Curriculum

for

Bachelor of Electronics Engineering Technology

Degree

(2023)

Higher Education Commission
Islamabad
Curriculum Division

Acronyms, Abbreviations & Definitions

Acronym/ Abbreviation	Definition
HEC	Higher Education Commission
NTC	National Technology Council
NCRC	National Curriculum Review Committee
IDEE	Integration of Data in Engineering Environment
IEA	International Engineering Alliance
IDTE	Inter Disciplinary Technology Elective
MATLAB	Matrix Laboratory
HEI	Higher Education Institution
RIC	Resistance, Inductance, Capacitance
IEEE	Institute of Electrical and Electronics Engineers
SIT	Supervised Industrial Training
LTI	Linear Time-Invariant System
BJT	Bipolar Junction Transistor
MOSFET	Metal–Oxide–Semiconductor Field-Effect Transistor
IGBT	Insulated-Gate Bipolar Transistor
Th	Theory
Lab	Laboratory
Cr. Hrs.	Credit Hours
PLO	Program Learning Outcome
CLO	Course Learning Outcome
ICT	Information and Communications Technology
CPU	Central Processing Unit
OSI	Open Systems Interconnection

LAN	Local Area Network
WAN	Wide Area Network
MAN	Metropolitan Area Network
RMS	Root Mean Square
ODEs/Diff.	Ordinary Differential Equations
PCB	Printed Circuit Board
DC	Direct Current
AC	Alternating Current
IDE	Integrated Development Environment
ALU	Arithmetic Logic Unit
IEEE	Institute of Electrical & Electronics Engineering
CAD	Computer Aided Design
LED	Light Emitter Diode
I/O	Input/Output
LTI	Linear Time-Invariant
PID	Proportional-Integral-Derivative
PLC	Programmable Logic Controller

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 intendedpackaging of competencies (i.e., knowledge, skills, and attitudes, underpinned by values) that learners should acquire through organized learning experiences.

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

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

2. Curriculum Development Methodology

2.1 Benchmarking

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

The course of studies clearly defines and differentiates the program from Electronics Engineering by contact hours spent in classrooms, laboratories, and 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).
- To run affairs smoothly, right at the start NCRC Members elect from among themselves a Coordinator, a co-Coordinator, and a Secretary to steer, control and record proceedings.
- Preliminary Meeting of NCRC spanning three days is held to establish framework and benchmarking issues and assign different facets of curriculum development to smaller teams within the NCRC.
- A draft of program curriculum is prepared by NCRC at the end of the Preliminary Meeting and sent to relevant foreign experts for review and feedback.
- After foreign expert's review, a Final NCRC Meeting lasting up to three days is held to finalize the recommendations and prepare final curriculum document.
- The entire cycle of curriculum development is completed in two months.

2.3 Historical Timeline of Meetings

Historical Timeline of meetings carried out in this context are enlisted below:

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

3. Curriculum Details

Bachelor of Electronics Engineering Technology Program			
Parameter	**HEC Framework**	**Framework - A (SIT in Semester 7 & 8)**	**Framework - B (SIT in Semester 8 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	27	31**
Non-Engineering Technology Domain Courses	13	15	15**
Total Credit Hours	124 – 136	131	131
Engineering Technology Domain Credit Hours	85	90	90
Percentage of Engineering Technology Domain Courses	74.42%	67.18%	67.18%
Percentage of Non-Engineering Technology Domain Courses	31.45%	32.82 %	32.82 %
Non-Engineering Technology Domain Credit Hours	39	41	41
No. of Credit Hours per Semester	15 – 18	15 – 18	15 – 18
** Optional Courses may be included for Framework B (SIT in Semester 8 only)			
1 credit hour: (1) 1 contact hour per week, for a minimum of 16 weeks for theory: (2) 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)	**Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
				As per Scheme ofStudies	**As per Framework**	**As per Scheme ofStudies**	**As per Framework**
Computing	Information and Communication Technology	1+1=2	1+3=4	4	6	3	3
	Computer Programming	0+1=1	0+3=3				
	Technical Drawing	0+1=1	0+3=3				
Electronics Engineering Technology (Foundation)	Linear Circuit Analysis	2+1=3	2+3=5	15	20	7	10
	Workshop Practices	0+1=1	0+3=3				
	Solid State Electronics	2+0=2	2+0=2				
	Electrical Network Analysis	2+1=3	2+3=5				
	Digital Electronics	1+1=2	1+3=4				
	Electronic Devices	2+1=3	2+3=5				
	Signals and Systems	0+1=1	0+3=3				
Electronics Engineering Technology (Breadth)	Instrumentations and Measurements	2+1=3	2+3=5	20	24	7	6
	Electrical Machines	2+1=3	2+3=5				
	Amplifiers and Oscillators	2+1=3	2+3=5				
	Microprocessors and Microcontrollers	2+1=3	2+3=5				
	Control Systems	2+1=3	2+3=5				
	Communication Systems	1+1=2	1+3=4				
	Power Electronics	2+1=3	2+3=5				
Electronics Engineering Technology (Depth)	Industrial Automations	1+1=2	1+3=4	21	14	9	5
	Industrial Electronics	2+1=3	2+3=5				
	VLSI Technology	2+1=3	2+3=5				
	Electronics Troubleshooting and Testing	0+2=2	0+6=6				
	Depth Elective-I	1+0=1	1+0=1				
	Depth Elective-II	1+0=1	1+0=1				
	Depth Elective-III	2+1=3	2+3=5				
	Depth Elective-IV	2+1=3	2+3=5				
	Depth Elective-V	2+1=3	2+3=5				

IDEE	IDTE-I	2+1=3	2+3=5	6	5	2	2
	IDTE-II	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)		103	32+136= 168	99-92		27-31	

Notes:
1- SIT of 16 Credit hours (40 Contact hours) is mandatory in 8th Semester and Optional in 7th Semester.
2- If SIT is opted in 7th Semester also, then Credit hours and Contact hours shall be 32 and 80, respectively.
3- The overall percentage calculations given above shall remain same for both options of SIT.

Non-Engineering Technology Domain Courses in

Recommended Schemes of Studies as per Framework

Knowledge Area	Sub-Area	Name of Course	Credit Hours (Th+Lab)	Contact Hours (Th+Lab)	Total Credit Hours		Number of Courses	
					As per Scheme of Studies	As per Framework	As per Scheme of Studies	As per Framework
Humanities and Social Sciences	English (Expository Writing)	Communication Skills	3+0=3	3+0=3	6	6	2	2
		Technical Report Writing	3+0=3	3+0=3				
	Culture	Islamic Studies / Social Ethics	3+0=3	3+0=3	6	6	2	2
		Pakistan Studies	3+0=3	3+0=3				
	Social Sciences Electives	Elective-I	3+0=3	3+0=3	9	9	3	3
		Elective-II	3+0=3	3+0=3				
		Elective-III	3+0=3	3+0=3				
Management Sciences	Management Sciences	Elective-I	3+0=3	3+0=3	8	6	3	3
		Elective-II	3+0=3	3+0=3				
		Elective-III	2+0=2	2+0=2				
Natural Sciences	Math (Quantitative Reasoning)	Calculus and Analytical Geometry	2+0=2	2+0=2	6	6	3	2
		Differential Equations	2+0=2	2+0=2				
		Linear Algebra	2+0=2	2+0=2				
	Physics	Applied Physics	3+1=4	3+3=6	4	4	1	1
	Elective-I	Natural Sciences Elective-I	3+1=4	3+3=6	4	4	1	1
Total Credit Hours and Courses (For Non-Engineering Technology Domain Courses) ** Optional Courses may be included for Framework B (SIT in Semester 8 only)					Cr. Hrs. **43/41**		Courses **15 /14**	

List of Elective Topics	
Social Sciences	**Management Sciences**
➢ Professional Ethics ➢ Sociology for Technologist ➢ Critical Thinking ➢ Organizational Behavior ➢ Professional Psychology and Human Behavior ➢ Elective Courses by HEI*	➢ Fundamentals of Economics ➢ Project Management ➢ Entrepreneurship ➢ Principles of Marketing ➢ Leadership and Personal Grooming ➢ Elective Courses by HEI*
Depth Courses*	**Natural Sciences**
➢ FPGA-based Technology ➢ Embedded Systems ➢ Integrated Circuits Fabrication ➢ Electromagnetic Field Theory ➢ Opto-Electronic Devices ➢ Microwave Electronics ➢ Computer Architecture ➢ Robotics Technology ➢ Digital Signal processing ➢ Renewable Energy ➢ Nanotechnology ➢ Elective Courses by HEI*	➢ Numerical Analysis ➢ Elective Courses by HEI*
*Any related course can be included with approval of the HEI's Statutory Bodies (maximum: 3 courses per elective knowledge area)	

4. Admission Criteria

Criteria for admission in Bachelor of Electronics Engineering Technology program is defined in NTC's Accreditation Manual, Clause 3.2.4.1. Salient features for eligibility for admission are:

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

Weighted average score for admission is calculated by:

- 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 Electronics Engineering Technology program spanning 4 years, spread over 8 semesters, and encompassing 129 credit hours is presented below:

SEMESTER I				
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	**Contact Hrs. (Th+Lab)**
ECH-111	Communication Skills	Humanities	3+0	3+0
ECN -111	Calculus and Analytical Geometry	Natural Sciences	2+0	2+0
ECH-112 ECH-113	Islamic Studies / Social Ethics	Humanities	3+0	3+0
ECN-112	Applied Physics	Natural Sciences	3+1	3+3
ECC-111	Information and Communication Technology	Computing	1+1	1+3
ECT-111	Workshop Practices	Foundation	0+1	0+3
	Subtotal		**12+3=15**	**12+9=21**
SEMESTER-II				
ECT-121	Linear Circuit Analysis	Foundation	2+1	2+3
ECN-121	Differential Equations	Natural Sciences	2+0	2+0
ECH-121	Pakistan Studies	Humanities	3+0	3+0
ECT-122	Solid State Electronics	Foundation	2+0	2+0
ECC-121	Computer Programing	Computing	0+1	0+3
ECM-121	Management Sciences Elective-I	Management Sciences	3+0	3+0
ECS-121	Social Sciences Elective-I	Social Sciences	3+0	3+0
	Subtotal		**15+2=17**	**15+6=21**

SEMESTER-III				
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	**Contact Hrs. (Th+Lab)**
ECT-211	Electrical Network Analysis	Foundation	2+1	2+3
ECN-211	Linear Algebra	Natural Sciences	2+0	2+0
ECT-212	Digital Electronics	Foundation	1+1	1+3
ECS-212	Social Sciences Elective-II	Social Sciences	3+0	3+0
ECC-211	Technical Drawing	Computing	0+1	0+3
ECT-213	Electronic Devices	Foundation	2+1	2+3
ECI-211	IDTE-I	IDTE	2+1	2+3
	Subtotal		**12+5=17**	**12+15=27**
SEMESTER-IV				
ECT-221	Electrical Machines	Breadth	2+1	2+3
ECH-221	Technical Report Writing	Humanities	3+0	3+0
ECT-222	Instrumentations and Measurements	Breadth	2+1	2+3
ECT-223	Amplifiers and Oscillators	Breadth	2+1	2+3
ECT-224	Microprocessors and Microcontrollers	Breadth	2+1	2+3
ECT-225	Signal and Systems	Foundation	0+1	0+3
	Subtotal		**11+5 =16**	**11+15=26**

SEMESTER-V				
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	**Contact Hrs. (Th+Lab)**
ECT-311	Communication Systems	Breadth	1+1	1+3
ECT-312	Control Systems	Breadth	2+1	2+3
ECN-311	Numerical Analysis (Elective-1)	Natural Sciences	3+1	3+3
ECM-311	Management Sciences Elective-II	Management Sciences	3+0	3+0
ECT-312	Industrial Electronics	Depth	2+1	2+3
ECT-313	Project-I	Project	0+3	0+9
	Subtotal		**11+7 =18**	**11+21=32**
SEMESTER-VI				
ECT-321	Power Electronics	Breadth	2+1	2+3
ECT-322	Industrial Automation	Depth	1+1	1+3
ECT-323	VLSI Technology	Depth	2+1	2+3
ECT-324	Elective-I	Depth	1+0	1+0
ECT-325	Elective-II	Depth	1+0	1+0
ECS-321	Social Sciences Elective-III	Social Sciences	3+0	3+0
ECT-326	Project-II	Project	0+3	0+9
	Subtotal		**10+6 =16**	**10+18=28**

SEMESTER-VII				
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	**Contact Hrs. (Th+Lab)**
ECT-411	**Supervised Industrial Training (Optional)**	**Electronics Engineering Technology Domain Industrial Training**	**16**	**40 (per Week)**
ECM-411	Management Sciences Elective-III	Management Sciences	2+0	2+0
ECT-412	Elective-III	Depth	2+1	2+3
ECT-413	Elective-IV	Depth	2+1	2+3
ECT-414	Elective-V	Depth	2+1	2+3
ECT-415	Electronics Troubleshooting and Testing	Depth	0+2	0+6
ECI-411	IDTE-II	IDTE	2+1	2+3
	Subtotal		**10+6=16**	**10+18=28 /40**
SEMESTER-VIII				
ECT-421	**Supervised Industrial Training (Compulsory)**	**Electronics Engineering Technology Domain Industrial Training**	**16**	**40 (Per Week)**
	Subtotal		**0+16= 16**	**0+40= 40**
Total Credit Hours & Contact Hours in Four Years (When SIT conducted in both 7th and 8th Semesters)			**147**	**263**
Theory vs Practical with respect to Contact Hours			Theory Practical	(35.85%) (64.14%)
Total Credit Hours & Contact Hours in Four Years (When optional courses conducted instead of SIT in 7th Semester)			**131**	**223**
Theory vs Practical with respect to Contact Hours			Theory Practical	(37.00%) (63%)

6. Course Codes

Details pertinent to course codes 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 2 semesters per year, Spring and Fall (with possible inclusion of Summer Semester).

Digits in course-codes are defined in table below:

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

Letters in course-code prefix are defined below:

- First two letters pertain to the program (e.g., EC for Electronics)
- Third letter pertains to specifics of the course (e.g., T for technology, E for expositorywriting etc.)

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

7. Elective Courses

The lists of elective courses – grouped across depth categories – are presented below:

Elective Depth Courses				
Course Code	**Title**	**Knowledge Area**	**Credit Hrs.**	**Contact Hrs.**
ECT-324	Integrated Circuits Fabrication	Depth Elective-I	1+0	1+0
ECT-325	Electromagnetic Field Theory	Depth Elective-I	1+0	1+0
ECT-326	Nanotechnology	Depth Elective-II	1+0	1+0
ECT-327	FPGA-based Technology	Depth Elective-II	1+0	1+0
ECT-411	Embedded Systems	Depth Elective-III	2+1	2+3
ECT-412	Opto-Electronic Devices	Depth Elective-III	2+1	2+3
ECT-413	Microwave Electronics	Depth Elective-IV	2+1	2+3
ECT-414	Computer Architecture	Depth Elective-IV	2+1	2+3
ECT-415	Robotics Technology	Depth Elective-V	2+1	2+3
ECT-416	Digital Signal processing	Depth Elective-V	2+1	2+3
ECT-417	Renewable Energy	Depth Elective-V	2+1	2+3

8. Course Contents

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

Program Learning Objectives (PLO's), Course Learning Objectives (CLO's) and Bloom's Taxonomy levels are expected learning outcomes and are aligned to standards set by the Sydney Accord andthe International Engineering Alliance.

Course Content

8.1 Communication Skills

COURSE TITLE (ECH-111) **Communication Skills**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Humanities**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Acknowledge** the importance and basic concepts of communications.	A-1	10
CLO-2	**Identify** common errors usually made by the Learners of English as second language.	A-2	10
CLO-3	**Communicate** effectively in technical writing and presentation, using basic-to-intermediate level English while developing the understanding of essentials of communication skills.	A-3	10

Course Outline for Theory

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

Recommended Books

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

Course Content

8.2 Calculus and Analytical Geometry

COURSE TITLE (ECN-111) **Calculus and Analytical Geometry**	**CREDIT HOURS** (2+0) **32 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Natural Sciences**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the ideas of rate of change, derivatives and it basic Applications.	C-2	1
CLO-2	**Apply** the techniques of integration for solving and analyzing problems in integral calculus.	C-3	2
CLO-3	**Describe** the vector calculus and analytical geometry in multiple dimensions for investigation of different engineering problems.	C-2	2

Course Outline for Theory

Definition of derivatives: differentiation of different function, rule of differentiation, chain rule implicit differentiation
Applications: slope, equation of tangent and normal. maxima, minima and point of inflection Indefinite integral, different technique for integration i.e., integration by parts, integration by substitution, by partial fraction, integration of different trigonometric identity
Definition of definite integrals: 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.
Vectors in space: vector calculus, divergence, curl of vector field, directional derivatives, multivariable functions, partial derivatives, spherical, polar, cylindrical coordinates
Vectors in plane: Dot product and cross products, line, and plane in space.
*Application*s: 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 Ed. (or Latest Edition)
3. G. B. Thomas, A. R. Finney, "Calculus", 14th Ed. (or Latest Edition), Pearson Publisher
4. S.M Yousaf, "Calculus and Analytic Geometry" (or Latest Edition)
5. Advanced Engineering Mathematics by Erwin Kreyszig, (Latest Edition) Willey

Course Content

8.3 Islamic Studies/Social Ethics

COURSE TITLE (ECH-112) (ECH-113) **Islamic Studies/Social Ethics**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Humanities**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Recite** from the Holy Qur'an with correct pronunciation.	C-1	12
CLO-2	**Apply** understanding of basic concepts of teaching of Islam (faith, pillars, dawat, preaching and seerat).	C-3	12
CLO-3	**Understand** compilation of the Holy Quran and basic concepts of Hadith.	A-2	12
CLO-4	**Present** Islam as a complete code of life.	A-3	8

Course Outline for Theory

History of Islam: Compilation of the Holy Quran and Hadith, fundamental doctrine 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, importance of peace and causes of terrorism.
Khutba Hajjatul Wida (last Address of the Holy Prophet Peace be upon him): Seeratun-Nabi (Peace Be upon him).
Life of Holy Prophet (Peace Be upon him): The life of the Holy prophet before and after prophet hood. The Hijra (Migration to Madina), Treaty of Al madina, Makki and Madani

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 Qur'an and Sunnah, relevant verses of the Holy Quran about technology (Baqara 28,30,33,201, Nahal:76, Jasia: 13, Araf: 32, Noor: 55 etc), Islamic and scientific knowledge.

Recommended Books

1. A guidebook for Muslims by Syed. Abul Hasan Ali Nadvi. (Latest Edition)
2. An Introduction to Islam by Dr. Muhammad Hameedullah. (Latest Edition)
3. What is Islam by Maulana Manzoor Nomani. (Latest Edition)
4. Islamiat (A standard book for CSS), Prof. Dr. Arif Naseem. (Latest Edition)
5. Islamiat for Students O levels, Farkhanda Noor Muhammad. (Latest Edition)

Course Content

8.4 Applied Physics

COURSE TITLE (ECN-111) **Applied Physics**	**CREDIT HOURS** (3+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Natural Sciences**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** fundamental physical principles.	C2	1
CLO-2	**Apply** these principles, together with logical and mathematical reasoning, to situations of the physical world.	C3	2
CLO-3	**Analyze** different physical problems using the laws of physics.	C4	2
CLO-4	**Identify** knowledge of constructing basic circuits and demonstration of relevant theorems using Resistors and Capacitors.	P1	2
CLO-5	**Differentiate** classroom knowledge and laboratory techniques for learning of basic principle used in magnetism.	P1	1

Course Outline for Theory

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

Course Outline for Lab

- Investigate the properties of series combination of Capacitors
- Determine the given resistance by leakage method using ballistic Galvanometer
- Study the variation of Photoelectric current with intensity of incident beam
- Determine the temperature coefficient of resistance of coil by wheat stone bridge
- Study Ohm's law
- Investigate the properties of Series Combination of Resistances
- Investigate the properties of Parallel combination of Resistances
- Practical Demonstration of Ampere Law
- Practical Demonstration of Faraday Law
- Demonstrate the function of transformer as Step Up and Step-Down Transformer
- Any other contents relevant to the theory course outlines

Recommended Books
1. Halliday, Resnick and Walker, “Fundamentals of Physics” (Latest Edition) 2. Hugh D. Young and R.A. Freedman, University Physics. (Latest Edition) 3. Raymond A Serway and John W. Jawett, Jr. Physics for Scientists and Engineers with modern Physics, (Latest Edition) 4. Fundamentals of Electromagnetic Phenomenon by D. Corson & Lorrain. (Latest Edition)

Course Content

8.5 Information and Communication Technology

COURSE TITLE (ECC-111) **Information and Communication Technology**	**CREDIT HOURS** (1+1) **16 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Computing**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** the working of computer hardware and software.	C1	1
CLO-2	**Compare** problem solving skills and develop small scale computer programs.	C2	1
CLO-3	**Use** the concepts of data communication and networks.	C3	1
CLO-4	**Explain** the working of hardware components of computer.	P2	1
CLO-5	**Follow** typing speed and develop office application skills.	P3	1
CLO-6	**Express** problem-solving skills by developing computer programs.	C2	3

Course Outline for Theory

Introducing Computer Systems: Basic Definitions, Computer and Communication Technology, the applications of ICT - particularly for engineering technology
Basic Operations and Components of a Generic Computer System: Basic operations: Input, Processing, output, storage Basic components: Hardware, Software, Data, Users, types of storage devices
Processing Data: Transforming data into information, how computers represent and process data, Processing Devices, CPU architectures
The Internet: The Internet and the World Wide Web- browsers, HTML, URLs/ How DNS works, Email and other programs
Introduction to Embedded Systems: What is an Embedded System, Applications, Components, Programming Languages, Popular Development Platforms.
Networking Basics: Uses of networks, Common types of networks (LAN, WAN, MAN etc.), Introduction to OSI Model, Future of Networks
Database Management: Hierarchy of Data, Maintaining Data, Database Management Systems
Exposure to ICT Tools and Blogs (Student Assignment)
Protecting your privacy, your computer and your data: Basic Security Concepts, threats to users, threats to hardware, threats to Data

Course Outline for Lab

- Introduction to basics of internet e.g., using search engines, using Wikipedia, checking your Email
- Personal computer components, inside the CPU
- Introduction to typing tutors, typing practice. Introduction to MS word
- Introduction to MS Power point, MS Excel
- Introduction to HTML, HTML codes, Writing small HTML codes
- Introduction to web designing, Introduction to programming languages
- Any other contents relevant to the theory course outlines

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

COURSE TITLE (ECT-111) **Workshop Practices**	**CREDIT HOURS** (0+1) **0 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Foundation**

	After completion of this course students will be able to:	**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Display** the use of safety equipment during workshop practice.	P2	7
CLO-2	**Participation** in workshop activities individually as well as in a group.	A2	9

Course Outline for Lab

- Use of carpenter's tools
- Exercise in preparing simple joints
- Bench fitting practice
- Exercise in marking and fittings
- Smith's forge
- Exercise in bending, Upsetting, and swaging
- Introduction to various technical facilities in the workshop including mechanical and electrical equipment 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
- Electric soldering and soldering tools, Soldering methods and skills
- PCB designing, transferring a circuit to PCB, etching, drilling, and soldering component on PCB testing.

Recommended Books

1. S. K. Choudhury, "Elements of Workshop Technology", Latest Edition.
2. Chapman, "Workshop Technology", Latest Edition

Course Content

8.7 Linear Circuit Analysis

COURSE TITLE (ECT-121) **Linear Circuits Analysis**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Foundation**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** circuit reduction techniques, source conversions and circuit solving techniques.	C2	2
CLO-2	**Explain** the basics of mathematics & electrical engineering.	C1	1
CLO-3	**Solve** basic electronic circuits involving active, passive and semiconductor devices.	C3	4
CLO-4	**Identify** and troubleshoot response of basic electrical components in various configurations, through basic electrical circuits laws and theorems.	P1	9
CLO-5	**Perform** experiments in laboratory, interpret experimental data and observe its conformance with analyzed results of circuits.	P2	12

Course Outline for Theory

Electrical elements and circuits: Resistance, inductance, and capacitance. Difference between AC and DC.
Laws of resistances: Ohm's law, Kirchhoff's laws, circuits containing resistance, capacitance, and inductance. Series and parallel circuits employing resistances, capacitors, and inductors. Circuit analysis techniques, Mesh/Loop analysis. Nodal analysis of circuits with DC source. Idea and real current/voltage source. Network theorems employing Thevenin and Norton theorem. Principle of superposition. Reciprocity and maximum power transfer theorem.

Course Outline for Lab

- Learn the use of basic instruments in electrical i.e., function generators power supplies, oscilloscopes.
- Design and implement circuits using different laws verify the node voltages and loop currents using instruments. Verify Circuit-theorems using lab instruments.
- Verify circuit transformations using lab instruments broadly defined Engineering Technology Problems.

Recommended Books

1. Charles Alexander and M Sadiku, "Fundamentals of Electric Circuits", McGraw- Hill, Latest Edition.
2. S. Franco, "Electric Circuits Fundamentals", Oxford University Press, Latest Edition.
3. R.E Thomas, Rosa & G. Toussaint, "The Analysis & Design of Linear Circuits" John Wiley, Latest Edition.
4. J D Irwin and R M Nelms, "Basic Engineering Circuit Analysis", Wiley, Latest Edition.
5. W Hayt, J Kemberly and S Durbin, "Engineering Circuit Analysis", McGraw- Hill, Latest Edition.

Course Content

8.8 Differential Equations

COURSE TITLE (ECN-121) **Differential Equations**	**CREDIT HOURS** (2+0) **32 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Natural Sciences**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Have** knowledge of differential equations, solutions of first and higher orders homogenous and non-homogenous differential equations by appropriate methods.	C-2	1
CLO-2	**Solve** linear differential equations using the Laplace Transform technique and power series methods.	C-4	1

Course Outline for Theory

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

Recommended Books

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

Course Content

8.9 Pakistan Studies

COURSE TITLE (ECH-121) **Pakistan Studies**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Humanities**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the difference between ideological and non-ideological states.	A-1	12
CLO-2	**Discuss** Pakistan Movement, and political and constitutional history of Pakistan.	A-3	8
CLO-3	**Understand** current issues of Pakistan, and their cause and solutions.	A-4	12

Course Outline for Theory

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

Recommended Books

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

Course Content

8.10 Solid State Electronics

COURSE TITLE (ECT-121) **Solid State Electronics**	**CREDIT HOURS** (2+0) **32 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Foundation**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Know** the general concepts of Solid-State Physics.	C1	1
CLO-2	**Compare** the different application of semi-conductor devices to develop the sustainable solutions.	C2	7
CLO-3	**Construct** circuits with semiconductor devices to design solutions for societal problems.	C3	3

Course Outline for Theory

Understand the differences between metals, insulators, and semiconductors and origin of their properties based on the crystal structures of materials, intrinsic and extrinsic semiconductors, and role of doping in engineering the properties of semiconductor structures. Understand the fabrication process of silicon wafers, starting from silica. Generation and recombination of charge carriers in semiconductors under electrical, optical, and thermal excitation, and transport of these carriers under an electric field. Formation of p-n junctions, p-n junction devices, fabrication, electrical characteristics, and their wide range of applications as diodes, LEDs, and solar cells. Metal-semiconductor contacts resulting in ohmic vs. Schottky (rectifying) junctions.

Recommended Books

1. B.G. Streetman, S.K. Banerjee "Solid State Electronic Devices", 7th edition, Pearson (2015)
2. M. Razeghi, Fundamentals of Solid-State Engineering, 3rd ed., Springer, 2009.

Course Content

8.11 Computer Programming

COURSE TITLE (ECC-121) **Computer Programming**	**CREDIT HOURS** (0+1) **0 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Computing**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Use** C++ to analyze and solve problems in effective way.	C-3	2
CLO-2	**Illustrate** the use of Integrated Development Environment (IDE), especially Code Blocks for writing and compiling programs.	P-2	1
CLO-3	**Write** and compile simple programs, and remove errors.	P-3	2

Course Outline for Lab

- Introduction to C++
- Data Types and Operators
- Arithmetic Operations
- Repetitive Statements/Loops, Functions, Iteration (for Loop, While, Do-While), Iteration (Do-While)
- Recursion, File Handling
- Structures Arrays- One Dimensional
- Sorting Algorithms
- Arrays – Two Dimensional
- Strings, Pointers
- Open ended Lab

Recommended Books

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

Course Content

8.12 Technology Economics & Management

COURSE TITLE (ECM-121) **Technology Economics & Management**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Management Sciences**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Estimate** the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value.	C-2	12
CLO-2	**Predict** cost effectiveness of individual projects and effects of inflation on economic analysis of engineering projects.	C-3	6
CLO-3	**Use** appropriate engineering economics analysis method(s) for problem solving i.e., present worth, annual cost, rate of return, payback period, break-even price, cost-benefit ratio.	C-4	12

Course Outline for Theory

Basic concepts, technological economy defined, types of business organizations, financial statements and financial ratios, time value of money, cash flow series and its types, basic cost concepts. Profit and interest, discrete and continuous compounding, nominal and effective interest rate. Economic analysis of alternatives: Alternatives having identical lives: Alternatives having different lives, PW, AW, FW, cost-benefit analysis and rate of return analysis, break-even and payback analysis. Use of spreadsheet for economic analysis, economic effects of inflation. Replacement and retention decisions, depreciation, amortization, and depletion of economic resources. Price, supply and demand relationship. Project financing. Factors of production, capital budgeting, and economic analysis in the service sector.

Recommended Books

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

Course Content

8.13 Organizational Behavior

COURSE TITLE (ECS-121) **Organizational Behaviours**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Social Sciences**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** organizational behaviour and the impact of organizational culture on individuals and the workplace.	A-1	9
CLO-2	**Explain** group dynamics within organizations, impact of diversity on the workplace, and strategies to manage groups and teams.	A-3	9
CLO-3	**Discuss** theories of motivations, importance of managing stress and emotions, and strategies to manage change and improve motivation in the workplace.	A-2	9

Course Outline for Theory

Overview, Introduction to the field of organizational behaviour, motivation, individual and group behaviour, personality and values, perceiving ourselves and others in organizations, workplace emotions, attitudes, and stress foundations of employee motivation, applied performance practices, decision making and creativity, team dynamics, communicating in organizations, power and politics in the workplace, conflict and negotiation in the workplace, leadership in organizational settings, designing organizational structure, organizational culture, organizational change and development.

Recommended Books

1. Canadian Organizational Behaviour 9th Edition. McShane, Steven L. & Sheen, Sandra L. McGraw Hill Ryerson, 2014, (or Latest Edition)
2. Organizational Behaviour, 15th edition, by Robbins & Judge, Prentice-Hall Publishing, (or Latest Edition)
3. Luthan Fred, (2005), Organizational Behaviour, McGraw Hill Inc, (or Latest Edition)
4. Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.
5. Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3rd Oxford, (or Latest Edition)

Course Content

8.14 Electrical Network Analysis

COURSE TITLE (ECT-211) **Electrical Network**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN Foundation**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the behavior of complex electrical networks.	C2	1
CLO-2	**Apply** differential equations and Laplace Transform to solve electrical networks.	C3	2
CLO-3	**Analyze** the RLC circuits to develop sustainable solutions.	C4	7
CLO-4	**Demonstrate** the basic principles of AC circuit analysis using lab equipment adhering to ethical values.	P4	8
CLO-5	**Imitate** the AC network response using SPICE software for lifelong learning.	P3	12

Course Outline for Theory

Current and voltage transients, RLC circuits with DC and AC excitation, resonant circuit: series and parallel resonance in AC circuit, Q-Factor, self and mutual inductances, introduction to phasor representation of alternating voltage and current, star-delta transformation for AC circuits, phase sequence, vector diagrams of three phase networks, power in three phase circuits, impedance, and power triangles. Two-port networks and their interconnections. Application of Laplace transform in circuit analysis and introduction to difference equations

Course Outline for Lab

- Learn the use of basic instruments Design and implement RLC circuits and observe resonance and impedance characteristics.
- Verify the node voltages and loop currents in RLC circuits using.
- Verify Circuit-theorems using lab instruments.
- Verify circuit transformations using lab instruments.
- Learn the use of Circuit Simulation computer package such as SPICE.
- Observe transient and steady state response in RL, RC and RLC circuits using SPICE.

Recommended Books

1. M. E. Van Valkenburg, "Network Analysis", Pearson, Edition 3rd, 2006
2. S. Franco, "Electric Circuits Fundamentals", Oxford University Press, (Latest edition).
3. C. Alexander and M. Sadiku, "Fundamentals of Electric Circuits", McGraw Hill, 4th Edition, 2008
4. RE Thomas, Rosa & G. Toussaint, "The Analysis & Design of Linear Circuits" John Wiley, Latest Edition.
5. J D Irwin and R M Nelms, "Basic Engineering Circuit Analysis", Wiley, Latest Edition

Course Content

8.15 Linear Algebra

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

Course Outline for Theory

Algebra of matrices; inverse of a matrix; Gauss-Jordan method for the solution of a system of linear algebraic equations; vectors in the plane and in three dimensions; vector spaces; subspaces; span and linear independence; basis and dimension; homogeneous systems; coordinates and isomorphism; rank of a matrix; determinant; inverse of a matrix; applications of determinants; determinants from a computational point of view; properties of determinants; eigenvalues and eigenvectors; systems of linear differential equations; diagonalization; Hermitian matrices; singular value decomposition; quadratic forms; positive definite matrices; non-negative matrices; floating-point numbers; Gaussian elimination; pivoting strategies; matrix norms and condition numbers; orthogonal transformations; eigenvalue problem; least square problems, Vectors in 2-Space and 3-Space, Inner Product (Dot Product) Vector Product (Cross Product), Vector and Scalar Functions and Their Fields.

Recommended Books

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

Course Content

8.16 Digital Electronics

COURSE TITLE (ECT-212) **Digital Electronics**	**CREDIT HOURS** (1+1) **16 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Foundation**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** fundamental concepts of digital system, Boolean functions, and techniques for simplification of functions.	C2	1
CLO-2	**Analyze** the working of combinational and sequential logic circuits using digital logic principles and Boolean algebra.	C4	2
CLO-3	**Apply** the principles of digital system to design solutions for Broadly Defined Problems.	C3	3
CLO-4	**Execute** small-scale digital circuit using Boolean algebra and K-maps for sustainable solutions.	P4	7
CLO-5	**Justify** results of experiments in the form of well-written manuals and reports.	A3	9

Course Outline for Theory

Number Systems, Complement, Boolean Algebra, Logic Simplification, K-Map, Universal Gate, Combinational Logic, Sequential Logic, Latches, Flip-Flops (SR, JK, data and toggle) and their applications. Adders (half adder and full adder), Multiplexers and Demultiplexers, Counters (synchronous and asynchronous), Shift Registers (left and right registers), and simple Arithmetic Logic Unit (ALU).

Course Outline for Lab

- Basic logic gates
- Hardware implementation of combinational logic circuits such as multiplexers and demultiplexers, encoders/decoders
- Implementation of sequential circuits such as flip-flops, registers, shift registers, counters, and other digital circuits.

Recommended Books

1. Morris Mano and Charles R. Kime, "Logic and Computer Design Fundamentals", Prentice Hall
2. Tocci and Widmer, "Digital Systems: Principles and Applications".

Course Content

8.17 Professional Ethics

COURSE TITLE (ECS-212) **Professional Ethics**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Social Sciences**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Comprehend** the basic concepts of a profession, professional ethics, various moral and social issues, importance of values and professional ethics in personal life and professional career, and consequences of acting unethically in organization and society.	C-1	8
CLO-2	**Apply** acquired knowledge in various roles with ethical principles at various professional levels.	A-3	8
CLO-3	**Resolve** the ethical dilemmas using common ethical values and identify possible actions to be taken in response.	A-5	8

Course Outline for Theory

Introduction: Introduction to ethics, personal and professional ethics, the nature of engineering ethics; legal, professional, and historical definitions; origin of professional ethics, profession, and professionalism; professional accountability, professional success, professional risks, professional associations; benefits of acting ethically and consequences of acting unethically.

Value of Ethics: Values in professional ethics, central responsibility of engineering technology professionals, ethics in different fields of work, IEEE code of ethics, ethical code for engineering 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 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

8.18 Technical Drawing

COURSE TITLE (ECC-211) **Technical Drawing**	**CREDIT HOURS** (0+1) **0 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Computing**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Recognize** basic tools and shapes of Engineering Drawing.	C-1	1
CLO-2	**Understand** Engineering Drawing tools and use its principles to represent engineering drawing models.	C-2	1
CLO-3	**Practice** Engineering Drawing principles to draw 2-D & 3D sketches using modern tools.	P-3	5

Course Outline for Lab

Mechanical Drawing: Sheet layout, free hand sketching, basic drafting techniques, drawing and lettering, dimensioning, projections and section of solids, practice of assembly drawing.
Civil Drawing: Plans, Elevations and Sections
Electrical Drawing: Electrical safety drawings, electric substation equipment layout, schematic diagrams of substations, lighting, and power distribution boards in contrast with house and industrial wiring diagrams, electrical symbols and one-line diagrams of a typical power system and its parts using all details, 2D modelling using AutoCAD, layering using AutoCAD, 3D Wireframe modelling in AutoCAD, 3D Solid modelling in AutoCAD, Helical Spring using AutoCAD, 3D Surface modeling, Open Ended Lab

Recommended Books

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

Course Content

8.19 Electronic Devices

COURSE TITLE (ECT-213) **Electronic Devices**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN Foundation**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** structure and operation of electronic devices, particularly Diodes, Bipolar Junction Transistors (BJTs), and Field-Effect Transistors (FETs).	C2	1
CLO-2	**Solve** basic electrical circuits containing Diodes, BJTs and FETs.	C3	2
CLO-3	**Investigate** the circuits containing semiconductor device to develop solutions for societal problems.	C4	6
CLO-4	**Practice** in the lab using semiconductor devices to develop sustainable solutions.	P3	7
CLO-5	**Demonstrate** the results of experiments in the form of well-written manuals and reports.	A3	9

Course Outline for Theory

Physics of semiconductor, concept of Doping, formation of P & N type semiconductor, PN junction formation, Drift & diffusion currents, Diode Characteristics curve, resistances in Diode, Ideal & practical Models, Q-point, Diode as Half wave & Full wave Rectifier, Diode Switching Circuit, introduction to Clippers, Clippers Circuits, Clampers Circuits, Bipolar Junction Transistors, Common Base Characteristics, Common Emitter Characteristics, Common collector Characteristics, Bias Circuits, BJT as inverter, Transistor types, rating & specification, Zener Diode, LED, Laser Diode, Photo & tunnel Diode, Field Effect Transistors, JFET, JFET current source, JFET Analog switch, JFET Biasing, JFET as Analog switch, Chopper, MOSFET types & configuration, Amplifier fundamentals

Course Outline for Lab

- Investigate the electrical characteristics of Diodes BJT and FET.
- Design, implementation, and measurements of electronic circuits for rectifiers
- Zener diode regulators
- Biasing in BJT and FET
- Small signal amplifiers in BJT and FET
- Operational amplifiers using lab equipment and computer simulation tools.

Recommended Books

1. Behzad Razavi, "Fundamentals of Microelectronics", Latest Edition
2. Theodore F. Bogart, Jeffrey S. Beasley, Guillermo Rico, "Electronic devices and circuits" ,6th Edition
3. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", Oxford University Press, Latest Edition.

Course Content

8.20 Inter Disciplinary Technology Elective

COURSE TITLE (ECI-211) **As per HEI resources and offered programs**	CREDIT HOURS (2+1) **32 Theory + 16 Lab Sessions**	KNOWLEDGE AREA/DOMAIN **IDTE**
The course (with outline, CLO's etc.) to be offered by HEI from amongst the list of elective courses defined in this Curriculum. The HEI must ensure adequacy of academic and other resources for the course.		

Course Content

8.21 Electrical Machines

COURSE TITLE (ECT-221) **Electrical Machines**	CREDIT HOURS (2+1) **32 Theory + 16 Lab Sessions**	KNOWLEDGE AREA/ DOMAIN **Breadth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** the working principles/basic laws and operation of various electrical machines like transformers, AC & DC motors, and generators.	C-1	1
CLO-2	**Understand** the electrical machines to sketch their equivalent circuits, phasor diagrams, rotating magnetic fields and the relationships between different parameters.	C-2	2
CLO-3	**Illustrate** the voltage regulation, losses, and efficiency of various electrical machines.	C-3	3
CLO-4	**Simulate** different electrical machines using software.	P-3	5
CLO-5	**Work** effectively as an individual or in group for performing different laboratory experiment.	A-3	9
CLO-6	**Report** effectively the laboratory work including procedures, results and conclusion of experiments**.**	P-4	10

Course Outline for Theory

Magnetic Circuits and Calculations. Linear DC machines. Transformers: Principle of Operation, Construction, Types, Instrumentation Transformers. DC Machines: Construction, Types, Armature Reaction, Torque Speed Characteristics, Measurement of Losses and Efficiency. AC Machines: AC Machine Armature Winding, Induced EMF. Synchronous Generator. Special Purpose Motors, Introduction to Brushless DC Motor. Switched-Reluctance Motor. Stepper Motor.

Course Outline for Lab

- Safety precaution in performance and operation of experiments
- To identify and study main parts of a DC machine
- Different Types of Connections in Dc Generators
- O.C.C of Separately Excited Dc Generator
- External characteristics of Separately Excited Dc Generator
- Characteristics of DC shunt motor
- Plotting Graph of Torque Speed Curve of a Shunt DC motor using MATLAB
- Plotting Graph of Speed(n) Vs Field Resistance (RF) of a Shunt DC Motor
- Plotting Graph of Torque Speed Curve of a Shunt DC motor using MATLAB

Recommended Books

1. Stephen J. Chapman, "Electric Machinery Fundamentals", McGraw-Hill. (Latest Edition)
2. Fitzgerald, Kingsley, and Umans, "Electric Machinery", McGraw-Hill. (Latest Edition)

Course Content

8.22 Technical Report Writing

COURSE TITLE (ECH-221) **Technical Report Writing**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Humanities**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** the basic concepts in technical writing and use of a standard word processing software along with referencing tool for report writing.	A-2	10
CLO-2	**Initiate** technically correct statements, assignments, final year project report, project proposal, short reports, research paper and business/ professional correspondence.	A-3	10

Course Outline for Theory

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

Recommended Books

1. Technical Report Writing Today, by Daniel Riordan, 10th Edition (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 Glasman-Deal, Imperial College Press. (Latest Edition)

Course Content

8.23 Instrumentations and Measurements

COURSE TITLE (ECT-222) **Instrumentations and Measurements**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Breadth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the fundamentals of instrumentation and measurement systems.	C-2	1
CLO-2	**Apply** the principles of measurement techniques for practical scenarios and various operations.	C-3	2
CLO-3	**Apply** different types of bridges for measurement of resistance inductance, and capacitance.	C-3	3
CLO-4	**List** the technology trends in the field of measurement and instrumentation.	C-1	12
CLO-5	**Operate** different modern instruments for measurement of electrical quantities.	P-3	5
CLO-6	**Report** effectively the laboratory work including procedures, results, and conclusion of experiments **.**	P-4	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; systems for signal processing and signal transmission. Modern instrumentation techniques; static and dynamic responses of instrumentation and signal conditioning; basic data manipulation skills using personal computers and graphs; data acquisition systems. Principles of operation, construction and working of different analog and digital meters, oscilloscope, recording instruments, signal 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.

Course Outline for Lab

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

Recommended Books

1. Klaas B. Klaassen and Steve Gee, "Electronic Measurement and Instrumentation," Cambridge University Press, 1996, ISBN: 0521477298.
2. David A. Bell "Electronic Instrumentation and Measurements", 3rd Edition.

Course Content

8.24 Amplifiers and Oscillators

COURSE TITLE (ECT-223) **Amplifiers and Oscillators**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Breadth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the operation and applications of various classes of amplifiers, multistage amplifiers, power amplifiers and oscillators.	C-2	1
CLO-2	**Analyze** the various amplifiers circuits to determine voltage/current gains, input/output impedance, efficiency/losses, loading effects.	C-4	2
CLO-3	**Design** the typical multistage amplifiers and oscillators.	C-6	3
CLO-4	**Evaluate** the performance of amplifiers and oscillators in laboratory.	P-4	4
CLO-5	**Report** effectively the laboratory work including procedures, results, and conclusion of experiments**.**	P-4	10
CLO-6	**Apply** the basic design principles to manage the lab project.	A-4	11

Course Outline for Theory

Classification of Amplifiers based on Biasing, Class A Amplifier, Class B Amplifier, Class AB Amplifier, Class C Amplifier. Push-Pull Amplifier, and Complementary Symmetry Amplifier; Classification of Amplifiers Voltage. Feedback Amplifier, Current Feedback Amplifier, Effect of Feedback on Frequency Response. Practical Amplifier Considerations: Input and Output Impedance, Amplifier Loading, Impedance Matching. Oscillators: Basic Theory, Tank Circuit, Damped and Un-damped Oscillations.

Course Outline for Lab

- Introduction to development of all types of Amplifiers.
- Implementation of amplifiers to different applications.
- Introduction to development of all types of Oscillators.
- Implementation of Oscillators to different applications.

Recommended Books

1. Thomas Floyd, (2009) "Electronics Fundamentals: Circuits, Devices, and Applications," 8th Edition, Prentice Hall, ISBN: 0131111388.
2. Donald A. Neaman, (2006), "Electronic Circuits Analysis and Design", Third Edition, ISBN: 9780070634336
3. TF Bogart, "Electronic devices and circuits", Prentice Hall International Inc.

Course Content

8.25 Microprocessors and Microcontrollers

COURSE TITLE (ECT-224) **Microprocessors and Microcontrollers**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Breadth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the architecture of microcontroller and its assembly instructions.	C-2	1
CLO-2	**Understand** built-in I/O's micro-controller.	C-3	2
CLO-3	**Practice** and program microcontroller-based circuits.	P-3	3
CLO-4	**Report** the outcome of an experiment/task.	A-3	10
CLO-5	**Report** effectively the laboratory work including procedures results, and conclusion of experiments.	P-4	10

Course Outline for Theory

Introduction to Intel family microprocessors, instruction set architecture (ISA). Assembly Language Programming, hardware model, read/write cycles, exception/interrupt processing, I/O devices, DMA, interfacing to memory and I/O devices. Introduction to PIC/Atmel 8051.

Introduction to microcontrollers; architecture and programming, Arithmetic Instructions, Logic Instructions, Program Control Instructions, Introduction to Interrupts

Course Outline for Lab

- Introduction to development kit of any microcontroller
- Development of different applications on microcontroller kit.
- Learn to read datasheets/manuals in order to develop practical applications.
- Assembly and C language-based microcontroller (PIC or Raspberry Pi)
- Interfacing for interrupt and data-based applications involving LED/ LCD, GPIO ports, communication ports, A/D, and D/A interfacing.
- Project can be input voltage-based speed control of DC Motor / stepper motor using PWM.

Recommended Books

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

Course Content

8.26 Signals and Systems

COURSE TITLE (ECT-225) **Signals and Systems**	**CREDIT HOURS** (0+1) **0 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN Foundation**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Use** different mathematical tools to classify different types of signals to design engineering alternatives.	C2	3
CLO-2	**Relate** the basics of signals and systems with real life scenarios to understand their hands on applications.	P1	1
CLO-3	**Explain** the different transformation techniques to understand the signals in different domains.	P2	2

Course Outline for Lab

Continuous-time and discrete-time signals; commonly encountered signals; unit impulse and unit step functions; sampling and aliasing; continuous-time and discrete-time systems; basic properties. Linear Time-Invariant Systems, The convolution sum; the convolution integral; properties; difference and differential equations. Fourier Series Representation of Periodic Signals, Continuous and discrete-time periodic signals; properties of continuous and discrete-time Fourier series; Fourier series and LTI systems. Continuous-Time Fourier Transform, Properties; convolution and multiplication properties. Discrete-Time Fourier Transform, Properties; convolution and multiplication properties. Laplace Transform, Region of convergence; inverse Laplace transform; properties; analysis of LTI systems using the Laplace transform. z-Transform, Region of convergence; inverse z-transform; properties; analysis of LTI systems using the z-transform.

Recommended Books

1. A Oppenheim, A Willsky and H Nawab, "Signals and Systems" Pearson, Edition 2nd
2. Simon Haykin and Barry Van Veen, "Signals and Systems" Wiley, Edition 2nd

Course Content

8.27 Communication Systems

COURSE TITLE (ECT-311) **Communication Systems**	**CREDIT HOURS** (1+1) **16 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Breadth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the fundamental concepts of analog and digital communication systems.	C-1	1
CLO-2	**Illustrate** various types of analog and digital modulation and demodulation techniques and their properties, including bandwidth, channel capacity, transmission techniques.	C-2	3
CLO-3	**Demonstrate** the waveforms of modulation/demodulation techniques in time/frequency domain and error performance in the presence of noise in both time and frequency domain.	C-3	5
CLO-4	**Realize** a hardware project by incorporating theoretical knowledge and practical skill.	P-3	3
CLO-5	**Explain** various analog and digital modulation and demodulation techniques by applying simulation tool.	P-2	5
CLO-6	**Report** effectively the laboratory work including procedures, results, and conclusion of experiments**.**	P-4	10

Course Outline for Theory

Basic definitions; modulation and de-modulation techniques: amplitude, angle, pulse modulation, digital modulation techniques.

Information theory; error detection and correction.

Multiplexing techniques; noise and its effects on signal transmission; BER performance of various modulation techniques under noisy environment.

Course Outline for Lab

- Amplitude Modulation: Baseband and carrier communications, Double Sideband (DSB), Single Sideband (SSB), Vestigial Sideband (VSB), Super-heterodyne AM Receiver, Carrier Acquisition.
- Television Angle Modulation: Instantaneous frequency, Bandwidth of FM/PM, Generation of FM/PM, Demodulation of FM/PM Noise
- Mathematical representation, Signal to Noise Ratio, Noise in AM, FM, and PM systems Pulse Modulation
- Sampling and Quantization, Pulse Amplitude Modulation, Pulse Position and Pulse width Modulation, Quantization Noise, Signal to Quantization Noise Ratio, Pulse code Modulation, Delta Modulation, Frequency Shift Keying, Phase Shift Keying.

Recommended Books

1. B. P. Lathi, (2009) "Modern Digital and Analog Communication Systems," 4th Edition, Oxford University Press, ISBN: 0195110099.
2. Leon W. Couch, (2012) "Digital and Analog Communication Systems," 8th Edition, Prentice Hall, ISBN: 0131424920.

Course Content

8.28 Control Systems

COURSE TITLE (ECT-312) **Control Systems**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN Breadth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** control technology in term of various types, applications, performance analysis of open loop and closed loop systems and familiarization of stability.	C-1	1
CLO-2	**Illustrate** and develop a mathematical model of electrical and mechanical systems and understand the block diagram representation and signal flow graph techniques.	C-2	3
CLO-3	**Analyze** stability of Linear Time Invariant systems using stability tools. E.g., Routh Hurwitz Criteria, Bode etc.	C-4	4
CLO-4	**Analyze** industrial applications of control technology, having servo mechanism and PID controller familiarization.	C-4	2
CLO-5	**Use** MATLAB Simulink to evaluate various control blocks outputs	P-3	5
CLO-6	**Report** effectively the laboratory work including procedures, results, and conclusion of experiments.	P-4	10

Course Outline for Theory

Introduction to control systems; open-loop and closed-loop systems.
Transfer functions; block diagrams, signal flow graphs.
Introduction to modeling; formation of differential equations of electrical, mechanical, and other systems, transfer functions.
Stability; Routh's stability criterion, types, and analysis of feedback control systems; root locus, transfer function matrices; PID controllers and compensators.

Course Outline for Lab

- Using MATLAB for control systems
- Modelling of physical systems, linear control system modelling
- LTI Systems
- First & Second Order system response, Nyquist Criteria, Root-Locus & Bode plots
- PI, PD and PID controllers
- Servo motor control

Recommended Books

1. Katsuhiko Ogata, (2009) "Modern Control Engineering," 5th Edition, Prentice Hall, ISBN: 0130609072.
2. Constantine H. Houpis and Stuart N. Sheldon, (2013), "Linear Control System Analysis and Design with MATLAB", Sixth Edition, ISBN-13: 978-1466504264

Course Content

8.29 Numerical Analysis

COURSE CODE & TITLE (ECN-311) **Numerical Analysis**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Natural Science-I**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Comprehend** different numerical techniques such as: error propagation, interpolation, differentiation, integration, eigenvalues, and solution of algebraic and differential equations.	C-2	1
CLO-2	**Apply** numerical techniques to different linear and nonlinear problems.	C-3	2
CLO-3	**Apply** proper software tools and techniques of MATLAB Programming for developing numerical computation solutions.	P-3	5

Course Outline for Theory

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

Lab Outlines

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

Recommended Books

1. Numerical Analysis by Richard L.Burden, J. Douglas Faires by Brooks/ Cole Boston USA, (Latest Edition)
2. Numerical Methods for Scientific Computing by J.H. Heinbockel Trafford Publishing USA, (Latest Edition)
3. Applied Numerical Analysis, by C. F. Gerald and P. O. Wheatley, (Latest Edition)
4. Numerical Methods Using MATLAB by John H. Mathews and Kurtis D. Fink, (Latest Edition)
5. Numerical Mathematics and Computing by W. Cheney and D. Kincaid, (Latest Edition)
6. E. Kreyszig, Advanced Engineering Mathematics, 9th edition, Wiley, (Latest Edition)
7. A. Greenbaum & T. P. Chartier, Numerical Methods, Princeton University Press, (Latest Edition)

D. P. O'Leary, Scientific Computing with Case Studies, SIAM, (Latest Edition)

Course Content

8.30 Entrepreneurship

COURSE TITLE (ECM-311) **Entrepreneurship**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Management Sciences**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the understanding of entrepreneurship concept as a whole and the role of entrepreneurship in economic development.	A-3	12
CLO-2	**Compare** the role and importance of the small and medium sized enterprises in the economy.	A-4	6
CLO-3	**Find** an attractive market and apply the understanding of business planning concept for new business creation and growth.	A-3	12

Course Outline for Theory

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

Recommended Books

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

Course Content

8.31 Industrial Electronics

COURSE TITLE (ECT-312) **Industrial Electronics**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** the working principles of different electric heating techniques and sensors to measure non-electrical quantities used in the industry.	C4	2
CLO-2	**Employ** different techniques to control industrial processes using ladder logic diagram, wiring diagram, PLC, and SCADA systems.	P5	5
CLO-3	**Develop** an industrial application-oriented project by adopting the concepts learned from industrial electronics.	P1	3
CLO-4	**Examine** the health and safety issues in the electronic industry and ways to cope with it using proactive approach.	C4	6

Course Outline for Theory

Electric heating: Principles and applications; induction and dielectric heating; high-frequency welding. Spot welding control, Industrial control: Speed control of DC, AC, and servo motors. Process control. Measurement of non-electrical quantities: Temperature, displacement, pressure, time, frequency; digital industrial measuring systems, Ultrasonic generation, and applications. X-ray applications in industry. Photo-electric devices, Industrial control using PLCs. Data acquisition. Distributed control system in process industries, Industrial safety, and its techniques to avoid any hazard using proactive approach

Course Outline for Lab

- Experiments related to the principles of welding, electric heating, PLCs
- speed control of DC, AC, and servo motors
- Industrial safety guidelines and its inspection
- Industrial automation
- industrial measurement systems
- Industrial-oriented projects by adopting the concepts learned from electronics
- ladder logic diagram, wiring diagram, and PLC and SCADA system.

Recommended Books

1. Frank D. Petruzella, "Programmable Logic Controllers," McGraw-Hill, ISBN: 0078298520.
2. Frank D. Petruzella, "Industrial Electronics," McGraw-Hill, ISBN: 0028019962
3. Programmable Logic Controllers Frank D. Petruzella
4. Industrial Electronics Frank D. Petruzella
5. Principles of Industrial Instrumentation Patranabis. D

Course Content

8.32 Project-I

COURSE TITLE (ECT-313) **Project-I**	**CREDIT HOURS** (0+3) **0 Theory + 48 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Project-I**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** and apply knowledge of engineering fundamentals for suggested problem scenario along with comparison with previous related solutions.	C-3	1
CLO-2	**Analyze** the problem statement through research and literature review.	C-4	2
CLO-3	**Defend** the impact of proposed idea in societal and environmental contexts and demonstrate knowledge of sustainable development.	C-5	7
CLO-4	**Develop** a wide range of technical skills by delivering a working prototype using latest design tools that has passed through the design, implementation, testing and evaluation stages.	C-6	3
CLO-5	**Integrate** the solution of complex Engineering Technology problem for improvement of society or environment.	A-4	6
CLO-6	**Practice** various methods to avoid plagiarism in reports	A-5	8
CLO-7	**Organize** effectiveness as an individual and in a teamwork management.	A-4	9
CLO-8	**Display** their communication skills through presentations, technical reports, and posters.	A-5	10
CLO-9	**Display** the results of hardware components testing which could be used for SDP.	P-5	5

Course Content

8.33 Power Electronics

COURSE TITLE (ECT-321) **Power Electronics**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Breadth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the fundamentals of power semiconductor devices and their applications in power electronics converters.	C-2	1
CLO-2	**Analyze** different types of AC-DC, DC-DC, DC-AC, and AC-AC converters under different loading conditions.	C-4	2
CLO-3	**Design** power electronics converters for modern societal applications.	C-5	6
CLO-4	O**perate** power electronics trainer and apply MATLAB for the analysis and design of converters.	P5	5
CLO-5	W**ork** effectively as an individual or as a team member while performing laboratory experiments.	A4	9
CLO-6	**Report** effectively the laboratory work including procedures, results, and conclusion of experiments.	P-4	10

Course Outline for Theory

Introduction to power electronics; solid-state devices used in power electronics: power diode. Power BJT, power MOSFET, SCR, GTO, GBT, TRIAC, DIAC. Semi controlled, fully-controlled and uncontrolled rectifiers: single-phase and three-phase, six-pulse, twelve-pulse and twenty-four pulse rectifiers. Single-phase and three-phase inverters;44 pulse-width-modulated (PWM) inverters. UPS; types of converters; switched mode power supplies, AC and DC motor drives.

Course Outline for Lab

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

Recommended Books

1. Cyril W. Lander, (1994) "Power Electronics," Third Edition, McGraw-Hill UK, ISBN: 0077077148.
2. Muhammad H. Rashid, (1993) "Power Electronics: Circuits, Devices and Applications," 4th Edition, Prentice Hall, ISBN: 0131011405.

Course Content

8.34 Industrial Automation

COURSE TITLE (ECT-322) **Industrial Automation**	**CREDIT HOURS** (1+1) **16 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** concepts of measurement systems and their performance measures, sensors, signal processes and display elements, open loop and close loop systems, process controllers, correction elements and PLC systems.	C2	1
CLO-2	**Analyze** the controller for automation and prototyping to understand industrial automation to improve productivity.	C4	2
CLO-3	**Identify** fundamental issues within sustainable industrial development from an automation perspective and be able to exemplify the consequences.	C5	5
CLO-4	**Design** different types of prototypes of automation /robots on LabVIEW according to their usage and specifications.	P2	3

Course Outline for Theory

Introduction to Industrial Automation, architecture of industrial automation. Measurement system specifications, industrial measurement. Temperature sensors, Pressure and Force Sensors, hydraulic, proximity, infrared, light, ultrasonic and radiation sensors. Analog to Digital conversion of sensor output. control of dc and ac motors, stepper motor control, servo motors control, position control friction, backlash and resilience machine tool control, remote position control; process control, pneumatic controllers. Flow and level Sensors. Programmable Logic Control Systems and their evolution, Architecture of PLC. Architecture of PLC. PLC programming languages. PLC software environment+ Ladder programming Introduction. PLC software environment+ Ladder programming Introduction. Ladder programming Instruction Set. Ladder programming Instruction Set. Ladder programming of practical scenarios. Industrial Motor Control Circuits. Industrial safety standards. SCADA

Course Outline for Lab

- Measurement system specifications, industrial measurement.
- Temperature sensors, Pressure and Force Sensors
- hydraulic, proximity, infrared, light, ultrasonic and radiation sensors.
- Analog to Digital conversion of sensor output.
- control of dc and ac motors
- stepper motor control
- servo motors control
- position control friction
- backlash and resilience machine tool control
- remote position control
- process control, pneumatic controllers
- Flow and level Sensors
- Programmable Logic Control Systems and their evolution
- Architecture of PLC. Architecture of PLC
- PLC programming languages
- PLC software environment+ Ladder programming Introduction
- PLC software environment+ Ladder programming Introduction
- Ladder programming Instruction Set.
- Ladder programming Instruction Set

Recommended Books
1. Automation, Production Systems & Computer Integrated Manufacturing, Miikell P. Goover
2. R.R. Hunter, “Automated process control systems”, Prentice Hall Inc.
3. N.M. Morris, “Control Engineering”, Mc-Graw-Hill.

Course Content

8.35 VLSI Technology

COURSE TITLE (ECT-323) **VLSI Technology**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the general concept of VLSI Technology methodologies.	C2	1
CLO-2	**Identify** and formulate different types of VLSI Front-End/Back-End techniques.	C3	2
CLO-3	**Analyze** different solutions for Front-End/Back-End IC problems.	C4	2
CLO-4	**Report** effectively the laboratory work including procedures, results, and conclusion of experiments**.**	P-4	10
CLO-5	**Apply** the basic Front-End IC design problems to manage the lab project.	A-4	11

Course Outline for Theory

Review of Integrated Electronics. Basic terminologies, size and complexities, overview of IC design process, economics, yield, trends in VLSI technology, Integrated Circuit Technology. IC production process, semiconductor processes, design rules and process parameters, layout techniques and practical considerations, Modes of Transistor, Device Modelling. Small signal model, diode model, BJT model, MOS models, passive component models (monolithic capacitors and resistors). DC characteristics of CMOS Inverter, Noise Margin, Introduction to Static & Dynamic Logic Circuits, Structural & Behavioural Modelling of Combinational & Sequential Logic Circuits with VHDL/Verilog language

Course Outline for Lab

- Introduction to SPICE, DSCH & MICROWIND
- Implementation of CMOS gates Schematic using DSCH
- pn-Junction, MOSFET modeling and simulation
- BJT Modeling, BJT Noise Modeling
- Implementation of CMOS Basic gates Layout using MICROWIND
- Structural & Behavioral Modeling of Combinational & Sequential simple Logic Circuits with VHDL/Verilog language

Recommended Books

1. Digital Integrated Circuits, Jan M. Rabaey, A. Chandrakasan, Borivoje Nikolic, Pearson Publisher
2. CMOS VLSI Design: A Circuits & Systems Perspective by N. Weste, David Harris, Pearson Publisher
3. VLSI Design Circuit Methodology, Liming Xiu
4. Digital Design & Fabrication, V. G. Oklobdzija
5. S.M. Kang & Y. Leblibici, "CMOS Digital Integrated Circuits-Analysis & Design", TMH, Ed. 2003.
6. B.G. Streetman & S. Banerjee, "Solid State Electronic Devices", PHI.
7. K. Eshraghian & Pucknell, "Introduction to VLSI", PHI.
8. B. Razavi, "Design of Analog CMOS Integrated Circuits", TMH.
9. N.H.E. Weste & K. Eshraghian, "Principles of CMOS VLSI Design: A System Perspective", McGraw Hill Pub.
10. Zainalabedin Navabi, "Verilog Computer-Based Training Course", McGraw-Hill.

Course Content

8.36 Foreign Language (Chinese Language)

COURSE TITLE (ECS-321) **Foreign Language (Chinese Language)**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Social Sciences Elective-III**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Communicate** in the Chinese language with accurate pronunciation, reading and writing.	A-2	10
CLO-2	**Follow** the Chinese language rules for communication and realization of modern language emergence to meet the demand of society.	A-3	12
Course Outline for Theory			
Introduction to trends and emergence of Chinese language, Chinese Language philosophy, 300 new Chinese words and 50 fundamentals of Chinese grammar, sentences, and some communicative functions such as Greetings, Making an Acquaintance, Making an Inquiry to carry on conversations. Chinese language basics for reading initials, finals, and tones (phonetics and pronunciation), language principles to write the characters			
Recommended Books			
1. Conversational Chinese 301 by Kang Yuhua & Lai Siping (or latest edition) 2. Oxford Beginner's Chinese Dictionary REV ed. Edition, 3. Road to Success: Threshold, Zhang Hui, 2008 (or latest edition)			

Course Content

8.37 Project-II

COURSE TITLE (ECT-326) **Project-II**	**CREDIT HOURS** (0+3) **0 Theory + 48 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Project**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Devise** an experimentally verified system which can solve a Broadly Defined Engineering Technology Problem.	C6	3
CLO-2	**Implement** proposed design using modern technology for solution of Broadly Defined Engineering Technology Problem.	C3	5
CLO-3	**Investigate** and analyze the results obtain from the implemented design.	C4	4
CLO-4	**Practice** ethical principles (Plagiarism in particular) and engineering norms.	A5	8
CLO-5	**Display** effectiveness as an individual and in a teamwork management.	A4	9
CLO-6	**Display** their communication skills through presentations, technical report, and poster.	A5	10
CLO-7	**Demonstrate** management skills as a member and/or leader to manage the project.	A4	11
CLO-8	**Alter**/Revise conventional solutions by adapting modern technology.	P6	5

Course Content

8.38 Project Management

COURSE TITLE (ECM-411) **Project Management**	**CREDIT HOURS** (2+0) **32 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN Management Sciences Elective-III**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** and understand the basic concepts of management with a special focus on project management.	A1	11
CLO-2	**Demonstrate** competency in various project management knowledge areas, project scheduling and controlling techniques including Critical Path Method and Earned Value Management.	A3	11
CLO-3	**Use** computers in Project Management, especially a tool like MS Project & Primavera etc.	C3	5

Course Outline for Theory

Introduction to Management: History of management, functions and functional areas of management, levels of management, managerial skills, types of organizations, managerial control, principles of management.

Introduction to Project Management: Definition of project and project management, knowledge areas of project management, project life cycle, project characteristics, project constraints, project organization structure.

Project Quality Management: History of Quality Management, Defining Quality, relationship between project management and quality management, Quality Management Frameworks

Project Stakeholder Management: The roles of project manager and project sponsor, Project team selection, skills, and competencies of project manager, building and managing successful project teams, stakeholder management.

Project Cost Estimating and Budgeting: Cost components and methods for cost estimation in projects, cost control in projects, life cycle cost, cost scheduling and forecasting, project resource allocation and levelling, estimation of outstanding work, elements of budgets and estimates, earned value management.

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

Project Time Management: Introduction to project scheduling, Critical Path Method, network representation of projects, critical activities, and critical path, project Gantt chart.

Project evaluation, project and project management success, success criteria for projects, project audits, project termination process.

Project Management Tools: Introduction and use of project management tools like MS project and primavera, Emerging trends in project management, Six Sigma Project Management Tools

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

Course Content

8.39 Electronics Troubleshooting and Testing

COURSE TITLE (ECT-415) **Electronics Troubleshooting and Testing**	CREDIT HOURS (0+2) **0 Theory + 32 Lab Sessions**	KNOWLEDGE AREA/DOMAIN **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** basic troubleshooting and testing techniques.	C2	1
CLO-2	**Adopt** good troubleshooting and testing techniques using modern tools in electronic circuits under test.	P6	5
CLO-3	**Display** professional commitment and ethics towards equipment and circuits troubleshooting and testing.	A5	8

Course Outline for Lab

Electronic circuit troubleshooting, Electronic circuits testing, Safety guidelines for troubleshooting and testing, High voltages and high currents safety guidelines, Magnetic circuit/equipment safety guidelines, Fault finding techniques in electric and electronic circuits, Basic troubleshooting techniques, What are the basic testing techniques, Tools used in troubleshooting and testing of electronic circuits, Testing electric components with a Multimeter, Use multimeter to test electric and electronic circuits, Different methods of electrical troubleshooting and testing, Recognize and master the Techniques to Troubleshoot and test Electronics Circuit, Testing electronic components in PCB, Practice more to enhance the troubleshooting and testing skills.

Recommended Books

1. Frank D. Petruzella, "Electrician's Troubleshooting and Testing Pocket Guide," McGraw-Hill,
2. Ronald Quan, "Troubleshooting Electronic Circuits: A Guide to Learning," McGraw-Hill
3. Everything Electrical How To Test Circuits Like A Pro – all Parts

Course Content

8.40 Inter Disciplinary Technology Elective

COURSE TITLE (ECI-411) As per HEI resources and offered programs	CREDIT HOURS (2+1) 32 Theory + 16 Lab Sessions	KNOWLEDGE AREA/DOMAIN IDTE-II
The course (with outline, CLO's etc.) to be offered by HEI from amongst the list of elective courses defined in this Curriculum. The HEI must ensure adequacy of academic and other resources for the course.		

Course Content

8.41 FPGA-based Technology

COURSE TITLE: (ECT-327) FPGA-based Technology	CREDIT HOURS (2+1) 32 Theory + 16 Lab Sessions	KNOWLEDGE AREA/DOMAIN Depth	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the FPGA programmable technology and the logic design process.	C2	1
CLO-2	**Apply** the combinational and sequential circuits using Hardware description language.	C3	2
CLO-3	**Set** mechanism of experiments in laboratory to interpret experimental data and observe its conformance with results.	P4	5

Course Outline for Theory

Overview of the applications in digital systems. Hardware Description Languages (HDL); Selection of HDL Language, Fundamentals of Language, Design and Modeling of combinational & sequential circuits, simulation & synthesis. Implementation Technologies; Programmable Array Logic, Programmable Logic Array, Complex Programmable Logic Devices (CPLD), Field Programmable Gate Array (FPGA)Technologies. Arithmetic Algorithms and Hardware Designs using FPGAs technologies, Block RAMs in FPGAs & modeling of RAM/ROM using HDL, Electronic Design Automation; Usage of CAD Tool, Programmable Device Design Flows, Physical Design Automation -- Systems; Partitioning; Placement; Routing, Clock Design Considerations -- Timing Margins, Clock Skew, Clock Distribution, use of test benches for synthesis, simulation, testing and floor planning, Digital circuits Examples and Applications.

Course Outline for Lab

- Introduction to Software Tools (ModelSim, Xilinx ISE, Vivado Design Suite)
- Introduction to FPGA Boards and Simple Circuit Implementation
- Introduction to Verilog HDL gate-level modeling
- Data flow modeling, behavioral modeling
- design, Simulation, synthesis and fitting of combinational circuits
- Design and implementation of FSM and memory
- Verilog simulation and hardware implementation of combinational circuits such as MUX/DEMUX, encoder/decoder
- Arithmetic logic unit (ALU)
- Verilog simulation and hardware implementation of sequential circuits such as flip-flops
- shift registers, counters, Realization of simple digital circuits using VHDL
- Familiarization of FPGA trainer kits
- Realizations of digital circuits using FPGA

Recommended Books
1. Wayne Wolf, “FPGA-Based System Design,” Prentice Hall, ISBN: 0131424610. 2. Samir Palnitkar, “Verilog HDL,” Prentice Hall, ISBN: 0130449113. 3. Michael D. Ciletti, “Advanced Digital Design with the Verilog HDL,” Prentice Hall, ISBN: 0130891614. 4. Pong P. Chu, “FPGA Prototyping by Verilog Examples: Xilinx Spartan-3,” Wiley-Interscience, , ISBN-10: 0470185325.

Course Content

8.42 Embedded Systems

COURSE TITLE (ECT-411) **Embedded Systems**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** the functional elements of an embedded system to meet given system specifications.	C3	1
CLO-2	**Analyze** the suitability of hardware/software for required embedded system keeping in view the technology metrics.	C4	2
CLO-3	**Apply** the embedded system methodologies to implement a system as solution technological problem.	C3	5
CLO-4	**Set** a mechanism of experiments in laboratory to interpret experimental data and observe its conformance with results.	P4	10

Course Outline for Theory

Introduction to elements of Embedded systems and their applications, Trends and challenges in embedded system, Modern methodologies, Hardware/software tradeoffs, use of single-purpose processors (hardware), use of General-purpose processors (software), General purpose computer architecture, pipelining, Datapath, memories and peripherals, Custom single purpose computer architecture, Standard single purpose computer architecture, Firmware, Firmware development and debugging, hardware/firmware partitioning, Microcontroller architecture, components, analysis, Application of microcontroller modules IO, Timers, counters, interrupts, EEPROM etc., Applications of embedded systems

Course Outline for Lab

- Introduction to 8051 microcontroller and I/O port programing using LED Interfacing
- 7-Segment Display Interfacing and Programming using 8051 Architectures
- Timer and Counter Mode Programming using 8051 Architectures
- Interrupt Based Programming in 8051 Architectures
- LCD Interfacing using 8051 Architectures
- Serial Communication between PC & Microcontroller using 8051 Architectures
- ADC interfacing with microcontroller
- Getting Started with Chip KIT PIC32 Microcontroller Module – Switch and LED Interfacing
- Hurdle Detection using InfraRed Sensor on PIC Architectures
- Implementation of Traffic Light Control System using PIC Architectures
- Variable Speed Controller Design of DC Motor using PWM

Recommended Books

1. Frank Vahid and Tony D. Givargis, "Embedded System Design: A Unified Hardware/Software Introduction," John Wiley & Sons ISBN: 0471386782.
2. Mazidi, Muhammad A., et al. PIC microcontroller and embedded systems. Prentice-Hall, Inc.

Course Content

8.43 Integrated Circuits Fabrication

COURSE TITLE (ECT-324) **Integrated Circuits Fabrications**	**CREDIT HOURS** (1+0) **16 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Know** about the general concept of Silicon wafer processing methods.	C2	1
CLO-2	**Understand** different methods of IC fabrication processing steps and environment of clean room.	C2	2

Course Outline for Theory

Introduction to Silicon Wafer Processes such as Raw Materials & Purification, CZ & FZ Crystal Growth Methods to develop Ingot tube, Liquid-Encapsulated Czochralski GaAs Growth, Wafer & Die Preparation methods, Cleaning steps, Clean room, Common airborne contaminants, Containment Reduction: Level 1, 2 & 3, IC Fabrication Processes: Epitaxy, Oxidation, Lithography, Etching, Diffusion, Ion Implantation, Film Deposition, Packaging, VLSI Process Integration

Recommended Books

1. Silicon VLSI Technology, Fundamentals, Practice & Modeling, James D. Plummer, M.D.Deal, P. B. Griffin, Pearson Publisher, ISDN: 978-81-317-2604-4
2. Introduction to Semiconductor Manufacturing Technology, Hong Xiao, SPIE digital library
3. IC Fabrication technology, Gouranga Bose,
4. Semiconductor Devices, Kannaan Kano, Prentice Hall Publisher, ISBN:81-203-2877-9

Course Content

8.44 Electromagnetic Field Theory

COURSE TITLE (ECT-325) **Electromagnetic Field Theory**	**CREDIT HOURS** (1+0) **16 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the basic vector algebra and calculus, orthonormal and non-orthonormal coordinate systems, introduces the concepts of gradients, divergence, and curl operations.	C2	1
CLO-2	**Analyze** the theory of magnetostatics in general and apply them in various situations.	C4	2

Course Outline for Theory

Vector algebra, coordinate systems and transformations, Vector calculus, electrostatic fields in materials, electrostatic boundary value problems, resistance, and capacitance calculation. Magneto-static fields, magneto-static fields and materials, inductance calculation. Faraday's Law, displacement current and Maxwell's equation.

Recommended Books

1. William Hayt and John A. Buck, "Engineering Electromagnetics", McGraw-Hill, ISBN: 0073104639, Latest Edition.
2. Sadiku, Matthew N, "Elements of Electromagnetics", Oxford University Press, ISBN: 0195103688, Latest Edition.
3. J. D. Kraus, "Electromagnetics", John Wiley & Sons, Latest edition.
4. David K. Cheng, "Fundamentals of Engineering Electromagnetics", Addison Wesley

Course Content

8.45 Opto-Electronic Devices

COURSE TITLE (ECT-412) **Opto-Electronic Devices**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** basic concepts of fiber optics and optoelectronics systems.	C2	1
CLO-2	**Demonstrate** detailed understanding and analysis of operating principles, characteristics, and design architectures of semiconductor optoelectronic devices.	C4	2
CLO-3	**Apply** basic operations and its applications of fiber optic communication system.	C3	2
CLO-4	**Perform** experiments in laboratory to interpret experimental data results using opto-electronic devices.	P2	5

Course Outline for Theory

An introduction to optoelectronics, Introduction to optical materials, Incandescent, discharge, and arc lamp sources, Detection of optical radiation, Propagation along optical fibers and waveguides, Introduction to lasers and optical amplifiers, Basic concepts in photometry, radiometry, and colorimetry, Light emitting diodes (LEDs), Semiconductor lasers, Optical detectors and receivers, Optical amplifiers, Ultrafast optoelectronics, Organic light emitting devices

Course Outline for Lab

- Introduction To Optoelectronic Devices
- Fiber Optic Transmitter Through Digital Circuit
- Analog Signal Through the Optical Fiber
- Digital Signal Through the Optical Fiber
- Optical Fiber Receiver Circuit
- To Determine the Numerical Aperture Of Optical Signal
- Study The Optical (E-O) Characteristics Of Fiber Optic 660nm Converter
- Triangular Wave Through the Optical Fiber
- Amplitude Modulated Signal Through the Optical Fiber
- Light Dependent Resistor, Making A Light Guide Circuit
- Losses In Optical Fiber
- Frequency Modulated Signal Through the Optical Fiber
- Losses In Optical Fiber

Recommended Books

1. Handbook of Optoelectronics: Concepts, Devices, and Techniques, By John P. Dakin, Robert Brown, Published by CRC Press, ISBN 9780367735678
2. Optoelectronic Devices and Properties, by Oleg Sergiyenko, Autonomous University of Baja California, Mexico, ISBN: 978-953-307-204-3
3. Semiconductor Optoelectronic Devices: Introduction to Physics and Simulation by Joachim Piprek

Course Content

8.46 Microwave Electronics

COURSE TITLE (ECT-413) **Microwave Electronics**	**CREDIT HOURS** (1+0) **16 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the basic concepts of microwave electronics.	C2	1
CLO-2	**Analyze** the operating principles, characteristics, and architectures of microwave electronic devices.	C4	2

Course Outline for Theory

RF and Microwave frequencies and technology, Passive microwave components: resistors, capacitors and inductors at RF and microwave frequencies; Transmission lines: coaxial lines, strip line, Slot line, coplanar line, and suspended-substrate strip line; Waveguides and its types (rectangular and circular etc.), Analysis and optimization of transmission lines: Impedance matching, Standing Wave Ratio (SWR), reflection loss, impedance matching on Smith chart, Passive microwave devices and circuits: directional couplers, isolators, circulators, resonant circuits, passive filter design, Active microwave components; Diodes, Transistor at RF frequencies, Small signal RF amplifier design, RF power amplifier, microwave mixers and detectors, Transceiver architectures.

Recommended Books

1. D. M. Pozar, "Microwave Engineering", 2011, Wiley, ISBN-13: 978-0470631553.
2. Behzad Razavi. "RF Microelectronics", Prentice Hall.
3. Pozar M.D, "Microwave Engineering", 2011.
4. Collin R. E., "Foundations for Microwave Engineering", Wiley.
5. Liao Y S., "Microwave Devices and Circuits", Pearson Education.
6. Yeom K. W. , Microwave Circuit Design: A Practical Approach Using ADS, Prentice Hall; (2015).
7. Vendelin G. D., Pavio A. M., Rohde U. L., "Microwave Circuit Design Using Linear and Nonlinear Techniques", Wiley-InterScience.

Course Content

8.47 Computer Architecture

COURSE TITLE (ECT-414) **Computer Architecture**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO	**Description**		
CLO-1	**Understand** the functional elements of computer architecture to meet given system specifications.	C3	1
CLO-2	**Analyze** the suitability of hardware/software for required computer system keeping in view the technology metrics.	C4	5
CLO-3	**Apply** the computer architecture methodologies to implement a system as solution technological problem.	C3	5
CLO-4	**Perform** experiments in laboratory in order to interpret experimental data and observe the results of simulator for computer system.	P2	2

Course Outline for Theory

Difference between architecture & organization, Introduction to Flynn's classification of Computer Architecture (SISD, SIMD, MISD, MIMD systems), Performance metrics of CPU (MIPS and Mega-Flops), Overview of main computer architectures (SAP-1), CPU architecture, functional blocks and development of instruction set, design of basic functional blocks (PC,IR,CU,ALU etc.), introduction to superscalar processors (CISC, RISC), cache memory, different designs of cache memory system, virtual memory system, address mapping using pages, pipelining and threading, instruction level parallelism (ILP), introduction to parallel processing. Branch prediction, pre-fetching, multithreading.

Course Outline for Lab

- To understand the use of computer simulator and basic computer architecture of computer system
- Study the complete instruction set of 8085 and write the instructions in the instruction set of 8085 along with examples
- Use of assembly language code to implement data transfer instruction
- To store numbers in reverse order in memory location to implement arithmetic instruction
- To add two numbers using lxi instruction
- To add two 8-bit numbers stored in memory and storing the carry
- To find the factorial of a number and to implement logical instructions.

Recommended Books

1. David A. Patterson, John L. Hennessy, "Computer Organization & Design ", Morgan Kaufmann, or Latest Edition.
2. Morris Mano, "Computer Architecture and Organization", Latest Edition.

Course Content

8.48 Robotics Technology

COURSE TITLE (ECT-415) **Robotics Technology**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** various robotic structures and their workspace.	C2	1
CLO-2	**Analyze** the performance of kinematics of robot systems.	C4	5
CLO-3	**Evaluate** the skills associated with robot control.	C5	2
CLO-4	**Interpret** experimental data and observe the results of robotics experiments.	P2	4

Course Outline for Theory

Fundamental of robotics, Classification of robotic systems, Robot anatomy and related attributes: Degree of freedom, types of joints/links, common robot configurations, Kinematics of serial robots, screw-based mechanics, Robot control system: Fundamentals of robot controllers, including analysis and design tools, Robot components, robot characteristics, robot languages, and robotic applications, Common robot sensors and actuators knowledge

Course Outline for Lab

- Differential drive kinematics, Forward and inverse kinematics
- Path planning and obstacle avoidance
- 2D mapping and occupancy grid map
- Image acquisition, processing and reasoning
- Localization and mapping
- High level control architecture of mobile robots
- Vision-guided vehicle control

Recommended Books

- Introduction to Robotics: Mechanics and Control, By John J. Craig, ISBN-13: 978-0201543612
- Introduction to Robotics: Analysis, Control, Applications, by Saeed B. Niku, ISBN-13: 978-1119527626
- Nikku, S.B., Introduction to Robotics, Prentice–Hall Publisher
- Schilling. R. J., Fundamentals of Robotics: Analysis and Control, Prentice–Hall
- Criag, J., Fundamentals of Robotics: Analysis and Control, Prentice–Hall
- Gonzalex, R. C. and Fu, K. S., Robotics Control Sensing, Vision and Intelligence, McGraw–Hill.

Course Content

8.49 Digital Signal Processing

COURSE TITLE (ECT-416) **Digital Signal Processing**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the sampling theorem and perform sampling on continuous-time signals by applying knowledge of sampling theory (i.e., aliasing, quantization errors, pre-filtering).	C2	1
CLO-2	**Analyze** the properties of LTI systems in terms of z-transforms.	C4	2
CLO-3	**Evaluate** the problems related to frequency selective processing and FIR/IIR filters.	C5	5
CLO-4	**Measure** the relevant theoretical knowledge to analyze a practical discrete-time signals and systems.	P4	4

Course Outline for Theory

Overview of basic concepts of Signals and Systems, Applications of DSP, Analog to Digital Signal Conversion, Nyquist Rate Sampling, Aliasing, Quantization, Correlation, Auto-Correlation, Introduction to Fast Fourier Transform, Introduction to Z-Transform, Properties of Z-Transform, Inverse Z- Transform, Digital Filters and their Applications, Digital Filter Design by Pole Zero Placement Method, Design of FIR Filters, Design of IIR Filters

Course Outline for Lab

- To study the architecture of DSP chips such as TMS 320C 5X/6X Instructions
- To verify linear convolution
- To verify the circular convolution
- To design FIR filter (LP/HP) using windowing technique Using rectangular window Using triangular window Using Kaiser window
- To Implement IIR filter (LP/HP) on DSP Processors N-point FFT algorithm
- MATLAB program to generate sum of sinusoidal signals
- MATLAB program to find frequency response of analog LP/HP filters
- To compute power density spectrum of a sequence
- To find the FFT of given 1-D signal and plot.

Recommended Books

1. Discrete time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer: Latest Edition
2. Digital Signal Processing By John G. Proakis And Dimitris G. Manolakis: Latest Edition

Course Content

8.50 Renewable Energy

COURSE TITLE (ECT-417) **Renewable Energy**	**CREDIT HOURS** (1+0) **16 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the solar thermal performance of solar water heater, solar dryer and solar PV cells characterization and its networking.	C2	1
CLO-2	**Apply** the Renewable Energy Sources for sustainable solution to energy crisis.	C3	2

Course Outline for Theory

Introduction to Renewable Energy: energy and society, types of renewable energy, advantages and disadvantages, energy and power, Pakistan and world energy consumption and demand, Environmental impact assessment and sustainability issues. Solar Energy: introduction, sources and uses, solar thermal electricity, concentrating solar power, solar thermal Molten salt technology, Photovoltaic cell materials, Principle of photovoltaic, conversion of solar energy, V-I characteristics of solar Photovoltaic cell, types of solar cells and fabrication. Photo voltaic applications. Wind Energy: introduction, wind resource, wind turbine and shear, wind speed monitoring, small and large wind system, storage of electricity, grid connection, characteristics and applications. Biomass: biomass resources, feedstock collection, feedstock preprocessing and treatment methods, biomass conversion technologies, thermo-chemical platform, combustion technology, Gasification technology, pyrolysis technology, biodiesel technology, biomass into ethanol, waste to energy, recent advances and applications of bioenergy technology. Hydropower: introduction, construction methods, turbines and their types, small and large hydroelectric power system, efficiency. Wave and Tidal energy: introduction, hydel power, wave power, tidal current energy, tidal barrage method, principle of operation, tidal turbines and their types, Geothermal energy: introduction, resource, types of geothermal resource, heat pumps, geothermal electricity, applications.

Recommended Books

1. Renewable energy Fourth Edition by Bent Sirensen.
2. Fundamental of renewable energy process, Aldo Vieira Da Rosa.
3. Renewable Energy Conversion, Transmission, and Storage By Bent Sorensen
4. Wave Energy Conversion By John Brooke
5. Alternative Energy Sources By Efstathios E. Stathis Michaelides

Course Content

8.51 Nanotechnology

COURSE TITLE (ECT-326) **Nanotechnology**	**CREDIT HOURS** (2+1) **32 Theory + 16 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Depth**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the basic concept of nanotechnology.	C2	1
CLO-2	**Analyze** the Microscopy techniques at Nanoscale level.	C4	4
CLO-3	**Explain** experiments in laboratory to interpret experimental data and observe with analyzed results of nanotechnology.	P3	2

Course Outline for Theory

Nanoscale science and nanotechnology are broad, interdisciplinary areas, encompassing not just materials science but everything from biochemistry to electrical engineering and more. This will be a survey course introducing some of the fundamental principles behind nanotechnology and nanomaterials, as well as applications of nanotechnology. The role of solid-state physics and chemistry in nanotech will be emphasized. Nanoscale tools such as surface probe and atomic force microscopy, nanolithography, and special topics such as molecular electronics will also be covered.

Course Outline for Lab

- Study of noble metal colloidal nanoparticles
- Study of SERS (Surface Enhanced Raman Spectroscopy)-sensing efficiencies by calculating their analytical and surface enhancement factors
- Study of nanoparticle adsorption to solid surfaces and other spatially-dependent characteristics of nanoparticle-surface interactions
- Study of terahertz spectroscopy of nanomaterial composite systems
- Study of fabrication of graphene nanosheets and electrode coating

  Study of electrochemical performance analyses of nanomaterials and Li-ion cell batteries.

Recommended Books

1. Charles P. Poole, Jr., Frank J. Owens, Introduction to Nanotechnology, ISBN: 978-0-471-07935-4
2. Nanotechnology: Principles and Practices by Sulabha K. Kulkarni
3. Introduction to Nano: basics to nanoscience and nanotechnology by Amretashis Sengupta; Chandan Kumar Sarkar

Course Content

8.52 Professional Ethics

COURSE TITLE (ECS-121) **Professional Ethics**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Social Science Elective**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Comprehend** the basic understanding of a profession, professional ethics, various moral and social issues, importance of values and professional ethics in personal life and professional career, and consequences of acting unethically in organization and society.	C-1	7
CLO-2	**Acquire** knowledge of various roles of engineering technologist in applying ethical principles at various professional levels.	A-3	6
CLO-3	**Resolve** the ethical dilemmas using common ethical values and identify possible actions to be taken in response.	A-5	8

Course Outline for Theory

Introduction: Introduction to ethics, personal and professional ethics, the nature of engineering ethics; legal, professional and historical definitions; origin of professional ethics, profession and professionalism; professional accountability, professional success, professional risks, professional associations; benefits of acting ethically and consequences of acting unethically.

Value of Ethics: Values in professional ethics, central responsibility of engineering professionals, ethics in different fields of work, IEEE code of ethics, ethical code for engineering professionals, global issues in professional ethics, ethics in manufacturing and marketing, intellectual property rights, business ethics and corporate governance.

Ethical Dilemmas: Common ethical dilemmas, resolution of ethical dilemmas, possible actions in response to dilemmas, probable consequences of these actions.

Recommended Books

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

Course Content

8.53 Organizational Behavior

COURSE TITLE (ECS-212) **Organizational Behavior**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Social Science Elective**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the field of organizational behaviour and the impact of organizational culture on individuals and the workplace.	A-1	9
CLO-2	**Explain** group dynamics within organizations, impact of diversity on the workplace, and strategies to manage groups and teams.	A-3	9
CLO-3	**Discuss** theories of motivations, importance of managing stress and emotions, and strategies to manage change and improve motivation in the workplace.	A-2	9

Course Outline for Theory

Overview, Introduction to the field of organizational behaviour, motivation, Individual and group behaviour, Personality and values, Perceiving ourselves and others in organizations, Workplace emotions, Attitudes, and stress foundations of employee motivation, Applied performance practices, Decision making and creativity, Team dynamics, Communicating in organizations, Power and politics in the workplace, Conflict and negotiation in the workplace, Leadership in organizational settings, Designing organizational structure, Organizational culture, Organizational change and development.

Recommended Books

1. Canadian Organizational Behavior McShane, Steven L. & Sheen, Sandra L. McGraw Hill Ryerson, (Latest Edition)
2. Organizational Behavior, by Robbins & Judge, Prentice-Hall Publishing, (Latest Edition)
3. Luthan Fred, Organizational Behaviour, McGraw Hill Inc, (Latest Edition)
4. Robins, Stephen, Organizational Behaviour, McGraw Hill Inc. (Latest Edition)
5. Finchan, R., & Rhodes, P. Principles of Organizational Behaviour, Oxford Press (Latest Edition)

Course Content

8.54 Critical Thinking

COURSE TITLE (ECS-321) **Critical Thinking**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Social Sciences**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Use** critical thinking skills when making business decisions and react with curiosity instead of emotion.	C-1	12
CLO-2	**Choose** the right techniques to recognize assumptions and draw conclusions.	C-3	12
CLO-3	**Translate** an abstract idea into something tangible.	P-4	12

Course Outline for Theory

Understanding Critical Thinking: What is Critical Thinking, Characteristics of a Critical Thinker, Common Critical Thinking Styles Making Connections, Left- and Right-Brain Thinking, and Whole-Brain Thinking, The Critical Thinking Process: The Critical Thinking Model, the Standards of Critical Thinking, Identifying the Issues, Identifying the Arguments, Clarifying the Issues and Arguments, Establishing Context, Checking Credibility and Consistency, Evaluating Arguments, Case Study, Developing Critical Thinking Skills: Asking Questions, Probing Techniques, Pushing My Buttons, Critical Thinking Questions, Active Listening Skills, challenging assumptions, Creating Explanations: Defining Explanations, Steps to Building an Explanation, Making Connections, Creative Thinking Techniques: Brainstorming, imagining the opposite, Mind mapping, DeBono's thinking Hats, Techniques for Thinking Creatively, Creative Thinking Exercise, Presenting and communicating your ideas to others.

Recommended Books

1. Diestler, Sherry. Becoming a Critical Thinker. New Jersey: Prentice Hall, (Latest Edition)
2. Browne, M. Neil, and Stuart M. Keeley. Asking The Right Questions. New Jersey: Prentice Hall, (Latest Edition)

Course Content

8.55 Professional Psychology and Human Behavior

COURSE TITLE (ECS-322) **Professional Psychology & Human Behavior**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Social Sciences**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the complexity of human behaviour and relationships.	C-2	1
CLO-2	**Comprehend** Psychology as science and empirical methods used for understanding different aspects of human behaviour.	C-2	4
CLO-3	**Apply** the skills in research and evaluation within a scientific framework to interact with different professionals and do an effective communicate information in both verbal and non-verbal way.	C-3	10
Course Outline for Theory			
Understanding Psychology: Scientific perspective of Psychology, Historical perspective, Schools of psychology, Methods of psychology, Ethical issues, Fields of psychology and their application, Biological Basis of Behaviour: Neuron and its function, Central nervous system, Peripheral nervous system, Endocrine system, Sensation and Perception: Senses: Vision, audition, smell, taste and kinesthetics, introduction to perception, Kinds of Perception, Gestalt principles, Binocular and monocular cues, Illusions and extra sensory perception, Learning: Definition of learning, Types of learning: Classical and operant conditioning, Punishment and its effects, Latent and observational learning, Memory: Definition and types of memory, Processes and techniques of improving memory, forgetting: Nature and causes, Cognition and Language: Concept of cognition, Problem solving, Judgment and decision making, Language development, Language and cognition, Language and culture, Intelligence and Creativity: Concept of intelligence, Theories of intelligence, Assessment of intelligence Mental retardation, Concept of creativity and its stages, Motivation and Emotion: Introduction to motivation, Factors affecting motivation, Introduction to emotions, Types of emotions, Physiological changes during Emotions (Neural, Cardial, Visceral, Glandular), Theories of emotion, Social Thinking and Social Influence: Definition and nature of thinking, Tools of thinking, kinds of thinking, Social facilitation, Attribution theory, Crowd behaviour, Conformity, Obedience, Helping behaviour			

Recommended Books
1. Atkinson R. C., & Smith E. E. Introduction to psychology(13thed.). Harcourt Brace College Publishers, (Latest Edition) 2. Fernald,L.D.,& Fernald,P.S. Introduction to psychology. USA: WMC Brown Publishers, (Latest Edition) 3. Glassman, W. E. Approaches to psychology. Open University Press (Latest Edition) 4. Hayes, N. Foundation of psychology Thomson Learning. Lahey, B. B. Psychology: An introduction McGraw-Hill Companies, Inc. (Latest Edition) 5. Coon, D., &Mutterer, J. Introduction to psychology: Gateways to mind and behavior Wadsworth Cengage Learning (Latest Edition) 6. Fredrickson, B., Nolen-Hoeksema, S.,Loftus, G., &Wagenaar, W. Atkinson & Hilgard's introduction to psychology USA: Wadsworth (Latest Edition) 7. Kalat, J. W. Introduction to psychology. USA: Cengage Learning, Inc. (Latest Edition) 8. Lahey, B. B. Psychology: An introduction UK: McGraw-Hill Companies, Inc. (Latest Edition) 9. Leahey, T. H. A history of psychology: Main currents in psychological thought. New Jersey: Prentice-Hall International, Inc, (Latest Edition)

Course Content

8.56 Fundamentals of Economics

COURSE TITLE (ECM-121) **Fundamentals of Economics**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN** **Management Science Elective**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Estimate** the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value.	C-2	2
CLO-2	**Predict** the cost effectiveness of individual projects using the methods learnt and the effects of inflation on economic analysis of engineering projects.	C-3	11
CLO-3	**Analyze** the appropriate engineering economics analysis method(s) for problem solving i.e. present worth, annual cost, rate of return, payback, break-even, benefit-cost ratio.	C-4	2

Course Outline for Theory

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

Recommended Books

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

Course Content

8.57 Entrepreneurship

COURSE TITLE (ECM-122) **Entrepreneurship**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/ DOMAIN Management Science Elective**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the understanding of entrepreneurship concept as a whole and the role of entrepreneurship in economic development.	A-3	7
CLO-2	**Compare** the role and importance of the small and medium sized enterprises in the economy.	A-4	6
CLO-3	**Find** an attractive market and apply the understanding of business planning concept for new business creation and growth.	A-3	12

Course Outline for Theory

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

Recommended Books

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

Course Content

8.58 Project Management

COURSE TITLE (ECM-311) **Project Management**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN Management Science Elective**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** and understand the basic concepts of management with a special focus on project management.	A-1	11
CLO-2	**Demonstrate** competency in various project management knowledge areas, project scheduling and controlling techniques including Critical Path Method and Earned Value Management.	A-3	11
CLO-3	**Use** computers in Project Management, especially a tool like MS Project & Primavera etc.	C-3	5

Course Outline for Theory

- Introduction to management: History of management, functions and functional areas of management, levels of management, managerial skills, types of organizations, managerial control, principles of management.
- Introduction to Project Management: Definition of Project and project management, knowledge areas of project management, project life cycle, project characteristics, project constraints, project organization structure.
- Project Quality Management: History of Quality Management, Defining Quality, relationship between project management and quality management, Quality Management Frameworks
- Project Stakeholder Management: The roles of project manager and project sponsor, Project team selection, skills and competencies of project manager, building and managing successful project teams, stakeholder management.
- Project Cost estimating and Budgeting: Cost components and methods for cost estimation in projects, cost control in projects, life cycle cost, cost scheduling and forecasting, project resource allocation and levelling, Estimation of outstanding work, elements of budgets and estimates, earned value management.
- Project Risk Management: Defining risk and uncertainty, business and project risk, probability and impact of risk, risk management process.
- Project Time Management: Introduction to project scheduling, Critical Path Method, Network representation of projects, critical activities, and critical path, project Gantt chart.
- Project Closure: Project evaluation, project and project management success, success criteria for projects, project audits, project termination process.
- Project Management tool: Introduction and use of project management tools like MS project and primavera.

Recommended Books

1. A Guide to the Project Management Body of Knowledge (PMBOK Guide), Project Management Institute (Latest Edition)
2. Project Management: A Systems Approach – A Book Review, Harold Kerzner, ISBN-10: 1118022270; ISBN-13: 978-1118022276 (Latest Edition)

Course Content

8.59 Principles of Marketing

COURSE TITLE (ECM-411) **Principles of Marketing**	**CREDIT HOURS** (3+0) **48 Theory + 0 Lab Sessions**	**KNOWLEDGE AREA/DOMAIN** **Management Science Elective**	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** marketing philosophies and marketing environment.	C-2	1
CLO-2	**Apply** marketing mix techniques to manage business efficiently and effectively.	C-3	12

Course Outline for Theory

- Introduction to Marketing: What is Marketing, understanding marketplace and customer needs, Customer driven marketing strategy, preparing marketing plan and capturing customer value, changing landscape of marketing. Marketing Mix and managing marketing effort.
- Understanding Market and Customer: Microenvironment, Macro environment, developing marketing information, marketing research, analysing and using market information, Models of Consumer Behaviour, Factors Influencing Consumer, Types of Buying Decision, Consumer Buying Process
- Making Product the Brand- creating value: What is product, Service and Experience, Product line and Product mix, product classification and Branding Strategy, product life cycle and new product development process?
- Pricing – understanding and capturing value: What is price, pricing strategies, new product pricing strategy, product mix pricing strategy and price adjustment strategy?
- Marketing Channel – delivering customer value: Supply chain and value delivery network, Types of channels, Decision of channel, retailing and whole selling.
- Promotion – Communicating customer value: The promotion mix, integrated marketing communication, effective marketing communication, socially responsible communication, advertising and public relations, personal selling and personal selling process and sales promotion.
- Creating Competitive Advantage: Competitor analysis whom to attack and avoid and competitive strategies.

Recommended Books

Principles of Marketing, Philip Kotler, Gary Armstrong, John Saunders and Veronica, (Latest Edition)

Marketing: Principles and Strategies Hardcover by Charles D. Schewe, (Latest Edition)

9. Supervised Industrial Training

9.1 Background

Supervised Industrial Training refers to students supervised hands-on experience in an environment where engineering 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 Electronics 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 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 (7th and 8th), these credit hours and contact hours will be doubled.

d. Students will maintain a daily Logbook, signed by the SIT supervisor at site, Training Administrator appointed by HEI and the student.

e. Students must observe safety & security rules of the Organization where they receive Training.

f. Students must wear specified working dress during training.

g. Students must obey all rules and regulations of the organization.

h. Students must observe working timings of the training Organization. Students may be allowed 10 days leave during Training period of 16 (or 32) for genuine reasons. The leave shall only be availed to cater for emergency/s, with prior sanction from the training Administrator/Coordinator.

i. Leave will be deducted from training hours and required to be made up later.

j. Unsanctioned leaves shall be treated as "absent", and liable to disciplinary action.

k. Public holidays and leaves should not be counted as working hours.

9.5 Training Progress Assessment and Review by HEI

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

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

a. To ensure the training organization is providing suitable and appropriate training to students.

b. To obtain feedback on students' performance and training progress through discussion with training supervisor(s).

c. To make courtesy visits and establish industrial relations between the HEI and the industries where students will receive their SIT.

d. To discuss the possibility of students' job placement with the training organization.

e. To survey new industries as potential training placement locations in the future.

9.6 Changing Student Placement During SIT

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

b. However, written permission may be granted by the training Administrator/Coordinator, if new placement of the student is available and confirmed in another organization, provided the student does not suffer loss of training hours due to this changeover.

c. After getting written permission from the Training Administrator/Coordinator, a fresh approval should be applied for the new placement.

9.7 Daily Training Logbook

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

a. The student's learning experience during the industrial training
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 describe fully 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. Major works performed during SIT
ii. Different modules of SIT
iii. Comments whether SIT met the training objectives
iv. Suggestions and recommendations for improvement of the SIT

(f) References

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

(g) Appendixes

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

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

(h) Figures and Tables

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

(i) Notations, Symbols & Acronyms

If the report contains notations, symbols, and acronyms, these must be defined before they first appear in the main text. It is good practice to put list of notations, symbols, and acronyms on a separate page, appropriately titled, and placed after 'Tables of Contents' page.
Every appendix must have a title and be mentioned in the main text of the Report. All page numbers for appendixes must be in continuation of page numbers of the main Report.

9.9.2 Format of the Report

(a) General

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

(b) Abstract or Preface

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

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

9.10 SIT Assessment

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

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

Please note that:

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

9.11 Completion of Industrial Training

i. Upon completion of a 16 or 32-week continuous SIT, a Confirmation Letter to this effect must be obtained from the training organization and/or probable employer.

ii. The Confirmation Letter must be submitted to the Industrial Training Administrator/Coordinator, together with the (1) On-the-Job Trainer's Report, (2) Student Feedback Form, and (3) Industrial Training Report for grading.

APPENDIX A: Sydney Accord Knowledge and Attitude Profile

(Retrieved from www.ieagreements.org)

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

APPENDIX B: Engineering Technologist Graduate Attribute Profile

(Retrieved from www.ieagreements.org)

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

Individual and Teamwork **SA9:** An ability to Function effectively as an individual, and as a member or leader in diverse teams.
Communication **SA10:** An ability to communicate effectively on broadly defined Engineering Technology activities with the Engineering Technologist community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project Management **SA11:** An ability to demonstrate knowledge and understanding of Engineering Technology management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.
Lifelong Learning: **SA12:** An ability to recognize the need for and have the ability to engage in independent and life-long learning in specialist Engineering Technologies.

APPENDIX C: Engineering Technologist Professional Competence Profile

(Retrieved from www.ieagreements.org)

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

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

APPENDIX D: Minutes of Preliminary Meeting of NCRC

1. Preliminary meeting of National Curriculum Review Committee (NCRC) in the discipline of Electronics Engineering Technology for bachelor's degree program was held on 18-11-2021 to 20-11-2021 for 3 days at the Khwaja Fareed University of Engineering & Information Technology (KFUEIT), Rahim Yar Khan.
2. The meeting started with recitation from the Holy Quran by the Engr. Prof. Dr. Yaseer Arafat Durrani. The NTC representative, Mr. Hafiz Ghulam Muhammad, welcomed Members, thanked them for attending the meeting, and briefed them about NTC expectations from the Committee. Participants introduced themselves highlighting their qualifications, experience, and areas of the expertise. Mutual consultations were held for nomination of the Convener, Co-Convener and Secretary of the CDC of the Electronics Engineering Technology. Engr. Prof. Dr. Yaseer Arafat Durrani, Engr. Dr. Amjad Ali, and Engr. Dr. Muhammad Ayub Tareen were selected unanimously as Convener, Co-Convener and Secretary, respectively.
3. The Convener Prof. Dr. Yaseer Arafat Durrani, in consultation with the Committee Members, assigned tasks related to the knowledge and area-wise courses among the sub-committees, keeping in view their experience and expertise in the field. The following Core Committee along with the four sub-committees was constituted with their separate Conveners and Secretaries to finalize the contents of their respective knowledge area courses. Dr. Amjad Ali as Co-Convener, briefed each sub-committee Member about the relevant tasks to be completed.

S.No	NCRC Members	Role
1.	Prof. Dr. Yaseer Arafat Durrani Professor Chairman, Electronics Engineering & Biomedical Engineering Technology Department, UET, Taxila	Convener
2.	Dr. Amjad Ali Associate Professor Chairman, Electrical Engineering Department UET, Peshawar Jalozai Campus	Co-Convener
3.	Dr. Muhammad Ayub Tareen Associate Professor Chairman, Electronics Engineering Department, BUITEMS, Quetta	Secretary
4.	Dr. Muhammad Amjad Professor Dean, Faculty of Engineering and Technology, IUB, Bahawalpur	Member
5.	Dr. Abdul Rauf Anwar Associate Professor Chairman, Biomedical Engineering Department, UET, Lahore, New Campus	Member
6.	Dr. Muhammad Irfan Assistant Professor KFUEIT, Rahim Yar Khan	Member
7.	Dr. Muhammad Hanif Ahmed Khan Khushik Assistant Professor Director ORIC, BBSUTSD, Khairpur Mirs	Member
8.	Dr. Muhammad Saleem	Member

	Assistant Professor Chairman, Electronics Engineering Technology, BBSUTSD, Khairpur Mirs	
9.	Dr. Abubakar Saddique Assistant Professor KFUEIT, Rahim Yar Khan	Member
10.	Engr. Dr. Shahid Atiq Associate Professor Chairman, Electrical Engineering, KFUEIT, Rahim Yar Khan	Coopted Member
11.	Engr. Dr. Muhammad Umair Shahid Assistant Professor KFUEIT, Rahim Yar Khan	Coopted Member
12.	Engr. Fazal ur Rehman Lecturer KFUEIT, Rahim Yar Khan	Coopted Member
13.	Engr. Muhammad Usman Sardar Lecturer KFUEIT, Rahim Yar Khan	Coopted Member
14.	Hafiz Ghulam Muhammad Admin & Account Officer National Technology Council	NTC Rep.

4. After taking charge by the nominated Committee, Convener, Engr. Prof. Dr. Yaseer Arafat Durrani chaired the meeting and emphasized to ensure reflection of Sydney Accord in curriculum and course titles, as well as to develop a curriculum that provides a unified framework for offering degrees under the title of Electronics Engineering Technology.
5. In continuation of above guidelines, Dr. Amjad Ali, Co-Convener, Dr. Muhammad Ayub Tareen, Co-Secretary highlighted the objectives of curriculum development.
6. Agreed upon objectives were categorized and assigned to Subcommittees, where Honorable Members reviewed, discussed, and submitted the following resolutions:
   - Develop an undergraduate curriculum of Electronics Engineering Technology which is at par with international standards and in substantial conformity with the Sydney Accord.
   - Clearly define program education objective (PEOs), course learning outcomes (CLOs) with Bloom's Taxonomy Levels, and course contents aligned with program learning outcomes (PLOs).
   - Incorporate latest relevant reading materials/ references.
   - Ensure that course content that is uniform across other disciplines (HEC's Gen Ed requirements) are not duplicated.
   - Curriculum must be futuristic, and answer needs of society.
7. In the next session, the house discussed the nomenclature of the discipline, preface, objectives of the programs, PLOs, methods of instruction and learning environment, assessment, and operational framework.
8. After long deliberations, the Committee proposed the curriculum framework, the duration of the program, number of semesters, number of weeks per semester, total number of credit hours, weightage of technology domain and non-technology domain courses and weightage of theory and practical of undergraduate 4-years program in Electronics Engineering Technology.
9. Furthermore, list of courses (core and elective) and semester wise breakup of courses were also discussed thoroughly and finalized.
10. Admission/intake criteria was discussed and adopted same as defined in NTC Accreditation Manual.

11. Supervised industrial training (SIT) was discussed in detail. There was a consensus that SIT will be mandatory for 8th Semester.
12. Those HEI's that can provide only one semester of SIT (in 8th), shall offer optional courses instead of SIT in the 7th semester to cover credit hours and other requirements.
13. HEI's that are geared to provide SIT in two semesters can do this in 7th and 8th Semesters.
14. In line with the experience and expertise of NCRC members, list of courses of various domains were distributed among the Sub-Committees.
15. These Committees were assigned responsibility for reviewing course objectives, adding course learning outcomes, appropriate mapping with taxonomy and PLOs, updating list of contents, adding teaching-learning methods and assessment, and updating bibliography/ references/ suggested books.

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

Electronics Engineering Technology Core Committee		
S. No.	**Name**	**Role**
1	Prof. Dr. Yaseer Arafat Durrani	Convener
2	Dr. Amjad Ali	Co-convener
3	Dr. Muhammad Ayub Tareen	Secretary
4	Dr. Muhammad Saleem	Member
1. Subcommittee: Electronics Engineering Technology Computing, Management & Social Sciences		
S. No.	**Name**	**Role**
1	Dr. Amjad Ali	Convener
2	Dr. Muhammad Hanif Ahmed Khan	Secretary
3	Engr. Fazal Ur Rehman	Member
2. Subcommittee: Electronics Engineering Technology Foundation		
S. No.	**Name**	**Role**
1	Dr. Abdul Rauf Anwar	Convener
2	Dr. Muhammad Irfan	Secretary
3	Dr. Shahid Atiq	Member
3. Subcommittee: Electronics Engineering Technology Breadth		
S. No.	**Name**	**Role**
1	Prof. Dr. Muhammad Amjad	Convener
2	Dr. Abubakar Saddique	Secretary
3	Engr. Usman Sardar	Member
4. Subcommittee: Electronics Engineering Technology Depth		
S. No.	**Name**	**Role**

1	Prof. Dr. Yaseer Arafat Durrani	Convener
2	Dr. Muhammad Ayub Tareen	Secretary
3	Dr. Muhammad Umair Shahid	Member
4	Dr. Muhammad Saleem	Member

17. After conclusion of the Preliminary Meeting, the Sub-Committees submitted the proposed course contents for theory and practicals, along with CLOs, list of recommended books, list of experiments and relevant information of each course.
18. The first draft was compiled by the Dr. Muhammad Ayub Tareen, Secretary NCRC, and distributed to members for review.
19. 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 NCRC in the discipline of Electronics Engineering Technology for the bachelor's degree program was held on 24-01-2022 to 26-01-2022 for 03 days at the Khwaja Fareed University of Engineering & Information Technology, Rahim Yar Khan (KFUEIT-RYK).
2. The inauguration session started with recitation from the Holy Quran. The Convener of the Committee, Prof. Dr. Yaseer Arafat Durrani appreciated Members for their efforts and completion of the tasks assigned in the preliminary meeting. The Registrar, KFUEIT, Dr. Muhammad Sagir attended the opening session of the final meeting. He welcomed the members and extended his best wishes to the national curriculum revision committee.
3. The Chairman also extended his gratitude to the entire team and briefed the objectives and arrangements for the second NCRC.
4. Mr. Muhammad Fahd Amin, Acting Registrar, NTC with Mr. Hafiz Ghulam Muhammad represented NTC.
5. The following Members attended the meeting:

S.No	NCRC Members	Role
1.	Engr. Prof. Dr. Yaseer Arafat Durrani Professor Chairman, Electronics Engineering & Biomedical Engineering Technology Department, UET, Taxila	Convener
2.	Engr. Dr. Amjad Ali Associate Professor Chairman, Electrical Engineering Department UET, Peshawar Jalozai Campus	Co-Convener
3.	Engr. Dr. Muhammad Ayub Tareen Associate Professor Chairman, Electronics Engineering Department, BUITEMS, Quetta	Secretary
4.	Engr. Dr. Muhammad Amjad Professor Dean, Faculty of Engineering and Technology, IUB, Bahawalpur	Member
5.	Engr. Dr. Abdul Rauf Anwar Associate Professor Chairman, Biomedical Engineering Department, UET, Lahore, New Campus	Member
6.	Engr. Dr. Muhammad Irfan Assistant Professor KFUEIT, Rahim Yar Khan	Member
7.	Engr. Dr. Muhammad Hanif Ahmed Khan Khushik Assistant Professor Director ORIC, BBSUTSD, Khairpur Mirs	Member
8.	Engr. Dr. Abubakar Saddique Assistant Professor KFUEIT, Rahim Yar Khan	Member

9.	Engr. Dr. Muhammad Umair Shahid Assistant Professor KFUEIT, Rahim Yar Khan	Coopted Member
10.	Engr. Fazal ur Rehman Lecturer KFUEIT, Rahim Yar Khan	Coopted Member
11.	Engr. Muhammad Usman Sardar Lecturer KFUEIT, Rahim Yar Khan	Coopted Member
12.	Hafiz Ghulam Muhammad Admin & Account Officer National Technology Council	NTC Rep.

6. After the inaugural session, deliberations on the agenda of the second meeting formally commenced which was headed by Convener Engr. Prof. Dr. Yaseer Arafat Durrani, Co-Convener Prof. Dr. Amjad Ali, Secretary Dr. Muhammad Ayub Tareen.
7. Honorable Members were informed that valuable feedback was received from the following international experts:

Sr#	Foreign Expert Name	Affiliation
1	Engr. Dr. Sheroz Khan	Onaizah College of EE & IT, KSA
2	Engr. Prof. Dr. NasimUllah	TAIF University, KSA
3	Engr. Dr. Ahmad Umair Mian	The Bradford Exchange, London, ON, Canada
4	Engr. Dr. Noman Baloch	University of Sheffield, UK

8. The Forum was informed that international experts appreciated the efforts done by NCRC to compose a balanced and standardized curriculum for Electronics Engineering Technology.
9. Various issues were thoroughly deliberated upon by Members of NCRC in Sub-Committees, and Honorable Members submitted the following resolutions:
    - Agreed upon curriculum preface, mission, vision, preamble, rationale, scope, course scheme etc.
    - Finalized bench marking of Recommended Scheme of Studies, Engineering Technology domain and non-Engineering technology domain courses in comparison with framework and list of Electives as defined earlier.
    - Approved the Semester-wise break-up of courses, credit hours allocations and Breadth and Depth courses.
    - Recommended sample course profiles and contents.
    - Recommend sample weekly lecture plan and laboratory work for Foundation and Breath courses.
10. The initial draft was compiled by Secretary Engr. Dr. Muhammad Ayub Tareen.
11. After review by Members, and with the approval of Convener Engr. Prof. Dr. Yaseer Arafat Durrani, Co-Convener Engr. Dr. Amjad Ali it was submitted to NTC.

APPENDIX F: Supervised Industrial Training Logbook (Sample Format)

Personal Details:

Student Name:
Student Roll Number:
Address:
Email:

Course of Study:
Year/Semester of Study:
Training Start Date:
Training End Date:

Training Organization Details:

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

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, _____ with student roll number _____, do hereby declare that all information provided above is true and correct to the best of my knowledge.

_____
Student signature with date

_____
Supervisor signature with date

APPENDIX G: Supervised Industrial Training Report (Sample Format)

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