	0+9
	Subtotal		**9+7 =18**	**09+21 =30**
SEMESTER-VI				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
IET-321	Project Management	Breadth-VI	2+1	2+3
IET-322	Computer Aided Manufacturing	Depth-II	1+1	1+3
IET-323	Industrial Repair and Maintenance	Breadth-VII	2+1	2+3
IET-324	Manufacturing Systems	Depth-III	2+1	2+3
IET-325	Entrepreneurship	Depth-IV	2+0	2+0
IET-326	Supply Chain Management	Depth-V	2+0	2+0
IET-327	Project Part-II	Project-II	0+3	0+9
	Subtotal		**11+7 =18**	**11+21 =32**

SEMESTER-VII				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
IET-411	**Supervised Industrial Training (Optional)**	**Industrial Engineering Technology Domain Industrial Training**	**16**	**40 (Per week)**
IET-XXX	Breadth Elective-I	Industrial Engineering Technology Breadth-VIII	2+1	2+3
IET-XXX	Breadth Elective-II	Industrial Engineering Technology Breadth-IX	2+1	2+3
IET-XXX	Breadth Elective-III	Industrial Engineering Technology Breadth-X	2+1	2+3
IET-XXX	Depth Elective-I	Industrial Engineering Technology Depth-VI	2+1	2+3
IET-XXX	Depth Elective-II	Industrial Engineering Technology Depth-VII	2+1	2+3
	Subtotal		10+5=15	**10+15 =25**
SEMESTER-VIII				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
IET-421	**Supervised Industrial Training (Compulsory)**	**Electrical Engineering Technology Domain Industrial Training**	**16**	**40 (Per Week)**
Subtotal			**0+16= 16**	**0+40= 40**
Total Credit Hours & Contact Hours in Four Years (SIT conducted in 7th and 8th Semesters)			**77+60 = 137**	**77+180=257**
Theory vs Practical with respect to Contact Hours			Theory Practical	77 (30 %) 180 (70 %)
Total Credit Hours & Contact Hours in Four Years (SIT conducted in 8th Semester only)			**87+49 = 137**	**87+147 =234**
Theory vs Practical with respect to Contact Hours			Theory Practical	87 (37 %) 147 (63 %)

6. Course Codes

Details pertinent to course code are presented below:

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

Letters in course-code prefix are defined below:

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

Digits in course-code are defined in table below:

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

Course Code Examples		
Sr.	**Course Code Prefix**	**Description**
1	IET	Industrial Engineering Technology
2	IEE	Expository Writing
3	IEH	Art & Humanities
4	IES	Social Sciences
5	IEQ	Quantitative Reasoning
6	IEN	Natural Sciences
7	IEC	Computing
8	IEM	Management Sciences
9	IEI	Inter Disciplinary Technology Elective
10	IEV	Civilization

7. Elective Courses

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

Elective Breadth Courses				Weekly Contact Hrs.
Course Code	**Title**	**Knowledge Area**	**Credit Hrs.**	
IET-412	Industrial System Simulation	Industrial Engineering Technology Breadth	2+1	2+3
IET-413	Operations Management	Industrial Engineering Technology Breadth Elective	2+1	2+3
IET-414	Design of Experiment	Industrial Engineering Technology Breadth Elective	2+1	2+3

Elective Depth Courses				Weekly Contact Hrs.
Course Code	**Title**	**Knowledge Area**	**Credit Hrs.**	
IET-415	Automation and Control	Industrial Engineering Technology Depth	2+1	2+3
IET-418	Metal Forming and Cutting Operations	Industrial Engineering Technology Depth	2+1	2+3
IET-419	Reliability Analysis	Industrial Engineering Technology Depth	2+1	2+3
IET-422	Industrial Facilities	Industrial Engineering Technology Depth	2+1	2+3
IET-423	Data Analytics	Industrial Engineering Technology Depth	2+1	2+3
IET-424	Industry 4.0	Industrial Engineering Technology Depth	2+1	2+3
IET-425	Special Topic	Industrial Engineering Technology Depth	2+1	2+3

Note: The HEI can add elective courses to the list, with approval from statutory bodies.

8. Course Contents

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

Program Learning Objectives (PLOs), Course Learning Objectives (CLOs) and Bloom's Taxonomy levels are expected Program Learning Outcomes (PLOs) and are aligned to standards set by SA and IEA.

Course Content

8.1 Islamic Studies/Social Ethics

CODE & TITLE (IEV-115) **Islamic Studies/Social Ethics**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Civilization-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Know** the essence of the Quran, Hadith, life of the Holy Prophet (S.A.W), Holy Wars, and Pillars of Islam.	C-1	SA-6
CLO-2	**Explain** Islamic heritage, understand civilization, oneness, suggest solutions to human problems, and importance of an honest character.	C-2	SA-8
CLO-3	**Apply** understanding of basic concepts of teaching of Islam (faith, pillars, Dawit, preaching and Seerat).	C-3	SA-8

Course Outline

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

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

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

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

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

Course Content

8.2 Functional English-I

CODE and TITLE (IEE-116) **Functional English-I**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Expository Writing-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** common errors made by learners of English as a second language.	C-1	SA-10
CLO-2	**Comprehend,** and understand spoken and written English, and have a robust vocabulary.	C-2	SA-10
CLO-3	**Use** grammar, punctuations, and sentences, effectively to structure, and compose correctly spoken and written English.	C-3	SA-10

Course Outline

Basics of Grammar, Parts of speech and use of articles, Sentence structure, Active and passive voice Practice in unified sentence, Analysis of phrase, clause and sentence structure Transitive and intransitive verbs, Punctuation and spelling Comprehension Answers to questions on a given text Discussion, General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students), Listening, To be improved by showing documentaries/films carefully selected by subject teachers), Translation skills, Urdu to English, Paragraph writing, Topics to be chosen at the discretion of the teacher.

Recommended Books

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

Course Content

8.3 Logical and Critical Thinking

COURSE CODE & TITLE (IEQ-111) **Logical and Critical Thinking**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Articulate** critical thinking, reasoning, arguments, and fallacies.		C-2	SA-10
CLO-2	**Apply** logical and critical thinking concepts in communicating ideas and arguments.		C-3	SA-10
CLO-3	**Differentiate** between deductive and inductive reasoning, classify the relevant criteria for reasoning, and differentiate formal and informal logical fallacies.		C-4	SA-2
Course Outline for Theory				
Introduction to critical thinking: Students will learn what critical thinking is, its importance, and its applications in various fields, Understanding of arguments, premises, conclusions, and fallacies, Different types of reasoning, such as deductive and inductive reasoning, How to make effective decisions by weighing evidence, evaluating alternatives, and considering the consequences, how to identify and define problems, generate alternative solutions, evaluate the solutions, and implement the best solution, critically analyze and evaluate texts, including identifying arguments, recognizing fallacies, and evaluating evidence, write effective arguments, common cognitive biases that can impact decision making and critical thinking, such as confirmation bias, availability bias, and anchoring bias, learning how to generate new ideas and think outside the box, communicate their ideas effectively, including presenting arguments, listening to others, and responding to feedback.				
Recommended Books				
1. The Power of Critical Thinking, by Vaughn Lewis, Oxford University Press. (Latest Edition) 2. "Thinking Critically" by John Chaffee and Christine McMahon, (Latest Edition) 3. Critical Thinking: A User's Manual" by Debra Jackson and Paul Newberry (Latest Edition)				

Course Content

8.4 Applied Mathematics

COURSE CODE & TITLE (IEN-117) **Applied Mathematics**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Natural Science-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** differentiation, integration, and vector calculus.	C-2	SA-1
CLO-2	**Apply** vector calculus and analytical geometry in multiple dimensions for investigation of different engineering technology problems.	C-3	SA-1
CLO-3	**Analyze** Broadly Defined Technology Problems, using suitable techniques of calculus.	C-4	SA-2

Course Outline

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

Recommended Books

1. H. Anton, I. C. Bivens, S. Davis, "Calculus, Early Transcendental", 11th edition (or Latest Edition), John Wiley, New York, 2016.
2. Essential Calculus by James Stewart, 2nd Edition (or Latest Edition)
3. G. B. Thomas, A. R. Finney, "Calculus", 14th edition (or Latest Edition), Pearson, USA, 2017.
4. S.M Yousaf, "Calculus and Analytic Geometry" (or Latest Edition).
5. Advanced Engineering Mathematics by Erwin Kreyszig, 10th Ed. (or Latest Edition) Willey 2014.

Course Content

8.5 Computer Fundamentals

COURSE CODE & TITLE (IEC-112) **Computer Fundamentals**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Know** about computer hardware, different software's, programming languages, and communication networks.	C-1	SA-1
CLO-2	**Discuss** contemporary trends related to computer and information technology.	C-3	SA-5
Course Learning Outcomes for IET-122L Computer Fundamentals (Lab)			
CLO-3	**Practice** assigned tasks using word processors, spreadsheets, and presentations.	P-3	SA-5
CLO-4	**Assemble** computer components.	P-4	SA-5
Course Outline for Theory			
Introduction to computer hardware and software, Introduction to information technology, Contemporary trends in computer hardware and software, Communication and networking, switches, routers and other wired and wireless devices, Introduction to programming, word processors, spreadsheets, presentations etc.			
Lab course outline			
Introduction to basic hardware of computer, assembling and dis-assembling of computer parts, operating system installation and troubleshooting, the internet e.g., , Word Processing programs, spreadsheet programs, presentation programs, computer networking.			

Lab Equipment
Number of computers as per allowed intake, connectors (RJ-45 etc.), networking cables, switches routers etc., and appropriate software.
Recommended Books
1. "Introduction to Computers", Peter Norton, McGraw-Hill. (Latest Edition) 2. "Computing Essentials", Timothy O'Leary and Linda O'Leary, McGraw-Hill. (Latest Edition) 3. Using Information Technology: A Practical Introduction to Computers & Communications", Williams Sawyer, McGraw-Hill. (Latest Edition) 4. "Discovering Computers, Complete: Your Interactive Guide to the Digital World. Cengage Learning" Shelly GB, Vermaat ME, (Latest Edition)

Course Content

8.6 Workshop Practices-I

CODE & TITLE (IET-113) **Workshop Technology-I**		CREDIT & CONTACT HOURS (0+1) **0 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Foundation-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Operate** different measuring tools in workshops.	P-3	SA-5
CLO-2	**Demonstrate** working of different electrical actuators, transducers, and wiring schemes.	P-4	SA-5
CLO-3	**Comply** the correct and safe usage of components, tools, and their associated operation.	A-2	SA-6
Note: The above are preliminary CLOs. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Lab Outline			
Concepts in electrical safety, safety regulations, earthing concepts, electric shocks, and treatment. Use of tools used by electricians, wiring regulations, types of cables and electric accessories including switches, plugs, circuit breakers, fuses etc., symbols for electrical wiring schematics e.g., switches, lamps, sockets etc., drawing and practice in simple house wring and testing methods, wiring schemes of two-way and three-way circuits and ringing circuits, voltage and current measurements. Use of multi-meter to test electrical /electronic components, breadboard, and circuit layouts tester to troubleshoot a digital circuit. Reading Schematic Diagrams and circuit layouts. To make Simple electronic circuits and study their function, simple power supply, Measurement of voltage and frequency with Oscilloscope.			
Lab Equipment			
Measurement instruments like multi-meters, switches, lamps, sockets etc. breadboard, soldering set up, electrician tool kits. Power supply, oscilloscope, function generators, cables, wires, circuit breakers and switches, AC/DC loads.			

Recommended Books
1. The Elements of Workshop Technology - Vol I & II, S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, 11th edition 2001 others, Media Promoters and Publishers, Mumbai. 2. Mike Tooley, "Electronic Circuits Fundamentals and Applications**"**, 4th Edition, 2020, Routledge, ISBN: 978-0367421991 3. R. P. Singh, (2012), "Electrical Workshop: Safety, Commissioning", ISBN-13: 978-9381141205

Course Content

8.7 Engineering Drawing

COURSE CODE & TITLE (IET-114) **Engineering Drawing**		**CREDIT & CONTACT HOURS** (0+2) **0 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Reproduce** orthographic projections, sectional views, and isometric views of different parts.	P-3	SA-3
CLO-2	**Sketch** Assembly drawing for industrial tools.	P-4	SA-3
CLO-3	**Work** as an individual, and as a team member, to accomplish given tasks.	A-3	SA-9
Note: The above are preliminary CLOs. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Lab Outline			
Introduction, Introduction to Engineering Drawing, Specification for preparation of drawings, Use of drawing instruments and materials, Basic Tools, Lines: Types, configuration and application, Selection of line thickness. Lettering, Numbering and Dimensioning Vertical and inclined single stroke letters, Lettering types and rules, Dimension lines, projection lines, leaders or pointer lines, Arrow heads, Dimensioning, Geometric Construction, Drawing simple geometric objects (polygon, pentagon and hexagons etc), Orthographic Projections of different Solids, Orthographic Projections of Machine Elements Rivets, Nut and bolts, Different kinds of threads, Lap and butt joints, Flange couplings, Journal bearing, Open bearing, Footstep bearing, Crankshaft, Bearings etc., 3D drawings, isometric view, Manufacturing drawings, dimensioning, tolerances, annotation etc., assembly drawings			
Lab Equipment			
Drafting boards as per allowed intake, standard prismatic models for drawing practice.			

Recommended Books
1. A. C Parkinson, A First Year Engineering Drawing. 2. Madsen, D.A. and Madsen, D.P., 2016. Engineering drawing and design.

Course Content

8.8 Pakistan Studies

COURSE CODE & TITLE (IEV-123) **Pakistan Studies**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Civilization-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** Pakistan's historical perspective, geographic location, constitution, contemporary affairs, and challenges.	C-1	SA-6
CLO-2	**Discuss** Pakistan Movement, and political and constitutional history of Pakistan.	C-2	SA-6
CLO-3	**Analyze** current issues of Pakistan, their causes, and solutions.	C-4	SA-6

Course Outline

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

Recommended Books

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

Course Content

8.9 Professional Ethics

COURSE CODE & TITLE (IEH-124) **Professional Ethics**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Arts and Humanities-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the basics of a profession, professional ethics, various moral and social issues, importance of values and professional ethics in personal life, and consequences of acting unethically in organizations and society.	C-1	SA-8
CLO-2	**Understand** various roles of engineering technologist in applying ethical principles at various professional levels.	C-2	SA-8
CLO-3	**Resolve** the ethical dilemmas using common ethical values by outlining possible actions to be taken in response.	C-4	SA-8

Course Outline

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

Recommended Books

1. Engineering Ethics Concepts & Cases by Charles E Harris, 5th Edition, Cengage 2014, (or Latest Edition)
2. Kenneth Blanchard, Professional Ethics, 4th Edition (or Latest Edition)
3. Ethics in Engineering 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005. (or Latest Edition)
4. The Seven Habits of Highly effective people by Stephan r. Covey (Latest Edition)

5. Engineering Ethics: Concepts and Cases, 4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008 (or Latest Edition)
6. Professional Ethics: R. Subramanian, Oxford University Press, 2015. (or Latest Edition)
7. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015. (or Latest Edition)

Course Content

8.10 Physics

CODE & TITLE (IEN-125) **Physics (Mechanics)**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Natural Science -II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** principles of physics and mechanics.	C-2	SA-1
CLO-2	**Solve** broadly defined problems using vector mechanics.	C-3	SA-1
Course Learning Outcomes for Lab			
CLO-3	**Operate** measuring instruments for fundamental physical quantities.	P-3	SA-5
CLO-4	**Communicate** effectively about laboratory work and document laboratory procedures.	A-2	SA-10
Note: The labs should be relevant to the theory topics. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline for Theory			
Measurement of Physical Quantities, vectors and scalers, distance, displacement, velocity, acceleration, force, work and energy. Force Systems: Force, rectangular components, moment, resultant couple (two- and three-dimensional systems). Newtons laws of motion, Newtons law of universal gravitation, projectile motion, work and energy, conservation of energy, centre of mass, conservation of momentum, collisions, static equilibrium of a rigid body, conditions for static equilibrium, translation and rotation of a rigid object, rotational kinetic energy, moment of inertia, angular momentum, conservation of angular momentum, rotation of rigid bodies. Structures: Plane trusses, method of joints, method of sections, frames. Friction: Types of friction, application of friction in wedges, screws, journal bearings, thrust bearings, flexible belts.			

Course Outline for Lab
Measurement of Physical Quantities like distance, displacement, velocity, acceleration, force, work and energy, Friction measurement, static, dynamic, rolling friction etc. determining moment of inertia, conservation of linear and angular momentum.
Lab Equipment
The lab may consist of Spring balance, momentum equipment, compound pendulum, vernier caliper, stopwatch, weighing scale, friction slide apparatus.
Recommended Books
1. Halliday, Resnick and Walker, Fundamentals of Physics, John, Wiley & Sons (Latest Edition) 2. Vector Mechanics for Engineers: Statics and Dynamics, by Ferdinand Beer and Johnston, Jr., E. Russell, 2015. (Latest Edition)

Course Content

8.11 Functional English-II

COURSE CODE & TITLE (IEE-126) **Functional English-II**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Expository Writing-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** key elements of writing and presentations.	C-2	SA-10
CLO-2	**Write** official letters, memorandums, essays ,reports, and be able to produce these documents in a professional manner.	C-3	SA-10
CLO-3	**Translate** Urdu phrases into English.	C-4	SA-10

Course Outline

Paragraph writing, Essay writing, CV, Cover Letter, Job application, Email Writing, Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension, Letter/memo writing, writing minutes of the meeting, use of library and internet recourses, Presentation skills, Public Speaking, Personality development (emphasis on content, style and pronunciation), documentaries to be shown for discussion and review.

Recommended Books

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

Course Content

8.12 Computer Programing

COURSE CODE & TITLE (IEC-121) **Computer Programing**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the basic knowledge of a suitable programming language.	C-2	SA-1
CLO-2	**Apply** the knowledge of programming to solve problems in an effective way.	C-3	SA-5
Course Learning Outcomes for Lab			
CLO-4	**Construct** programs using Integrated Development Environment (IDE).	P-4	SA-5
CLO-5	**Effectively** explain flow charts, programming algorithms and procedures.	A-2	SA-10
Course Outline for Theory			
Introduction to the course, Python and the IDE. Data types and operators. Functions. Conditions (if, if-else, nested if-else). Conditions (switch statement, conditional operator). Recursion. Iteration (for loop, while, do-while). Iteration (do-while). Strings. File handling Structures. Arrays, Sorting Arrays and passing arrays to functions. Pointers. Calling functions by reference. Introduction to classes and objects.			
Lab Course Outline			
Develop multiple programming codes including Data types and operators. Functions. Conditions, Recursion, Iteration (for loop, while, do-while). Iteration (do-while), Strings.			

Recommended Books
1. Introduction to Python Programming by Gowrishankar S, Veena A, Latest Edition 2. Python for Engineers and Scientists by Rakesh Nayak, Nishu Gupta, Latest Edition

Course Content

8.13 Workshop Practice-II

COURSE CODE & TITLE (IET-122) **Workshop Practice-II**	**CREDIT & CONTACT HOURS** (0+1) **0 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-III**

After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Practice** the associated skills and basic tools of various shops.	P-3	SA-9
CLO-2	**Demonstrate** the basic operations of tools in Mechanical Workshops.	P-4	SA-5
CLO-3	**Participate** actively in performing the tasks on different machines, taking all safety precautions.	A-2	SA-9

Note: The above are draft CLOs, A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.

Lab Outline

Fitter Shop: Assembly/disassembly of basic mechanical components, e.g., bearings, keys, belts, etc. Basic Processes in Woodwork/carpentry Shop: Timber, its defects and preservation methods, different types of wood joints, Functions of Forge & Foundry Shop: Brief introduction, tools and accessories, furnace types, heat treatment furnaces. Machine Shop: Introduction to machine tools, basic lathe operations including turning, facing, screw cutting, milling, planning, shaper machine, Welding: Introduction to soldering, brazing and welding, brief details of gas, and electric arc welding. Bench fitting Fabrication shop, sawing, hand drilling, tapping, filing, punching etc.

Lab Equipment

Measuring equipment like ruler, measuring tap, vernier, go, no-go gauges etc. Bench fitting shop including clamps, fixtures, bench vice, files, hand drills, power hacksaw, tap sets, welding plants including arc welding, gas welding etc. conventional machine tools like lathe, shaper, milling, bench drill etc. furnaces, soldering, brazing equipment, sand casting equipment. Forging equipment like hammers, anvil etc.

Recommended Books
1. Workshop technology by W A Chapman 2. A. C Parkinson, A First Year Engineering Drawing 3. Madsen, D.A. and Madsen, D.P., 2016. Engineering drawing and design.

Course Content

8.14 Basic Electric and Electronics

COURSE CODE & TITLE (IET-123) **Basic Electric and Electronics**	**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-VII**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** basic electrical terms like voltage, current, power, and series and parallel circuits.	C-2	SA-1
CLO-2	**Apply** KVL, KCL, nodal and mesh analysis techniques on linear circuits to find voltages and currents.	C-3	SA-1
CLO-3	**Analyze** the DC bias circuits of various amplifier configurations for the desired design requirements.	C-4	SA-2
Course Learning Outcomes for Lab			
CLO-4	**Operate** electronic workbench proficiently to measure electrical quantities	P-3	SA-5
CLO-5	**Work** effectively as an individual, or in a group, while performing laboratory experiments	A-3	SA-9
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline for Theory			
Basic Concepts: Voltage, Current, Power and Energy. Independent and Dependent Sources. Series and Parallel Combinations of Elements, Voltage Division and Current Division. Networks Laws: KVL, KCL, Node Analysis, Mesh Analysis, Current & voltage divider rules. Capacitor and inductor charging and discharging, parallel and series connection of capacitors. AC Fundamentals, Load Factor, Power Factor and Power Factor correction. **F**undamentals of basic electronics, basic operation of Diode and Transistor, PN Junction Diode, Forward and Reverse Characteristics of			

a Diode, Ideal Diode, Practical Diode, Applications of Diodes: Half- and Full-Wave Rectifiers, Bipolar Junction Transistor: Operation, NPN and PNP Transistors, DC Biasing of a Transistor.
Lab Outline
To study the Resistive, Capacitive, and inductive Circuits Response excited by AC & DC Sources. To study the RC Circuits Response excited by AC & DC Sources, RL Circuit Response excited by AC & DC sources. To study the LC Circuit Response excited by AC & DC Sources. To study the Various applications of junction diode are discussed and various types of diodes are also explained. Different configurations of Bipolar Junction Transistors (BJTs) are discussed.
Lab Equipment
Capacitor, inductors, resistors, diodes, NPN transistors with different specifications, bread boards, connecting wires, digital multi-meters, DC power supply, Oscilloscopes and Function generator. Analog multi-meters etc.
Recommended Books
1. Electrical Technology by Edward Hughes (Latest Edition) 2. Electric circuits fundamentals by Franco (Latest Edition) 3. Basic Engineering Circuit Analysis by J. David Irwin and Robert M. Nelms (Latest Edition)

Course Content

8.15 Economics

COURSE CODE & TITLE (IES-127) **Economics**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Sciences-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Recognize** the effect of economy on society and understand the relationship between currency and division of labor.	C-1	SA-6
CLO-2	**Explain** time value of money and associate it with the concept of interest and Minimum Acceptable Rate of Return (MARR).	C-2	SA-11
CLO-3	**Apply** various methods for Economic Management of projects.	C-3	SA-11

Course Outline for Theory

Introduction to economics, concept of currency and division of labour, history of currency and its role in human civilization. Introduction to demand and supply and inflation. Introduction to banking. Time value of money. Cost analysis, types of cost. Cash flow diagrams. Interest, simple interest, compound interest, Uniform series & Arithmetic & geometric gradient. Nominal & effective, continuous compounding Economic criteria, Present Worth, future worth and annuity. Minimum acceptable rate of return (MARR), Internal rate of return, External rate of return, Simple payback period, discounted payback period, breakeven analysis, Inflation.

Recommended Books

1. Engineering Economy, DeGarmo, E.P., W. G. Sullivan, C.P. Koelling and E.M. Wicks, , Prentice Hall, (Latest Edition)
2. Engineering Economy Thuesen, G.J. & W. J. Fabrycky, (Latest Edition)
3. Technological Economics by Shoubo Xu (Springer), (Latest Edition)
4. Engineering Economy, Latest Edition, Leland T. Blank and Anthony J. Tarquin, McGraw Hill, (Latest Edition)
5. Contemporary Engineering Economics, Latest edition, Chan S Part Pearson Prentice Hall (Latest Edition)
6. Engineering Economic Analysis by Donald G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, Oxford University Press, (or Latest Edition)

Course Content

8.16 Environment and Sustainability

CODE & TITLE (IEH217) **Environment and Sustainability**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Arts and Humanities-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** environmental standards, obligations, and sustainable development.	C-2	SA-7
CLO-2	**Analyze** different environmental challenges considering sustainability and solutions.	C-4	SA-7
CLO-3	**Propose** solutions for different environmental challenges considering sustainability and sustainable solutions.	C-5	SA-7

Course Outline

Introduction to Environmental Science, Climate Change, Biodiversity and Conservation, Diversity of life on earth, Threats to biodiversity, Sustainable Development and its applications, Environmental policy and governance, national and international environmental laws, Environmental monitoring and assessment, Water resources, Conservation of water resources, water scarcity, Renewable energy sources, Sustainable agriculture and foods systems, Waste management and Pollution Control, ISO 14000.

Recommended Books

1. "Environmental Science: Toward a Sustainable Future" by Richard T. Wright and Dorothy F. Boorse (Latest Edition)
2. "Sustainability: A Comprehensive Foundation" by Tom Theis and Jonathan Tomkin (Latest Edition)

Course Content

8.17 Organizational Behavior

CODE & TITLE (IES-218) **Organizational Behavior**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Sciences-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** individual and group behavior in organizations, including diversity, attitudes, job satisfaction, emotions, moods, personality, values, perception, decision making, and motivational theories.	C-2	SA-9
CLO-2	**Demonstrate** effective communication skills, negotiations skills, understand organization structure, power politics, and behavioral conflicts in an organization.	C-3	SA-10
CLO-3	**Analyze** the organizational system, including organizational structures, culture, human resources, and suggest change.	C-4	SA-6

Course Outline

Introduction to organizational behavior, individual differences and personality, perception and attribution, motivation and job satisfaction, group dynamics and teamwork, conflict resolution and negotiations, power and politics, organizational culture and change, ethical consideration, resistance to change, leadership and management, Leadership styles, communication and interpersonal skills, verbal and non-verbal communication, organizational structure.

Recommended Books

1. "Organizational Behavior" by Stephen P. Robbins and Timothy A. Judge (Latest Edition)
2. "Essentials of Organizational Behavior" by Stephen P. Robbins and Timothy A. Judge (Latest Edition)
3. "Organizational Behavior: Improving Performance and Commitment in the Workplace" by Jason A. Colquitt, Jeffery A. LePine, and Michael J. Wesson (Latest Edition)

Course Content

8.18 Probability and Statistics

COURSE CODE & TITLE (IEQ-219) **Probability and Statistics**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basic probability concepts and accounting principles.		C-2	SA-1
CLO-2	**Apply** different concepts such as measure of central tendency, dispersion, regression, and probability distribution.		C-3	SA-5
CLO-3	**Analyze** the concept of sample correlation coefficient, analyze real life problems using regression, including estimation, and testing of model parameters.		C-4	SA-2
Course Outline for Theory				
Introduction to probability, Measures of Central Tendency, Counting Techniques, Dispersion, Conditional Probability, Basic statistical concepts, Frequency Distributions, Random Variables, Types of Random Variables, Introduction to Distributions (Discrete Distributions, Continuous Distribution, Bernoulli Distribution, Poisson Distribution, Exponential Distribution, and Gaussian Distribution), samples and sampling distributions, hypothesis testing, Correlation and Regression.				
Recommended Books				
1. Applied Statistics and Probability for Engineers, by Douglas C. Montgomery, George C. Runger, Latest Edition 2. Introductory Statistics by Sheldon M. Ross, Latest Edition 3. Probability and Statistics, by Morris H. DeGroot, Mark J. Schervish,, Latest Edition				

Course Content

8.19 Fundamentals of Materials

COURSE CODE & TITLE (IET-213) **Fundamentals of Materials**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Engineering Technology Foundation**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** different materials of industrial importance and their applications.	C-2	SA-1
CLO-2	**Illustrate** bonding, properties, solidification, crystallization, and defects using miller indices and metallography.	C-3	SA-1
CLO-3	**Analyze** material properties obtained from mechanical testing of different materials from provided experimental data.	C-4	SA-4
Outline, Course Learning Outcomes, and Rubrics for Lab			
CLO-4	**Conduct** hands on cutting, grinding, polishing, etching and microscopy operations.	P-5	SA-5
CLO-5	**Work** as an individual and a team member to accomplish given tasks.	A-2	SA-9
Note: The labs should be relevant to the theory topics. The above are draft CLOs, A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline for Theory			
Introduction to Materials, Atomic Bonding. Structure of Crystalline Solids, theoretical density, Imperfections in Solids, physical properties of materials and failure analysis, material strengthening, heat treatment. Phase Diagrams and alloys, Phase Transformation and Development of Microstructures, metallography, Applications and Processing of			

Metallic Materials, ferrous and non-ferrous materials, Designation systems and grades of industrial alloys. Material testing methods, NDTs, destructive testing.
Course Outline for Lab
Metallography, determination of mechanical properties of materials like hardness, stress-strain curves, impact and fatigue testing etc. Material Characterization.
Lab Equipment
Cutting wheels, saw, mounting equipment like hot and cold mounting, grinding and polishing equipment, microscope, hardness tester, impact tester etc. Universal testing machine etc.
Recommended Books
1. Material Science and Engineering: An Introduction, William D. Callister Jr., 8th Edition, John Wiley & Sons, Inc. 2010 2. Elements of Materials Science and Engineering by L. H. Van Vlack. World Student Series Edition, Addison-Wesley Publishing Company. 1989

Course Content

8.20 Health and Safety

COURSE CODE & TITLE (IET-214) **Health and Safety**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-V**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** occupational health and safety and understand its benefits.	C-1	SA-6
CLO-2	**Explain** relevant health and safety regulations and standards in industrial environments.	C-2	SA-6
CLO-3	**Identify** and estimate different kinds of hazards and risks in industries.	C-3	SA-7

Course Outline

Introduction to Occupational Health and Safety, Workplace Health hazards, Workplace safety hazards, Risk assessment and management, Occupational health and safety laws, Occupational health and safety management systems, Workplace health promotion, occupational hygiene, emergency preparedness and response, psychosocial hazards including workplace harassment.

Recommended Books

1. "Occupational Health and Safety Management: A Practical Approach" by Charles D. Reese, Latest Edition
2. "Introduction to Health and Safety at Work" by Phil Hughes and Ed Ferrett, Latest Edition
3. "Fundamentals of Occupational Safety and Health" by Mark A. Friend and James P. Kohn, Latest Edition

Course Content

8.21 Computer Aided Drafting

COURSE CODE & TITLE (IET-215) **Computer Aided Drafting**	**CREDIT & CONTACT HOURS** (0+1) **0 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-VI**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Produce** 2D drawings using CAD software.	P-3	SA-5
CLO-2	**Create** 3D models and drawing views of industrial components and assemblies.	C-5	SA-3
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Introduction to CAD, Advantages of CAD, Overview of CAD Software, 2D drawing techniques, Editing Commands, Layers and Object properties, Dimensioning and annotation, blocks and attributes, 3D model techniques, Advanced modeling techniques, CAD standards and File management.			
Recommended Books			
1. Computer Aided Design, Engineering Design and Modeling using AutoCAD by Wilson R Nyemba, Latest Edition 2. Computer Aided Graphics and Design by Daneil L. Ryan, Latest Edition			

Course Content

8.22 Mechanical Technology

COURSE CODE & TITLE (IEI-216) **Mechanical Technology**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Interdisciplinary-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basic concepts of mechanical engineering technology, including Thermodynamics, Fluid Mechanics, Machine Design and Air conditioning & Refrigeration.	C-2	SA-1
CLO-2	**Apply** basic formulae of mechanical engineering for calculation of various efficiencies, power generation and transmission in cycles and air-conditioning.	C-3	SA-1
List of Experiments, Course Learning Outcomes, and Rubrics for Lab			
CLO-3	**Operate** mechanical systems using measuring instruments.	P-3	SA-5
CLO-4	**Analyze** experimental data for performance of various mechanical systems.	C-4	SA-4
CLO-5	**Work** actively in performing the tasks on different machines keeping all applicable safety precautions.	A-3	SA-6
Note: The labs should be related to theory topics. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline for Theory			
IIntroductory concepts & definitions, using energy and the laws of thermodynamics, , First Law and Second Law of thermodynamics, Air Cycles, Carnot's Cycle, The otto cycle, Diesel Cycle, and refrigeration systems. Working of Elements of Mechanical Power Transmission, Modes of heat transfer and their equations, basic concepts of cooling load calculation, Fluids and their properties, Fluid Statics, Pressure measurement: Bourdon pressure gauge,			

Manometers, Kinematics of fluid flow: Laminar and Turbulent flow, continuity and Bernoulli's Equation, Flow through pipes: Moody Charts. Introduction to hydraulic machinery.
Course Outline for Lab
Temperature and pressure measurements, fluid properties measurements, piping and fluid circuits, operation and selection of turbo machinery, valves and pumps, compressors etc. verification of gas laws and thermodynamic, IC Engine performance analysis, fault diagnosing of refrigeration systems.
Lab Equipment
Temperature, pressure, and flow devices/sensors, venturi meter, pitot tube, piping and plumbing kit, hydraulic and fluid benches, turbo machinery, engine testing setup, refrigeration bench and suitable kits etc.
Recommended Books
1. Thermodynamics – An Engineering Approach by Yunus A. Cengel and Michael A. Boles, (Latest Edition) 2. Fundamentals of Engineering Thermodynamics by Michael J. Moran and Howard N. Shapiro, (Latest Edition) 3. Introduction to thermal systems engineering: Thermodynamics, fluid Mechanics and heat transfer by Michael J. Moran, Howard N. Shapiro, Bruce R. Munson, (Latest Edition) 4. Fundamentals of Fluid Mechanics by Bruce R. Munson, Donald F. Young and Theodore H. Okiishi, (Latest Edition)

Course Content

8.23 Technical Writing

COURSE CODE & TITLE (IEE-228) **Technical Writing**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Expository Writing-III**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** attributes of technical writing, write covering letters, emails, other technical writing etc.	C-1	SA-10
CLO-2	**Explain** the need and requirement of different technical documents.	C-2	SA-10
CLO-3	**Write** proper statements, assignments, final year project reports, project proposals, short reports, research papers, and business and professional correspondence.	C-3	SA-10
Course Outline for Theory			
Introduction to technical writing, types of technical documents, purpose and audience of technical documents, technical communication fundamentals (clarity, conciseness, and accuracy), Use of graphs, tables and charts to present data, structure and format proposals, creating user manuals considering technical specifications, writing for digital media (website, social media, and other platforms) for technical audience, ethics in technical writing (avoiding plagiarism, plagiarism policy, maintaining confidentiality and security).			
Recommended Books			
1. Technical Report Writing Today, by Daniel Riordan, 10th Edition (or Latest Edition) 2. Technical Writing and Professional Communication, Leslie Olsen and Thomas Huckin, 2nd Edition. (Or Latest Edition) 3. Communication for Engineering Students by J. W. Davies, (or Latest Edition) 4. Science Research Writing for Non-Native Speakers of English by Hilary Glassman-Deal, Imperial College Press. (Latest Edition)			

Course Content

8.24 Management Information System

COURSE CODE & TITLE (IEC-221) **Management Information System**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-III**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** the fundamental concepts and key principles in management information systems.	C-1	SA-1
CLO-2	**Explain** the MIS advanced concepts like business objectives of MIS, system development, life cycle etc.	C-2	SA-1
Course Learning Outcomes for Lab			
CLO-3	**Practice** Inventory management system with MS Access.	C-1	SA-5
CLO-4	**Communicate** effectively the work procedures.	A-2	SA-10
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Introduction to Information Systems, Information System in Business Today, Collaboration through information system, Organizations and Information System, Databases, Business Intelligence, Securing Information Systems, Enterprise applications, Managing knowledge, and Artificial Intelligence.			
Course Outline for Lab			
Should focus on developing databases and doing data analytics. MS Excel/Access may be used for data analytics.			

Lab Equipment
Computer cluster as per allowed intake and relevant software MS Access
Recommended Books
1. Management Information Systems by K. C. Laudon & J. P. Laudon, Prentice Hall 2. Management Information System by Terrence Lucy, 9th Edition, 2005.

Course Content

8.25 Quality Engineering

COURSE CODE & TITLE (IET-223) **Quality Engineering**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-VIII**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** sources of variations, sampling plans, process capability, quality control, and quality engineering.	C-2	SA-1
CLO-2	**Apply** basic principles of quality to prepare control charts for variables and attributes.	C-3	SA-5
Course Leaning Outcomes for Lab			
CLO-3	**Construct** control charts and process capability indices using different software's (SPSS, Minitab etc.)	P-7	SA-5
CLO-4	**Support** and defend the results obtained from different software's (SPSS, Minitab etc.)	A-5	SA-6
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline for Theory			
Introduction to quality and quality engineering, Metrology, Geometric dimensioning, Tolerances, Review of probability and statistics, Introduction to sampling plans, Control Charts, Sources of Variations, Process Capability, Methods of Quality Improvement.			
Outline for Lab			
Construction of control chart and Process Capability indices using different software (SPSS, Minitab etc.)			

Lab Equipment
Computer clusters with appropriate software (SPSS, Minitab etc.)
Recommended Books
1. Introduction to Statistical Quality Control, by Douglas C. Montgomery, Latest Edition 2. Introduction to Statistical Process By Peihua Qiu, Latest Edition 3. Statistical Methods for quality improvement by Thomas P. Ryan, Latest Edition

Course Content

8.26 Work Study Methods

COURSE CODE & TITLE (IET-224) **Work Study Methods**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-IX**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** work study, time study, its measurement, applications, and limitations.	C-2	SA-1
CLO-2	**Apply** time and motion study principles for calculating various dimensions of time and motion on existing methods and suggest improved methods.	C-3	SA-1
Lab Work Learning Outcome			
CLO-3	**Practice** the experimental task related to Work Study.	P-3	SA-5
Note: The labs should be related to theory topics. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Introduction to work analysis and design, Methods engineering: study of the basic work measurement techniques, applications and limitations of the stopwatch time study, learning curve, Development and use of process flow charts, pre-determined motion time studies (PMTS), micro motion analysis, Human factors underlying the design of specific human-machine systems, Techniques of work optimization, energy expenditure and bodily functions.			
Course Outline for Lab			
Flow Chart, Gantt Chart, Process Chart, Activity Chart, Micro Motion Study, Simo Chart, Standard Time Calculations			

Lab Equipment
Stop Watches, Computer Cluster with relevant software such as Visio etc.
Recommended Books
1. Motion and Time Study by Benjamin W. Niebel, McGraw-Hill, Latest Edition 2. Time and Motion study by I. L. O., Latest Edition 3. Motion and time study design and measurement of work by Ralph M.Barnes, Latest Edition

Course Content

8.27 Operations of Manufacturing Systems

COURSE CODE & TITLE (IET-225) **Operations of Manufacturing Systems**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** concepts and applications of material requirement planning (MRP), enterprise resource planning (ERP), just in time(JIT), push, pull, and hybrid systems.	C-2	SA-1
CLO-2	**Solve** problems related to MRP, ERP, JIT, Push, Pull, and Hybrid systems.	C-3	SA-1
Course Learning Outcomes for Lab			
CLO-3	**Practice** appropriate tools and techniques for material and resource planning.	P-3	SA-5
CLO-4	**Effectively** communicate reliability and quality procedures.	A-2	SA-10
Note: The labs should be related to theory topics. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Material Requirement Planning (MRP), Manufacturing resource planning, Enterprise resource planning, just in time, Kanban System, Total quality manufacturing, Factory dynamics, Push, Pull and hybrid systems.			

Lab Outline
Implement appropriate tools/techniques for material and resource planning through suitable tools
Lab Equipment
Computer cluster with relevant software e.g., MS Excel etc.
Recommended Books
1. Factory Physics by Hopp & Spearman, McGraw-Hill (Latest Edition) 2. Production and Operations Analysis by Steven Nahmias, McGraw-Hill (Latest Edition)

Course Content

8.28 Operations Research

COURSE CODE & TITLE (IET-228) **Operations Research**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-Elective**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** different optimization methods and techniques, especially on linear programming problems, and queuing problems.		C-3	SA-3
CLO-2	**Formulate** real life problems into optimization problems.		C-5	SA-2
CLO-3	**Interpret** solutions obtained from different optimization methods and softwares.		C-6	SA-6
Course Outline				
Introduction to Operations Research (OR), Linear Programming (LP), Integer Programming, Graphical methods of solving problems, Simplex Method, Network Analysis, Transportation Models, Queuing Theory, Game Theory, Multi Criteria Decision Analysis, Optimization Software (Lingo, Excel Solver, Tora etc.)				
Recommended Books				
1. Operations Research by H. A. Taha, Prentice Hall, Latest Edition 2. Introduction to Operations Research by Hillier, Liberman, Latest Edition 3. Operations Research: Applications and Algorithms by Wayne L. Winston, Latest Edition				

Course Content

8.29 Production Planning and Control

COURSE CODE & TITLE (IET-311) **Production Planning and Control**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** forecasting, sequencing, scheduling, and inventory control.	C-1	SA-1
CLO-2	**Apply** different forecasting models, sequencing and scheduling algorithms, and inventory models.	C-3	SA-5
Course Learning Outcomes and Rubrics for Lab			
CLO-3	**Perform** and produce schedules, sequence, and forecasts and inventory values using different software's.	P-4	SA-4
CLO-4	**Support** and defend the results obtained from different softwares.	A-5	SA-6
Note: The labs should be related to theory topics. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline for Theory			
Forecasting, Sequencing and Scheduling, Flow shop, Job shop, Open shop, Algorithms for production planning and re-planning, Inventory Classification and models, Break Even Analysis, Aggregate planning, Capacity requirements planning, Introduction to mixed production models.			
Outline for Lab			
Develop and solve forecasting models, sequencing and scheduling algorithms, and inventory models.			

Lab Equipment
Computer Cluster as per allowed intake with appropriate software like MS Excel etc.
Recommended Books
1. HEIZER, J.R., *Operations management: Sustainability and supply chain management,* Pearson Education Limited, Latest Edition 2. Introduction to Statistical Quality Control, by Douglas C. Montgomery, Latest Edition 3. Introduction to Statistical Process By Peihua Qiu, Latest Edition 4. Statistical Methods for quality improvement by Thomas P. Ryan, Latest Edition

Course Content

8.30 Manufacturing Processes

COURSE CODE & TITLE (IET-312) **Manufacturing Processes**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** machining and non-machining processes.	C-2	SA-1
CLO-2	**Distinguish** between dimension, tolerance, and gauging.	C-3	SA-2
CLO-3	**Analyze** different manufacturing processes, mechanisms, output product characteristics, and physical phenomena.	C-4	SA-4
Course Learning Outcomes for Labs			
CLO-4	**Perform** hands on operation of industrial equipment using the techniques and tools.	P-5	SA-5
CLO-5	**Work** as an individual and team member to accomplish given tasks.	A-3	SA-9
Note: The labs should be related to theory topics. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline for Theory			
Introduction and Overview of Manufacturing, Processing and assembly operations, Introduction to dimensions and tolerances, precision of different manufacturing processes. Introduction to casting processes, types of casting processes, sand casting, other expendable mold casting processes, permanent mold casting processes, defects in casting, glass manufacturing, polymer parts manufacturing, manufacturing of textiles and composite, powder metallurgy, manufacturing of ceramic and cermet's. Welding and joining operations, surface processing operations.			

Outline for Lab
Demonstration of industrial manufacturing processes like expendable mold casting, permanents mold casting, GD&T (flatness, roughness, concentricity, roundness etc), joining operations, processing of rubbers and polymers, metal cutting etc.
Lab Equipment
Pattern making shop, melting furnaces, sand casting equipment, wax pattern making, injection molding equipment, vernier caliper, dial test indicators, V blocks, depth gauges, welding plants, CNC milling, turning etc. Computer cluster with appropriate software like Veri cut, Creo etc.
Recommended Books
1. Fundamentals of Modern Manufacturing; Materials, Processes and Systems, by M. P. Groover (Textbook) 2. Manufacturing Engineering & Technology, Serope Kalpakjian

Course Content

8.31 Ergonomics

COURSE CODE & TITLE (IET-313) **Ergonomics**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-IV**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basics of ergonomics such as illustration of information by text and graphics, climatic factors, noise, vibrations, their effects on various organs, and anthropometry.	C-2	SA-6
CLO-2	**Illustrate** and apply ergonomic principles at workplace, and equipment design along with controls in advance technology.	C-3	SA-6
Lab Work Learning Outcome			
CLO-3	**Practice** appropriate risk reduction techniques to reduce ergonomic hazards.	P-3	SA-5
CLO-4	**Work** as an individual and team member to accomplish given tasks.	A-3	SA-9
Course Outline for Theory			
Introduction to Human Factors Engineering, Human Characteristics relevant to ergonomics. Information on Human Role in artificial Intelligence, information by text, graphics and symbols. Anthropometry, Anthropology, Principles of workplace design, Equipment and workspace, Failure of design, Climatic Factors, Noise and Vibration, Effects of noise on various organs and its prevention, visibility (Illumination, contrast, quality, colour etc.) and its effects, Basic concepts of Human Error detection and reduction. The role of controls in advanced technology, Control devices.			

Outline for Lab
Apply appropriate risk reduction techniques to reduce ergonomic hazards.
Lab Equipment
Digital Video Recorder, Bicycle Ergometer with Electronic Heart rate Display, ECG Holter Recorder, and computer cluster with appropriate Ergonomics software.
Recommended Books
1. An Introduction to Human Factors Engineering by Wickens, Gordon, Liu., Latest Edition 2. Hand-Book of Industrial Engineering: Technology and Operations, by Salvendy G., McGraw-Hill, Latest Edition 3. Human Factors Engineering & Design by Sanders & Mc Cormick, Latest Edition

Course Content

8.32 Total Quality Management

COURSE CODE & TITLE (IET-315) **Total Quality Management**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-VI**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** quality management, leadership, commitment, ISO 9001, Six Sigma, Lean Six Sigma and other TQM terminologies.	C-2	SA-1
CLO-2	**Apply** different TQM techniques, processes, and methods such as Six Sigma, Lean Six Sigma, 5S, etc.	C-3	SA-5

Course Outline for Theory

Understanding quality, commitment and leadership, design for quality, planning for quality, quality system requirements, quality measuring tools and the improvement cycle, Quality assurance, ISO 9001, Six sigma, Lean Six Sigma, Kaizen, Balanced score card.

Recommended Books

1. Total Quality Management with text cases by John S. Oakland, Latest Edition
2. Total Quality Management by D.H. Besterfields and C.Besterfield- Michna , Latest Edition

Course Content

8.33 Instrumentation and Measurement

COURSE CODE & TITLE (IET-316) **Instrumentation and Measurement**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Interdisciplinary-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the fundamental principles of instrumentation and measurement systems, and description of performance parameters of instruments.	C-2	SA-1
CLO-2	**Manipulate** the configuration, ranges, and working principle of different types of meters.	C-3	SA-2
CLO-3	**Analyze** the design of instrumentation and measurements including the concept of sensors and transducers.	C-4	SA-4
Course Learning Outcomes for Lab			
CLO-4	**Study** the technology trends in the field of measurement and instrumentation.	A-3	SA-12
CLO-5	**Operate** different instruments for measurement of electrical quantities.	P-4	SA-5
CLO-6	**Communicate** effectively about laboratory work in writing, and document their work including laboratory procedures.	P-5	SA-10
Course Outline for Theory			
Precision measurements terminologies including resolution, sensitivity, accuracy, and uncertainty; engineering units and standards; principles of different measurement techniques; instruments for measurement of electrical properties, pressure, temperature, position, velocity, flow rates (mass and volume) and concentration; principles of operation, construction and working of different analog and digital meters, oscilloscope, recording instruments, generators, transducers, and other electrical and non-electrical instruments; types of bridges for measurement of resistance, inductance, and capacitance; power and energy meters; high-voltage measurements, Principles of Voltmeter,			

Ohmmeter construction and working. Rectifier Type instruments, Instrument Transformers, and its applications. Measurement of Power & Power Quality Measurements, Power factor Meter, Energy Meters, Dynamometer type Instrument, Megger, Function Generator and its applications.
Lab Outline
The course includes the concepts of Electrical and Electronic Instrumentation, Absolute Instruments, Secondary Instruments, Analog, Digital, Indicating, Recording, Integrating Instruments, PMMC Dynamometer Type Instruments: Voltmeter, Ammeter, Wattmeter, Ohmmeter, Transducers including Analog & Digital transducer, Active & Passive Transducers, temperature sensor, strain gauge, Frequency Counter.
Lab Equipment
Temperature Measurement Trainer, Computerized Temperature Control Trainer, Current To Pressure Measurement Trainer, Gas flow analyzers, Electrical, Electronic & Pneumatic Calibration Bench etc., AC/DC modular Servo Systems, programmable logical controller.
Recommended Books
1. Alan S. Morris, Measurement and Instrumentation, Theory and Application, Latest Edition 2. H S Kalsi, Electronic Instrumentation, McGraw Hill Companies, Latest Edition 3. Howard M. Berlin, Principle of Electronic Instrumentation & Measurements, Merrill Publishing Company, Latest Edition

Course Content

8.34 Project Part-I

COURSE CODE & TITLE	CREDIT & CONTACT HOURS	KNOWLEDGE AREA/ DOMAIN
(IET-317) **Project Part-I**	(0+3) **0 Theory + 144 Lab**	**Project**
A project will be evaluated through different types of rubrics such as proposal rubrics, progress presentation rubrics, final presentation rubrics, sessional rubrics, report rubrics, and viva rubrics. The institute can add or delete the rubrics as per their need and requirements. The sample rubrics are presented in Annex-J.		

Course Content

8.35 Project Management

COURSE CODE & TITLE (IET-321) **Project Management**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-VI**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** different concepts, techniques and stages involved in project management.	C-2	SA-11
CLO-2	**Apply** concepts such as planning, scheduling, monitoring, controlling through PERT and CPM analysis, and to address specific management needs at the individual, team, division and organizational level.	C-3	SA-11
Course Learning Outcomes for Lab			
CLO-3	**Practice** project management tool(s) for planning and scheduling.	P-3	SA-5
CLO-4	**Effectively** communicate project management procedures.	A-2	SA-10
Course Outline			
Introduction to project management, project management concepts, contemporary project management tools and techniques, project proposals and feasibility, initiating, Planning, execution, monitoring and control, closing and Exit strategy, knowledge areas as per PMBOK/PRINCE-2.			
Lab Outline			
Practice of Project Management's Software (MS Project or Primavera) for various management tasks.			

Lab Equipment
Cluster of computers with project management software such as MS Project or Primavera
Recommended Books
1. Gido, J. and Clements, J.P., Successful Project Management 2e, Thomson South-Western, Latest Edition 2. Meredith, J.R. and Mantel, S.J., Project Management: A Managerial Approach, 4th Edition, John Wiley, Latest Edition 3. Clifford F. Gray, Erik W. Larson Project Management: The Managerial Process McGraw-Hill Irwin, Latest Edition 4. HEIZER, J.R., *Operations management: Sustainability and supply chain management,* Pearson Education Limited, Latest Edition

Course Content

8.36 Computer Aided Manufacturing

COURSE CODE & TITLE (IET-322) **Computer Aided Manufacturing**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** Computer Aided Manufacturing (CAM) and its applications.	C-2	SA-1
CLO-2	**Apply** CAM concepts to simulate and produce products.	C-3	SA-5
Course Learning Outcomes for Lab			
CLO-3	**Produce** appropriate G and M codes using CAD models for parts and components.	P-4	SA-5
CLO-4	**Comply** with health and safety requirements relevant to industrial machine tools.	A-2	SA-6
Note: List of practicals should be related to theory topics. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Introduction to Computer Aided Manufacturing (CAM), Applications of CAM, Conventional Numerical Control, NC Part Programming, Computer Controls in NC, Additive Manufacturing including 3D printing technologies to create complex shapes and geometries, CAM software to generate toolpaths for cutting and shaping material, Simulation and Verification.			

Course Outline for Lab
Manual programming of CNC machines using G and M codes, introduction to standard controllers like Fanuc, Heidenhain etc. Interfacing of CNC machine with computer using relevant software and networking protocol
Lab Equipment
Cluster of Computers, Simulation Software's, NC and CNC Machines, 3D printer
Recommended Books
1. Mastering CAD/CAM by Ibrahim Zaid, McGrall-Hill 2. Principles of CAD/CAM/CAE Systems by Knunwoo Lee, Addison Wesley

Course Content

8.37 Industrial Repair and Maintenance

COURSE CODE & TITLE (IET-323) **Industrial Repair and Maintenance**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-VII**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** different types of maintenance procedures, and their significance.	C-2	SA-1
CLO-2	**Prepare** maintenance schedules and procedures for different industry equipment's, gadgets, and elements.	C-3	SA-11
Lab Work Learning Outcome			
CLO-3	**Practice** different techniques and tools for fault diagnosis, repair and maintenance for industrial parts and systems.	P-3	SA-5
CLO-4	**Comply** with health and safety requirements relevant to industrial machine tools.	A-2	SA-6
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Introduction to industrial maintenance, Importance of industrial maintenance, corrective maintenance, preventive maintenance, predictive maintenance, total productivity maintenance, Maintenance Planning and scheduling, Lockout/tagout procedures, operation and maintenance of pumps, valves, cylinders, motors, sensors, and control systems.			

Outline for Lab
Apply different techniques and tools for fault diagnosis, repair and maintenance for industrial parts and systems like pumps, motors, engines, compressors etc.
Lab Equipment
Mechanical tool kit, plumbing kit, electrician kit, used pumps, motors, engines etc.
Recommended Books
1. Maintenance, Replacement, and Reliability by Andrew K.S. Jardine, Albert H. C. Tsang, Latest Edition

Course Content

8.38 Manufacturing Systems

COURSE CODE & TITLE (IET-324) **Manufacturing Systems**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth -III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the basic concept of lean manufacturing, flexible manufacturing, cellular manufacturing, and material handling systems.	C-2	SA-1
CLO-2	**Analyze** different manufacturing systems, material handling systems, and assembly lines.	C-4	SA-2
Course Learning Outcomes for Lab			
CLO-3	**Demonstrate** the ability to carry out and relate a practical work to techniques of production processes.	P-3	SA-5
CLO-4	**Choose** appropriate production processes and procedures.	A-2	SA-10
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Introduction to Lean Manufacturing, Manufacturing automation fundamentals and strategies, High volume manufacturing systems, Flow lines, Assembly lines, Automated material handling and storage systems, Process planning, Group technology, Cellular manufacturing systems, Computer networks of manufacturing, Computer integrated manufacturing systems, Flexible manufacturing systems.			

Outline for Lab
Perform practical work on techniques of production processes and **select** appropriate production processes and procedures.
Lab Equipment
Assembly Lines, Material Handling Systems, Storage Systems, Computer cluster along with appropriate software's
Recommended Books
1. Automation, Production Systems and Computer Integrated Manufacturing by M. P. Groover, Prentice Hall, Latest Edition 2. Modelling and Analysis of Manufacturing Systems by Askin and Standridge, John Wiley and Sons, Latest Edition 3. HEIZER, J.R., *Operations management: Sustainability and supply chain management,* Pearson Education Limited, Latest Edition

Course Content

8.39 Entrepreneurship

COURSE CODE & TITLE (IET-325) **Entrepreneurship**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-IV**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** the concept of entrepreneurship, start-up ventures, and marketing systems.	C-2	SA-12
CLO-2	**Classify** the role of entrepreneur in economic development of a country, and society.	C-3	SA-6
CLO-3	**Propose** business plans for startup ventures.	C-5	SA-12

Course Outline

Introduction to Entrepreneurship, Importance of entrepreneurship in economy, types of entrepreneurships, Opportunity recognition and evaluation, feasibility and viability of business ideas, Business planning (Marketing plan, financial plan, and operational plan), Legal and Ethical issues in Entrepreneurship, Financing and funding, Scaling and growth.

Recommended Books

1. Entrepreneurship: Successfully Launching New Ventures by Bruce R. Barringer and R. Duane Ireland, Latest Edition
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries, Latest Edition

Course Content

8.40 Supply Chain Management

COURSE CODE & TITLE (IET-326) **Supply Chain Management**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-V**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the basic terminologies of supply chain management.		C-2	SA-1
CLO-2	**Apply** contemporary supply chain management knowledge to real life situations .		C-3	SA-5
CLO-3	**Explore** different issues arising in supply chain of an organization at organizational, national, and global levels.		C-4	SA-4
Course Outline				
Introduction to Supply Chain Management, Importance of Supply Chain Management, Evolution of Supply Chain Management, Supply chain strategy and planning, Supplier selection and management, procurement and sourcing, logistics management, warehousing and distribution, distribution management system, global supply chain management, information technology in supply chain management, Sustainability and ethics in supply chain management.				
Recommended Books				
1. Supply Chain Management: Strategy, Planning, and Operation by Sunil Chopra and Peter Meindl 2. Operations and Supply Chain Management by F. Robert Jacobs and Richard Chase 3. HEIZER, J.R., *Operations management: Sustainability and supply chain management,* Pearson Education Limited, Latest Edition				

Course Content

8.41 Project Part-II

COURSE CODE & TITLE	CREDIT & CONTACT HOURS	KNOWLEDGE AREA/ DOMAIN
(IET-327) **Project Part-II**	(0+3) **0 Theory + 144 Lab**	**Depth Elective – IV**
A project will be through different types of rubrics such as proposal rubrics, progress presentation rubrics, final presentation rubrics, sessional rubrics, report rubrics, and viva rubrics. The institute can add or delete the rubrics as per their need and requirements. The sample rubrics are presented in Annex-J		

Course Content

8.42 Industrial System Simulation

COURSE CODE & TITLE (IET-412) **Industrial System Simulation**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-Elective**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** fundamental concepts and techniques of modelling and simulation.	C-1	SA-1
CLO-2	**Apply** mathematical and statistical techniques to transform the real-world systems into simulation models.	C-3	SA-5
CLO-3	Validate, and interpret the results of simulation model.	C-6	SA-4
Course Learning Outcomes for Lab			
CLO-4	**Practice** different techniques and simulation tools for industrial systems.	P-3	SA-5
CLO-5	**Acquire** knowledge about technology trends, devices, and interconnect scaling.	C-1	SA-12
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Introduction to simulation concepts, Random number generation, Simulation model building, Simulation languages, Discrete Event Simulation, Continuous Simulation, Simulation languages and tools, verification and validation of simulation model and output, advanced simulation techniques, emerging trends and future directions in simulation.			

Lab Outline
Development of various simulation models of practical nature using ARENA or any other simulation software.
Lab Equipment
Cluster of computers with appropriate software's such as ARENA, SIMIO etc.
Recommended Books
1. Simulation with ARENA, Latest Edition 2. Simulation modeling with SIMIO: A Workbook, Latest Edition 3. Discrete System Simulation by Jerry Banks, Prentice Hall, Latest Edition

Course Content

8.43 Operations Management

COURSE CODE & TITLE (IET-413) **Operations Management**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-Elective**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the need and impact of operations management.	C-2	SA-1
CLO-2	**Apply** different techniques to manage and improve operations of an organization.	C-3	SA-5
Course Outline			
Operations and Productivity, Operations strategy for competitive advantage, Advance forecasting, Managing Quality, location and layout strategies, Maintenance and Reliability, Linear Programming, Transportation Models, Waiting Lines (Queuing Theory), Learning Curves, Introduction to simulation, statistical tools for management.			
Recommended Books			
1. HEIZER, J.R., *Operations management: Sustainability and supply chain management,* Pearson Education Limited, Latest Edition			

Course Content

8.44 Design of Experiments

COURSE CODE & TITLE (IET-414) **Design of Experiment**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth-Elective**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the importance of Design of Experiments (DOE).	C-2	SA-1
CLO-2	**Apply** different DOE concepts to solve real life problems.	C-3	SA-5
Course Learning Outcomes for Lab			
CLO-3	**Practice** experimental tasks.	P-3	SA-5
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Introduction to Design of Experiment (DOE), Importance of DOE, Types of Experiments, Block design, analysis of variance, hypothesis testing, Factional Design, Taguchi Methods, Response surface design, Robust parameter design, Application of DOE techniques to real world problems.			
Lab Outline			
Block Design, Analysis of Variance, Hypothesis testing, Factorial Design, Taguchi Analysis, Robust Parameter Design			
Lab Equipment			
Cluster of computers with relevant software's such as MS Excel, SPSS, Minitab etc.			

Recommended Books
1. Design and Analysis of experiments, by Douglas C. Montgomery, Latest Edition 2. Experiments: Planning, Analysis and Parameter design Optimization, Wu and Hamada, Latest Edition

Course Content

8.45 Automation and Control

COURSE CODE & TITLE (IET-416) **Automation and Control**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-Elective**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** process control fundamentals, sensors, architecture of PLC, DCS, SCADA, Relays and Robots.		C-2	SA-1
CLO-2	**Differentiate** and compare different types of automation gadgets as per industry requirements and needs.		C-4	SA-2
Course Learning Outcomes for Lab				
CLO-3	**Practice** simulation tools and hardware for various control algorithms and design systems.		P-3	SA-5
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.				
Course Outline				
Process control fundamentals, Relay logic and various control devices, Architecture and applications of programmable logic control units, Introduction to distributed control system (DCS) and SCADA Sensors for industrial processes, D/A and A/D converters, Microprocessors and Microcontrollers, Introduction to Robotics, Robot anatomy, Robot configuration, accuracy & Repeatability, Robot specifications, end effectors, Kinematics and Dynamics, Characteristics of Robot applications, Robot Cell Design, types of Robot Applications.				
Lab Outline				
Servo Mechanism, Sensors, Converters, Microprocessors and microcontrollers, PLC, and Robots				
Recommended Books				
1. Computer Automation in Manufacturing By Thomas O. Boucher, Latest Edition 2. R.R. Hunter, "Automated process control systems", Prentice Hall Inc., Latest Edition 3. N.M. Morris, "Control Engineering", Mc-Graw-Hill, Latest Edition 4. Dr. Malcolm Jr., "Robotics and introduction", Breton Publishers, Latest Edition 5. W.E. Snyder, "Industrial Robots Computer Interface and Control, Prentice Hall Inc, Latest Edition				

Course Content

8.46 Metal Forming and Cutting Operations

COURSE CODE & TITLE (IET-418) **Metal Forming and Cutting Operations**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-Elective**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Recognize** the importance of green and sustainable manufacturing for industrial processes.	C-2	SA-7
CLO-2	**Analyze** metal forming and cutting operations through process mechanics.	C-4	SA-4
Course Learning Outcomes for Lab			
CLO-3	**Perform** hands on operations of conventional NC and CNC machines.	P-5	SA-5
CLO-4	**Comply** with health and safety requirements relevant to metal cutting processes.	A-2	SA-6
Course Outline for Theory			
Introduction bulk deformation processes, Industrial bulk deformation processes (Rolling Forging, Drawing, Extrusion etc), Other bulk deformation processes (Upsetting and Heading, roll forging, hubbing etc.). Introduction to sheet metal, Sheet metal operations (bending, punching, deep drawing, hemming etc.). Theory of metal cutting, Machining operations and machine tools, geometric considerations, turning, milling, drilling, other machining operations, High Speed Machining.			
Outline for Lab			
Perform hands on operation of conventional machines like rolling, forging, pipe bending, sheet metal bending, drilling, drawing etc., NC and CNC machines.			
Lab Equipment			
Sheet Metal shop, shearing Machines, pipe bending machines, forging shop, NC milling, NC turning, CNC milling, CNC turning, Conventional milling, drilling, shaper, turning machines etc.			
Recommended Books			
1. Fundamentals of Modern Manufacturing; Materials, Processes and Systems, by M. P. Groover, Latest Edition 2. Metal Cutting Principles, M.C. Shaw, Latest Edition			

Course Content

8.47 Reliability Analysis

COURSE CODE & TITLE (IET-419) **Reliability Analysis**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth-Elective**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** basic concepts and importance of reliability analysis, reliability techniques, and reliability metrics.	C-2	SA-1
CLO-2	**Apply** different reliability techniques and models.	C-3	SA-5
Course Learning Outcomes for Lab			
CLO-3	**Practice** block diagram, Failure Mode and Effect Analysis (FMEA), and Fault Tree Analysis (FTA).	P-3	SA-5
Course Outline for Theory			
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline for Theory			
Definition, importance and objectives of reliability analysis, overview of reliability techniques and reliability metrics, statistical methods for reliability analysis, reliability block diagrams, fault tree, event trees, and Markov models, Failure Modes and Effect Analysis (FMEA), Fault Diagnosis and Prognosis.			
Lab Outline			
Statistical Methods, Block Diagrams, FMEA, FTA			
Lab Equipment			
Computer Cluster along with relevant software's e.g., MS Visio etc.			
Recommended Books			
1. An Introduction to Reliability & Maintainability Engineering by C. E. Ebeling, Latest Edition 2. Practical Reliability Engineering by P.O Connor and A. Kleyner, Latest Edition 3. Reliability in Engineering Design by K. C. Kapur & L. R. Lamberson, Latest Edition			

Course Content

8.48 Industrial Facilities

COURSE CODE & TITLE (IET-422) **Industrial Facilities**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-Elective**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** different stages of location analysis, facilities planning, layouts, and material handling systems.	C-1	SA-1
CLO-2	**Solve** facility location and layout problems by applying analytical facilities location and layout methods.	C-3	SA-7
Course Learning Outcomes for Lab			
CLO-3	**Conduct** facility location and layout planning by applying appropriate techniques and tool's facilities location and layout methods.	P-4	SA-5
CLO-4	**Work** as an individual and team member to accomplish given tasks.	A-3	SA-9
Note: A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Location and Site selection, Facility design stages, processes, material handling equipment and analysis, Area allocation and space requirements, Flow analysis, fabrication of individual parts, total plant flow, Plant layout, Utilities Layout, Computerized facility layout and location, Strategies for storages.			

Lab Outline
Conduct facility location and Layout planning by applying appropriate techniques and tool's facilities location and layout methods.
Lab Equipment
Computer clusters with appropriate software like MS Excel
Recommended Books
1. Manufacturing Facilities: Location, Planning & Design by D. Sule, B.W.S.- Kent Publishing, Latest Edition 2. Facilities Planning by Tomkins & White, John Wiley, Latest Edition

Course Content

8.49 Data Analytics

COURSE CODE & TITLE (IET-423) **Data Analytics**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-Elective**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** data collection, data cleaning, and data analysis; their concepts, techniques, and significance.	C-2	SA-1
CLO-2	**Apply** different techniques to analyze a data.	C-3	SA-5
Course Learning Outcomes for Lab			
CLO-3	**Practice** data analytics, data mining, and other data analytics applications through different software's.	P-3	SA-5
A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
Importance and benefits of data analytics, data collection methods, data cleaning and data preprocessing techniques, data modelling and analysis techniques, machine learning, data mining, deep learning, time series analysis, applications of data analytics.			
Lab Outline			
Data Modelling, Data Analysis, Data Mining, Machine Learning, Time Series Analysis.			
Lab Equipment			
Computer Cluster, MS Excel, Python etc.			

Recommended Books
1. Data Mining and Analysis: Fundamental Concepts and Algorithms by Mohammed J. Zaki and Wagner Meira Jrv, Latest Edition 2. Data Analytics Made Accessible by Anil Maheshwari, Latest Edition

Course Content

8.50 Industrial Internet of Things (IOT)

COURSE CODE & TITLE (IET-424) **Industrial Internet of Things (IOT)**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-Elective**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Articulate** the significance, benefits, and need of Industry 4.0.	C-2	SA-1
CLO-2	**Explore** opportunities to resolve problems through Industry 4.0.	C-4	SA-4
Course Learning Outcomes for Lab			
CLO-3	**Demonstrate** expertise using different Industry 4.0 elements.	P-4	SA-12
CLO-4	**Work** as an individual and team member to accomplish given tasks.	A-3	SA-9
A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Course Outline			
History and evolution of Industry 4.0, Overview of Industry 4.0 technologies, Benefits and Challenges of Industry 4.0, Cyber Physical Systems, Internet of Things (IOT), Big Data Analytics, 3D printing technologies, Augmented Reality and Virtual Reality, Block chain and its applications in Industry 4.0, Industry 4.0 adoption strategies.			
Lab Outline			
Virtual Reality Applications, Blockchain, Advanced 3D Printing			

Lab Equipment
Sensors, WIFI, Arduino education department kits, 3D Printer, Computers with VR software's,
Recommended Books
1. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, Latest Edition 2. Industry 4.0: Managing The Digital Transformation by Alp Ustundag and Emre Cevikcan

Course Content

8.51 Special Topic

COURSE CODE & TITLE (IET-425) **Special Topic**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth-Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
The CLOs will be generated for the specific topic.			
Course Outline			
The HEI can offer any topic as per their need and student's demand.			
Outline, Course Learning Outcomes and Rubrics for Lab			
Cover experiments related to theory topics. A Lab course will be evaluated through lab work rubrics, lab report rubrics, and lab viva rubrics, OEL rubrics, Midterm exam, final term exam. The combination of all these will generate different CLOs for different lab courses. Sample of CLOs along with Sample Rubrics are presented in Appendix H.			
Recommended Books			
Latest books should be adopted.			

9. Supervised Industrial Training

9.1 Background

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

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

9.2 Objectives

Through the SIT, students will:

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

9.3 Responsibility of HEI: Placement in SIT Program

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

9.4 Responsibilities of Students

a. Bachelor of Industrial Engineering Technology students shall get enrolled for SIT during the 6th semester and before commencement of 7th semester.
b. Students shall have to undergo continuous training of 16 (or 32) 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 help earn students 16 credit hours.

c. Total contact hours per semester are: 16 weeks per semester x 5 working days per week x 8 hours per day = 640. If an HEI opts SIT in 2 semesters (7^{th} and 8^{th}), these credit hours and contact hours will be doubled.
d. Students will maintain a daily Logbook, signed by the SIT supervisor at site, Training Administrator appointed by HEI and the student.
e. Students must observe safety & 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 the Training period of 16 (or 32) for genuine reasons. The leave shall only be used to cater for emergencies, with prior sanction from the training Administrator/Coordinator.
i. Leave will be deducted from training hours and required to be made up later.
j. Unsanctioned leaves shall be treated as "absent", and liable to disciplinary action.
k. Public holidays and leave should not be counted as working hours.

9.5 Training Progress Assessment and Review by HEI

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

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

a. To ensure the training organization is providing suitable and appropriate training to students.
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 a new placement of the student is available and confirmed in another organization, provided the student does not suffer loss of training hours due to this changeover.
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 daily in the Training Logbook [See Appendix F]. Students must get it signed on a daily basis, and an 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 on site, to ensure that no confidential materials are included in the report. The report shall be submitted to the Training Administrator. The student may present a copy of the report to the prospective employer. Any references made in preparation of the report should be recognized using standard referencing formats. Students should refer to the Industrial Training Report Template as provided [See Appendix G] and guidelines given below in preparing the Report. The Daily Training Logbook should be submitted together with the Report.

9.9 Guidelines for Preparation of Industrial Training Report

Under the guidance of supervisors, students need to properly document their experience and learning during the SIT in form of an Industrial Training Report. A properly prepared Report can portray their practical experience precisely in an orderly manner. The Report must be prepared according to the format and the guidelines below:

9.9.1 Contents of Industrial Training Report

(a) Table of Contents

This section of the report shall consist of:

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

Every appendix requires a title, and each page 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. Problems solving process or approach
v. Hands-on skills acquired.
vi. How productivity can be further enhanced.
vii. Quality Management system in place.
viii. Safety at work.

(e) Conclusion

Students provide an overall assessment in this section and arrive at a conclusion with regards to the SIT undergone. Content may include:

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

(f) References

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

(g) Appendixes

Appendixes are additional information appended to support the main text of the Report. A copy of the letter of permission from the Training Organization must be attached as an appendix. Other suggested appendixes are:

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

(h) Figures and Tables

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

(i) Notations, Symbols & Acronyms

If the report contains notations, symbols, and acronyms, these must be defined before they first appear in the main text. It is good practice to put a list of notations, symbols, and acronyms on a separate page, appropriately titled, and placed after 'Tables of Contents' page.

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

9.9.2 Format of the Report

(a) General

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

(b) Abstract or Preface

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

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

9.10 SIT Assessment

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

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

It is also be noted that:

i. A minimum of 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.

9.12 Laboratories

The proposed laboratories and their respective equipment(s) are mentioned below:

i. Computer Lab

Computers, Multimedia, and software's (MS Excel, MS Word, MS Visio, etc.)

ii. Workshops

Pattern Shop, Machine Shop, Welding Shop, Electric Shop, Smith Shop, Foundry Shop, and Fitting Shop.

iii. Manufacturing Lab

AS/RS (Automated Storage and Retrieval System), FMS, Robots, Conveyer belts, AGVs. CIM Package installation in progress, CNC lathe, CNC milling

iv. Materials Lab

Universal Testing Machine (UTM), X-ray diffractometer (XRD), Impact Tester, Creep Testing Machine.

v. Automation Lab

Sensor Technology for Factory Automation, Katana Robot, Kawasaki Robot, Denso Robot, Flexible Manufacturing System (FMS), Servo Mechanism System, Instrumentation and Control, Lucus Nulle PLC, Operation Amplifier Kit, Speed and Time Control Kit, Oscilloscope

vi. Metrology Lab

Manual Gauges, Digital Gauges, Time Measuring Devices etc.

vii. Mechanics Lab

Gyroscope Apparatus, Static and Dynamic Balancing Apparatus, Centrifugal Force Apparatus, Strain Gauge Apparatus, spring Testing Apparatus, Air Track Apparatus, Inclined Plane Kit(both simple and advanced), Spur Gear Lifting Machine, Torsion Tester Kit, Vibration Apparatus, Reaction Of Beams Apparatus, Triangle Of Forces Apparatus, Junior Mechanism Kit, Quick Return Mechanism, Shearing Force And Bending Moment Apparatus, Circular To Linear Motion Conversion Apparatus, Flywheel Apparatus, Wheel And Differential Axle, Torsional Vibration Apparatus, Determination Of Gear Efficiency Apparatus, Cam And Roller Kit, Free And Forced Vibration Apparat us Wall Mounted Screw Jack and many more.

viii. Ergonomics Lab

Digital Video Recorder, Bicycle Ergometer with Electronic Heart rate Display, ECG Holter Recorder, and several Ergonomics related software's.

APPENDIX A: Sydney Accord Knowledge and Attitude Profile

(Retrieved from www.ieagreements.org)

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

APPENDIX B: Engineering Technologist Graduate Attribute Profile

(Retrieved from www.ieagreements.org)

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

Communication **SA10:** An ability to communicate effectively on broadly defined Engineering Technology activities with the Engineering Technologist community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project Management **SA11:** An ability to demonstrate knowledge and understanding of Engineering Technology management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.
Lifelong Learning: **SA12:** An ability to recognize the need for and have the ability to engage in independent and life-long learning in specialist Engineering Technologies.

APPENDIX C: Engineering Technologist Professional Competence Profile

(Retrieved from www.ieagreements.org)

As per Sydney Accord, Engineering Technologist Graduate is expected to demonstrate the following competencies:
Comprehend and apply universal knowledge: **TC1:** Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems, or methodologies.
Comprehend and apply local knowledge: **TC2:** Comprehend and apply the knowledge embodied procedures, processes, systems, or methodologies that is specific to the jurisdiction of practice.
Problem analysis: **TC3:** Identify, clarify, and analyze broadly defined problems using the support of computing and information technologies where applicable.
Design and development of solutions: **TC4:** Design or develop solutions to broadly defined problems considering a variety of perspectives.
Evaluation: **TC5:** Evaluate the outcomes and impacts of broadly defined activities.
Protection of society: **TC6:** Recognize the foreseeable economic, social, and environmental effects of broadly defined activities and seek to achieve sustainable outcomes (represented by the 17 UN-SDGs).
Legal, regulatory, and cultural: **TC7:** Meet all legal, regulatory, and cultural requirements and protect public health and safety during all activities.
Ethics: **TC8:** Conduct activities ethically
Manage engineering activities: **TC9:** Manage part or all of one or more broadly defined activities.
Communication and Collaboration: **TC10:** Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders during all activities.

Continuing Professional Development (CPD) and Lifelong learning: **TC11:** Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work.
Judgement: **TC12:** Choose appropriate technologies to deal with broadly defined problems. Exercise sound judgement in the course of all broadly defined activities.
Responsibility for decisions: **TC13:** Be responsible for making decisions on part or all of one or more broadly defined activities.

APPENDIX D: Minutes of Preliminary Meeting of NCRC

1. The preliminary Meeting of National Curriculum Review Committee (NCRC) was held on 22-2-2023 to 24-2-2023, at the University of Azad Jammu and Kashmir (UAJ & K), Muzaffarabad.
2. The Welcome Session started with the recitation of the Holy Quran, and it was chaired by Honorable Engr. Imtiaz Hussain Gilani, Chairman NTC. In a welcome speech, objectives, and arrangements for NCRC were presented by the host Honorable Vice Chancellor, University of Azad Jammu and Kashmir, Muzaffarabad. The Chairman NTC highlighted the importance of curriculum development for technology programs with a sharper focus on hands-on, practical work, and keeping in view future needs, market demand, and societal needs as per the scope of NTC and guidelines of Sydney Accord.
3. Hafiz Ghulam Muhammad represented NTC.
4. In the second session, NTC representative invited the house to nominate a Convener, a Co-Convener, and a Secretary of the NCRC. After discussion, Engr. Prof. Dr. Shahid Maqsood was nominated as Convenor, Engr. Dr. Lubna Farhi, was nominated as Co-Convener, and Dr. Sikandar Bilal Khattak was nominated as Secretary for the NCRC.

   The following nominated members from various HEI's were part of the NCRC for Bachelor of Industrial Engineering Technology program:

Sr.	NCRC Members	Role
1	Engr. Prof. Dr. Shahid Maqsood Professor and Chairman, Department of Industrial Engineering, UET Peshawar, Jalozai Campus	Convener
2	Dr. Lubna Farhi Chairperson Sir Syed UET, Karachi	Co-Convener
3	Prof. Dr. Muzaffar Ali Professor University of Engineering & Technology Taxila	Co-Convener
4	Dr. Sikandar Bilal Khattak Associate Professor, Department of Industrial Engineering, UET Peshawar	Secretary
5	Prof. Dr. Azmat Ullah Khan Sherani Professor, BUITEMS, Quetta	Member
6	Prof. Dr. Hussain Imran Jafferi Professor NUST, Islamabad	Member
7	Prof. Dr. Saadat Hanif Dar Professor and Dean, The University of Azad Jammu & Kashmir, Muzaffarabad	Member
8	Dr. Hassan Raza Associate Dean Hamdard University	Member
9	Dr. Shahab Ahmad Niazi Chairman IUB, Bahawalput	Member
10	Dr. Muhammad Ilyas Menhas Associate Professor, MUST, AJK	

Sr.	NCRC Members	Role
11	Dr. Khalid Khwaja HOD, The University of Azad Jammu & Kashmir, Muzaffarabad	Member
12	Dr. Sheeraz Iqbal Assistant Professor, The University of Azad Jammu & Kashmir, Muzaffarabad	NTC Representative
13	Engr. Syed Muhammad Zaid Hamdard University, Islamabad	Member

5. After taking charge, the Convenor, Engr. Prof. Dr. Shahid Maqsood, chaired the meeting and emphasized to ensure the reflection of Sydney Accord in curriculum and course titles, as well as develop curriculum that provides a unified framework for offering degrees under the title of Industrial Engineering Technology.
6. In continuation of above guidelines, the Co-Convener, and the Secretary highlighted the objectives of curriculum development.
7. Agreed upon objectives were categorized and assigned to Subcommittees, where Honorable Members reviewed, discussed, and submitted the following resolutions:

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

8. In the next session, the Committee discussed the nomenclature of the discipline, preface, objectives of the programs, PLOs, methods of instruction, learning environment, assessment, and operational framework.
9. After long deliberations, the Committee proposed the curriculum framework, the duration of the program, number of semesters, number of weeks per semester, total number of credit hours, weightage of technology domain and non-technology domain courses, and weightage of theory and practicals of an undergraduate, 4-years program in industrial engineering technology.
10. Furthermore, the list of courses (core and elective,) and semester-wise breakup of courses, were also finalized.
11. Admission and intake criteria were discussed and adopted as defined in NTC's Accreditation Manual.
12. Supervised Industrial Training (SIT) was discussed in detail. There was a consensus that SIT will be mandatory for 8th Semester, and optional for 7th Semester.
13. Those HEI's that can provide only one semester of SIT (on the 8th), shall offer optional courses in the 7th Semester to cover credit hours and other requirements.
14. HEI's that are geared to provide SIT in two semesters can do this in 7th and 8th Semesters.
15. In line with the experience and expertise of NCRC members, list of courses of various domains were distributed among the Sub-Committees.

16. These Sub-Committees were assigned responsibility for reviewing course objectives, adding course learning outcomes, appropriate mapping with Bloom's Taxonomy and PLOs, updating list of contents, adding teaching-learning methods, assessment, and updating bibliography, references, and suggested books.
17. The following Core Committee's, along with four Sub-Committees, were constituted with separate Convenors and Secretaries:

Industrial Engineering Technology Core Committee		
Sr#	**Name**	**Role**
1	Engr. Prof. Dr. Shahid Maqsood	Convenor
2	Engr. Dr. Lubna Farhi	Co-convenor
3	Dr. Sikandar Bilal Khattak	Secretary
1. Sub-Committee: Quality Domain		
Sr#	**Name**	**Role**
1	Engr. Prof. Dr. Azmat Ullah Khan Sherani	Convenor
2	Dr. Khalid Khawaja	Member
3	Dr. Sikandar Bilal Khattak	Secretary
2. Sub-Committee: Manufacturing Domain		
Sr#	**Name**	**Role**
1	Engr. Prof. Dr. Shahid Maqsood	Convenor
2	Engr. Prof. Dr. Hussain Imran Jafferi	Member
3	Engr. Prof. Dr. Muzaffar Ali	Secretary
3. Sub-Committee: Automation Domain		
1	Engr. Dr. Lubna Farhi	Convenor
2	Prof. Dr. Saadat Hanif Dar	Member
3	Dr. Muhammad Ilyas Minhas	Member
4	Dr. Shahab Ahmad Niazi	Secretary

4. Sub-Committee: Management Domain		
Sr#	**Name**	**Role**
1	Dr. Shahab Ahmad Niazi	Convenor
2	Engr. Dr. Sheeraz Iqbal	Member
3	Engr. Syed Muhammad Zaid	Member
4	Dr. Hassan Raza	Member
5	Dr. Sikandar Bilal Khattak	Secretary

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

APPENDIX E: Minutes of the Final Meeting of NCRC

1. The Final Meeting of the NCRC was held on 24-04-2023 to 26-04-2023, at the University of Azad Jammu and Kashmir (UAJ & K), Muzaffarabad.
2. The inaugural session started with recitation of the Holy Quran.
3. Engr. Imtiaz Hussain Gilani, Chairman NTC, joined the meeting online. He appreciated the efforts by Members and highlighted their valuable contribution for the national cause in setting standards for quality-education in industrial engineering technology.
4. The Convenor of NCRC also extended his gratitude to the entire team, and briefed about objectives and arrangements for the second NCRC.
5. Mr. Hafiz Ghulam Muhammad represented NTC.
6. The following members attended the meeting, or were available online:

Sr.	NCRC Members	Role
1	Engr. Prof. Dr. Shahid Maqsood Professor and Chairman, Department of Industrial Engineering, UET Peshawar, Jalozai Campus	Convener
2	Dr. Lubna Farhi Chairperson Sir Syed UET, Karachi	Co-Convener
3	Prof. Dr. Muzaffar Ali Professor University of Engineering & Technology Taxila	Co-Convener
4	Dr. Sikandar Bilal Khattak Associate Professor, Department of Industrial Engineering, UET Peshawar	Secretary
5	Prof. Dr. Azmat Ullah Khan Sherani Professor, BUITEMS, Quetta	Member
6	Prof. Dr. Hussain Imran Jafferi Professor NUST, Islamabad	Member
7	Prof. Dr. Saadat Hanif Dar Professor and Dean, The University of Azad Jammu & Kashmir, Muzaffarabad	Member
8	Dr. Hassan Raza Associate Dean Hamdard University	Member
9	Dr. Shahab Ahmad Niazi Chairman IUB, Bahawalput	Member
10	Dr. Muhammad Ilyas Menhas Associate Professor, MUST, AJK	Member

Sr.	NCRC Members	Role
11	Dr. Khalid Khwaja HOD, The University of Azad Jammu & Kashmir, Muzaffarabad	Member
12	Dr. Sheeraz Iqbal Assistant Professor, The University of Azad Jammu & Kashmir, Muzaffarabad	Member
13	Engr. Syed Muhammad Zaid Hamdard University, Islamabad	Member

7. Benchmarking of the proposed curriculum was carried out with Purdue University, USA, and Hamdard University, Pakistan. The curriculum is as per national and international requirements.
8. Various issues were thoroughly deliberated upon by the members, and the following was resolved:
    - 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.
9. The final draft was compiled by the Co-Convener, Engr. Prof. Dr. Muzaffar Ali and Secretary Dr. Sikandar Bilal Khattak.
10. After review by Members and with the approval of Convener, Co-Conveners, and Members, it was submitted to NTC.

APPENDIX F: Supervised Industrial Training Logbook Sample Format

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

Course of Study:
Year/Semester of Study:

Training Start Date:
Training End Date:

Training Organization Details:

Name of Organization:
Address:

Contact Person:
Contact Number:

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

Daily Training Log

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

Training Week: _____

Date	Time	Training Log

Declaration:

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

_____
Student signature with date

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

APPENDIX G: Supervised Industrial Training Report Sample Format

A Sample format for Supervised Industrial Training (SIT) 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 supervisor, is also to be attached at the beginning of the submitted report.

APPENDIX H: Sample of Course Learning Outcomes (CLOs) and Rubrics for Lab

Table 1 Sample of Course Learning Outcomes for a Lab

CLO No.	Course Learning Outcomes (CLOs)	Assessment Activities & Weight Percentage	Taxonomy Domain	PLOs Addressed by Course (PLO No.)
1	To use proper safety gadgets, safety precautions, and other resources including dressing	Lab Work Rubrics Lab Report Rubrics Lab Viva Rubrics	A-3	Ethics (VIII)
2	To actively contribute individually and as team member	Lab Work Rubrics	A-2	Individual and Teamwork (IX)
3	To practice the experimental task and writing skills as per subject requirements (List of practical's of each course)	Lab Work Rubrics Lab Report Rubrics Lab Viva Rubrics	P-3	Modern Tool Usage (V)
4	To be able to apply, explain, express, and collect information regarding the course contents and labs	Lab Work Rubrics Lab Report Rubrics Lab Viva Rubrics	C-3	Investigation (IV)
5	To organize report in each format	Lab Report Rubrics	A-4	Communication (x)
6	To recognize the need and purpose of all aspects (technological change and lifelong learning)	OEL Rubrics	C-2	Lifelong Learning (xii)
7	Presenting and applying new ideas which are safe, healthy, legal, and culturally acceptable.	OEL Rubrics	A-3	The Engineer and Society (vi)
8	To manage, execute, and demonstrate all the deliverables.	OEL rubrics	P-4	Project Management (xi)
9	To advocate the impact of the lab, and its contribution to field and society	OEL Rubrics	A-5	Environment and Sustainability

1.1 Sample of Lab Report Rubrics

Course Code and Course Name:_____

Student Name and Registration Number:_____

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's Score
To use Appropriate Resources (Ethics viii) {Valuing A3}	Used proper resources including pages, covers, other resources etc.	Used proper pages but inadequate file cover	Used proper papers with no file cover	Neither used proper papers nor file cover	
To organize report in a given format (Communication x) {Organization A4}	All sections/steps are clearly organized in a logical order. Page layout is effective.	Most sections/steps are ordered well. No major problems with layout.	Report is disorganized and layout is somewhat weak.	Sections/Steps are not ordered and is incomplete	
To practice the writing skills as per the guidelines (Modern Tool Usage v) {Guide Response P3}	Report is as per the guidelines	Report is mostly as per the guidelines but requires minor improvements.	Report follows some guidelines but most of the guidelines are missing	Report is not as per the guidelines	
To discuss the actual experiment/task (Investigation iv) {Application C3}	The report completely discusses the required experiment/lab work in own words with some relevant additional information	The report discusses the required experiment/lab work	The report discusses the experiment/lab work but have irrelevant information	The report is totally irrelevant to the experiment/ lab work	

1.2 Lab Work Rubrics

Course Code and Course Name:_____

Student Name and Registration Number:_____

Criteria (PLO) {Taxonomy Level}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's Score
To use the proper safety gadgets and precautions (Ethics viii) {Valuing A3}	Proper safety precautions/gadgets are consistently used and think ahead for the safety of other group members	Proper safety precautions are consistently used	Proper safety precautions are generally used but some time needed to be reminded	No safety precautions are used	
To actively Contribute individually and as team member (Individual and Teamwork ix) {Responding A2}	Student proactively contributes to lab work and group tasks by offering ideas and implementation strategies	Student proactively contribute to the laboratory class by offering ideas	Student rarely contribute to the class by offering ideas	Student do not contribute to the class	
To practice the experimental task as per requirements (Modern Tool Usage v) {Guided Response P3}	Practice the complete Experiment/Task as per the guidelines	Practice experiment/tasks with some hiccups	Practice experiment/Tasks partially	Practice experiments/tasks inaccurately	
To collect information for the required experiment/task (Investigation iv) {Application C3}	Data was collected and recorded in orderly manner that accurately reflect the inputs and outputs of the experiment	Data was recorded in the manner that probably reflect the inputs and outputs.	Data was recorded in disorganized manner and require a lot of assistance	Data was incomplete or recorded inaccurately	

1.3 Lab Viva Rubrics

Course Code and Course Name:_____

Student Name and Registration Number:_____

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's Score
To choose proper dressing (Ethics viii) {Valuing A3}	Choose formal dressing	Choose a mix of formal and informal dressing	Dressing is informal and casual	Dressing is informal, casual and too flashy	
To be able to repeat the lab work/tasks (Modern Tool Usage v) {Guided Response P3}	Repeat the complete Experiment/Task as per the guidelines	Repeat the experiment/tasks with some hiccups	Repeat the experiment/Tasks partially	Repeat experiments/tasks inaccurately	
To be able to explain the basic topics (Investigation iv) {Application C3}	Perfectly explain topics with supporting materials (Explanations, examples, illustrations, Statistics and analogies)	Explain the topics but have no supporting material	Explain the topics in bit and pieces with no supporting material	Could not explain the topic	
To be able to explain the core topics (Investigation iv) {Application C3}	Perfectly explain topics with supporting materials (Explanations, examples, illustrations, Statistics and analogies)	Explain the topics but have no supporting material	Explain the topics in bit and pieces with no supporting material	Could not explain the topic	

Comments:

1.4 Lab Viva Rubrics

Course Code and Course Name:_____

Student Name and Registration Number:_____

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's Score
Recognize Need (Lifelong Learning xii) {Comprehension C2}	All aspects (technological change, need, and purpose) are properly covered before initiating any tasks.	All concerned aspects are covered but tasks need minor improvements	Few aspects are covered, and tasks need major adjustments	Neither aspects are covered nor the tasks	
Idea (The Engineer and Society vi) {Valuing A3}	Presenting and applying new ideas and progress which are safe, healthy, legal, and culturally acceptable.	Have genuine concern on work but still need guidance.	Always need guidance	Not committed to complete the Lab	
Management (Project Management xi) {Mechanism P4}	All the deliverables are executed or demonstrated properly	Most of the deliverables are executed or demonstrated	Only few deliverables are executed or demonstrated	Deliverables are patchy and major changes are required	
Impact (Environment and Sustainability vii) {Internalizing A5}	Advocate that lab is very relevant and have important contribution to the field and society	Lab has relevance but has little contribution to field and society	Lab is fairly relevant and has no contribution to field and society	Lab is neither relevant nor has any contribution to field and society	

Comments:

APPENDIX I: Rubrics Sample for Senior Design Projects

1.5 Project Proposal Evaluation Form

To be Filled by Evaluation Committee Member

Project Tittle:

Supervisor:

Group Members:

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Score
Project Area and Problem Statement (Problem Analysis ii) (Synthesis C5)	Area is relevant to Industrial Engineering and the problem statement is specific, well prepared and gives comprehensive explanation.	Area is relevant to Industrial Engineering, but the problem statement is needs improvement.	Area is fairly relevant, and the problem statements needs improvement.	The area is not relevant to Industrial Engineering and the problem statement needs to be redrafted.	
Proposed Methodology (Project Management xi) (Synthesis C5)	The proposed methodology and timeline is realistic and anticipates the challenges, complexity.	The proposed methodology and timeline are realistic but does not anticipate the challenges, complexity.	The proposed methodology and timeline are somehow realistic and requires minor modifications	The proposed methodology and timeline is unrealistic and needs to be modified completely.	
Area Knowledge (Engineering Knowledge i) (Mechanism P4)	Students demonstrates full knowledge by answering all questions with explanations and elaboration.	Students are at ease with expected answers to all questions without elaboration.	Students are uncomfortable with information and is able to answer only basic questions.	Student does not have basic information about the project	
Dressing and Confidence (Ethics viii) (Valuing A3)	Choose formal dressing and postures	Choose a mix of formal and informal dressing but are not confident	Dressing is informal and casual but are confident	Dressing is informal, casual and too flashy and are not confident	

Presentation and Slides (Communication x) (Organization A4)	Slides are numbered, properly organized and text/figures are readable	Slides are numbered and organized but few text/figures are not readable	Slides are numbered but are not organized and most text/figures are not readable	Slides are not numbered, organized and most of text/figures are not readable	

Comments:

1.6 Project Progress Evaluation Form

To be Filled by Evaluation Committee Member

Project Tittle:

Supervisor:

Group Members:

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's score
Problem Statement (Problem Analysis ii) (Synthesis C5)	Well drafted and prepared	The overall statement needs minor modifications	Problem is mentioned but the statement is poorly prepared	No link between the problem, project and the statement	
Data Collection (Investigation iv) {Analysis C4}	Multiple data sources are identified and used to satisfy project needs	Multiple data sources identified and used but few satisfies requirements	Few data sources identified and used but they satisfy requirements	Completely Unmatched or No data source identified and used	
Project Methodology (Modern Tool Usage v) {Application C3}	The methodology is perfectly aligned with problem statement and objectives	The methodology is good but other suitable methods can be used	The methodology used is satisfactory and lack the basics to achieve the project objectives	The methodology is irrelevant and project objective cannot be achieved from this methodology	
Analysis (Problem Analysis ii) {Analysis C4}	Excellent analysis, evidence of original contribution to or development in field	Analysis is able to set conclusions in context of current understanding in field	Patchy analysis, questionable reliability	Little or no analysis of data	

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's score
Progress/ Performance (Project Management xi) {Mechanism P4}	Execute tasks Ahead of schedule with either more than expected quantifiable results	On schedule with quantifiable and some promising results	Progress with some quantifiable results but behind schedule	Very little progress Made and very much behind the schedule	
Area Knowledge (Engineering Knowledge i) {Mechanism P4}	Students demonstrates full knowledge by answering all questions with explanations and elaboration.	Students are at ease with expected answers to all questions without elaboration.	Students are uncomfortable with information and is able to answer only basic questions.	Student does not have basic information about the project	
Dressing and Confidence (Ethics viii) {Valuing A3}	Choose formal dressing and postures	Choose a mix of formal and informal dressing but are not confident	Dressing is informal and casual but are confident	Dressing is informal, casual and too flashy and are not confident	
Presentation and Slides (Communication x) {Organization A4}	Slides are numbered, properly organized and text/figures are readable	Slides are numbered and organized but few text/figures are not readable	Slides are numbered but are not organized and most text/figures are not readable	Slides are not numbered, organized and most of text/figures are not readable	

Comments:

1.8 Project Final Presentation Evaluation Form

To be Filled by Evaluation Committee Member

Project Tittle:

Supervisor:

Group Members:

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's score
Literature Review (Lifelong Learning xii) {Comprehension C2}	All aspects of concerned literature are covered, and research gap is clearly mentioned	All aspects of concerned literature are covered but research gap needs improvement	Few aspects of literature are covered, and research gap is not identified properly	Sufficient literature is not covered, or the literature covered is not related to problem	
Problem Statement (Problem Analysis ii) {Synthesis C5}	Well drafted and prepared	The overall statement needs minor modifications	Problem is mentioned but the statement is poorly prepared	No link between the problem, project and the statement	
Data Collection (Investigation iv) {Analysis C4}	Multiple data sources are identified and used to satisfy project needs	Multiple data sources identified and used but few satisfies requirements	Few data sources identified and used but they satisfy requirements	Completely Unmatched or No data source identified and used	
Project Methodology (Modern Tool Usage v) {Application C3}	The methodology is perfectly aligned with problem statement and objectives	The methodology is good but other suitable methods can be used	The methodology used is satisfactory and lack the basics to achieve the project objectives	The methodology is irrelevant and project objective cannot be achieved from this methodology	
Analysis (Problem Analysis ii) {Analysis C4}	Excellent analysis, evidence of original contribution to or development in field	Analysis is able to set conclusions in context of current understanding in field	Patchy analysis, questionable reliability	Little or no analysis of data	

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's score
Result Discussion and Conclusions (Engineers and Society vi) {Evaluation C6}	The results and conclusions are properly discussed and have societal considerations	Some of the results and conclusions are missing	Most of the results and concluding arguments are missing	Results and Conclusions are missing	
Project Management (Project Management xi) {Mechanism P4}	All the project deliverables are achieved properly	Most of the project deliverables are achieved	Only few project deliverables are achieved	Project deliverables are patchy and major changes are required	
Ethics (Ethics viii) {Responding A2}	Data and results are not biased/ manipulated and clearly represents the real situation	Data and results are not biased/ manipulated but are slightly different from real situation	Data and results are slightly biased/ manipulated	Data and results are biased/ manipulated	
Area Knowledge (Engineering Knowledge i) {Mechanism P4}	Students demonstrates full knowledge by answering all questions with explanations and elaboration.	Students are at ease with expected answers to all questions without elaboration.	Students are uncomfortable with information and is able to answer only basic questions.	Student does not have basic information about the project	
Dressing and Confidence (Ethics viii) {Valuing A3}	Choose formal dressing and postures	Choose a mix of formal and informal dressing but are not confident	Dressing is informal and casual but are confident	Dressing is informal, casual and too flashy and are not confident	
Presentation and Slides (Communication x) {Organization A4}	Slides are numbered, properly organized and text/figures are readable	Slides are numbered and organized but few text/figures are not readable	Slides are numbered but are not organized and most text/figures are not readable	Slides are not numbered, organized and most of text/figures are not readable	

Comments:

1.9 Sessional Marks Evaluation Form

To be Filled by Project Supervisor

Project Tittle:

Group Member:

Criteria (PLO) {Taxonomy Domain}	**Excellent (4)**	**Proficient (3)**	**Basic (2)**	**Below Basic (1)**	**Student's Score**
Attendance (Ethics viii) {Valuing A2}	Participate in all scheduled and emergency meeting	Participate in scheduled meeting but not present in emergency meeting	Mostly present in the meeting but not punctual	Very rare meeting with supervisor and not punctual	
Project Tasks and Leadership (Project Management xi) {Mechanism P4}	Tasks are always executed accurately ahead of assigned schedule and can lead the team effectively	Tasks are always executed within the assigned schedule but cannot lead them effectively	Tasks are sometime late from assigned schedule and looks for other members to lead	Very few or no tasks are executed and looks for others to lead	
Commitment (The Engineer and Society vi) {Valuing A3}	Show commitment by presenting new ideas and progress in meetings	Have genuine concern on work but still needs to be guided by supervisor.	Always need guidance by supervisor	Not committed to complete the project	
Contribution (Individual and Teamwork ix) (Responding A2)	Student proactively contributes to both individual and group tasks	Student proactively contribute to either individual or group tasks	Student rarely contribute to any tasks	Student do not contribute to the tasks	
Intellectual input (Design and Development of Solution iii) {Synthesis C5}	Proposes solutions and ideas which are original and can be implemented	Proposes solutions which are original but requires proper implementation plan	Proposes solutions which are copied but can be implemented	Does not propose any solution	
Communication (Communication x) {Valuing A3}	Behaves good and interact with supervisor without hesitation	Behaves and interact with supervisor with a little hesitation	Lack of confidence while interacting with the supervisor	No interaction with the supervisor	

Comments:

1.10 Project Viva Evaluation Form

To be Filled by Project Supervisor, Internal Examiner and External Examiner

Project Tittle:

Supervisor:

Group Members:

Criteria (PLO) {Taxonomy)	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's Score
Dressing (Ethics viii) {Valuing A}	Choose formal dressing	Choose a mix of formal and informal dressing	Dressing is informal and casual	Dressing is informal, casual and too flashy	
Body Language (Ethics viii) {Set P2}	Achieve a good confident formal posture	Achieve good posture but is not confident	Posture is informal but shows confidence	Achieve informal posture and is not confident	
Pay Attention (Communication x) {Receiving A1}	Pay attention, tolerate and listen to the question patiently	Pay Attention to the question buts shows impatience	Pay attention but does not let the examiner complete the question	Does not pay attention to the question	
Fundamental Knowledge (Engineering Knowledge i) {Comprehension C2}	Explains project fundamentals in an articulate manner	Explains project fundamentals with some hiccups	Explain project fundamentals with some mistakes	Cannot explain the project fundamentals	
Command of Project (The Engineer and Society vi) {Comprehension C2}	Perfectly explain project complexity with supporting materials (explanations, examples, illustrations, Statistics and analogies)	Explain the project complexity but have no supporting material	Explain the projects in bit and pieces and have no supporting material	Could not explain the project	

Criteria (PLO) {Taxonomy)	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's Score
Logical Reasoning (Communication x) (Responding A2)	Comprehensive, insightful and valid logical reasoning in the viva	Most valid logical reasoning in viva	Little valid logical reasoning in viva	Invalid or no logical reasoning in viva	
Impact of research on the field (Environment and Sustainability vii) {Evaluation C6}	Justifies that project is very relevant and have important contribution to the field and society	Project has relevance but has little contribution to field and society	Project is fairly relevant and has no contribution to field and society	Project is neither relevant nor has any contribution to field and society	
Quality of Work (Modern Tool Usage v) {Application C3}	Illustrate that objective, data collection, methodology and results are perfectively justified, aligned and supported with analysis	The objective, data collection, methodology and results are aligned but lack justification and proper analysis	The objective, data collection, methodology and results are not aligned and also lack justification and proper analysis	There is no link between project objectives, methodology and results.	

Comments:

1.11 Project Report Evaluation Form

To be Filled by Project Supervisor

Project Tittle:

Group Members:

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's Score
Report Organization (Communication x) {Organization A4}	All sections/sub-sections/steps are clearly organized in a logical order. Page layout is effective.	Most sections/sub-sections/steps are ordered well. No major problems with layout.	Report is disorganized and layout is somewhat weak.	Sections/Steps are not ordered and is incomplete	
Language (Communication x) {Valuing A3}	Report is expressed in concise, clear, and easy to follow manner and have proper grammar, spelling and punctuation.	Choice of words is appropriate most of the time but have minor grammar, spelling, and punctuation mistakes	Choice of words is not appropriate and have spelling, and grammatical errors.	Choice of words is very poor and have too much grammatical errors	
Literature Review (Lifelong Learning xii) {Comprehension C2}	All aspects of concerned literature are covered, and research gap is clearly mentioned	All aspects of concerned literature are covered but research gap needs improvement	Few aspects of literature are covered, and research gap is not identified properly	Sufficient literature is not covered, or the literature covered is not related to problem	
Analysis (Communication x) {Analyze C4}	All the elements are adequately analyzed and supported with additional relevant information.	Most of the elements are adequately analyzed.	Some elements are missing and inadequately analyzed.	Most elements are missing and are inadequately analyzed.	
Result Discussion	The results and conclusions are properly	Some of the results and	Most of the results and concluding	Results and Conclusions are missing	

Criteria (PLO) {Taxonomy}	Excellent (4)	Proficient (3)	Basic (2)	Below Basic (1)	Student's Score
and Conclusions (Communication x) {Evaluation C6}	discussed and explained	conclusions are missing	arguments are missing		
Visuals (Communication x) {Responding A2}	All the Graphs/tables/figures/pictures are adequate, well labeled and presented	Some of the Graphs/tables/figures/pictures are adequate and labelled	Most of the Graphs/tables/figures/pictures are inadequate.	All the Graphs/tables/figures/pictures are missing.	
References (Communication x) {Application C3}	References are extensively used and properly listed	References are extensively cited but are not properly listed.	Some references are cited but not listed.	References are not cited and listed	
Use Resources (Communication x) {Valuing A3}	Used proper resources including pages, covers, other resources etc.	Used proper pages but inadequate file cover	Used proper papers with no file cover	Neither used proper papers nor file cover	
Plagiarism (Ethics viii) {Guided Response P3}	Less than 10%	10-13%	13-16%	16-19%	

Comments: