Curriculum

for

Bachelor of Computer Engineering Technology Degree

(2023)

Higher Education Commission
Islamabad
Curriculum Division

Acronyms, Abbreviations & Definitions

Acronym/Abbreviation	Definition
NTC	National Technology Council
NCRC	National Curriculum Review Committee
IDEE	Integration of Data in Engineering Environment
MATLAB	Matrix Laboratory
HEI	Higher Education Institution
SMEs	Small and Medium Enterprises
PLC	Programmable Logic Controller
DIAC	Diode for Alternating Current
RLC	Resistance, Inductance, Capacitance
IEEE	Institute of Electrical and Electronics Engineers
LTI	Linear Time-Invariant System
BJT	Bipolar Junction Transistor
SCR	Silicon Controlled Rectifier
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
IGBT	Insulated-Gate Bipolar Transistor
Th	Theory
Lab	Laboratory
Cr. Hrs.	Credit Hours

Contents

1. Introduction

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

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

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

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

2. Curriculum Development Methodology

2.1 Benchmarking

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

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

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

2.2 Curriculum Development Cycle

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

- Nominations are requested from academic circles and relevant industry forums to constitute a National Curriculum Review Committee (NCRC) comprising of leading national experts.
- From the nominations received, NCRC is finalized and notified by NTC/HEC.
- A preliminary Meeting of the NCRC, spanning three days, is held to establish framework and benchmarking issues, and assign different facets of curriculum development to smaller teams within the NCRC.
- NCRC Members elect a Convenor, a co-Convenor, and a Secretary amongst themselves for the proceedings of NCRC, after mutual consultations.
- A draft of program curriculum is prepared by NCRC at the end of the Preliminary Meeting and sent to relevant foreign experts for review and feedback.
- After the foreign expert's review and feedback is received, a Final NCRC Meeting, lasting up to three days, is held to finalize the NCRC Members recommendations, and prepare a final curriculum document.
- The entire cycle of curriculum development is completed in two months.

2.3 Historical Timeline of Meetings

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

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

3. Curriculum Details

Bachelor of Computer Engineering Technology Program			
Parameter	**HEC Framework**	**Framework - A (SIT in 8th Semester Only)**	**Framework - B (SIT in 7th & 8th Semesters)**
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	42	N/A
Engineering Technology Domain Courses	28	27	N/A
Non-Engineering Technology Domain Courses	13	15	N/A
Total Credit Hours	124 – 136	131	N/A
Engineering Technology Domain Credit Hours	85	90	N/A
Percentage of Engineering Technology Domain Courses	74.42%	68.70%	N/A
Non-Engineering Technology Domain Credit Hours	39	41	N/A
Percentage of Non-Engineering Technology Domain Courses	31.45%	31.30%	N/A
No. of Credit Hours per Semester	15 – 18	15 – 18	N/A
** Optional Courses shall be included for Framework A (SIT in 8th Semester only)			
1 credit hour: (1) For theory: 1 contact hour per week for a minimum of 16 weeks for theory. (2) For practical's: 3 contact hours per week for a minimum of 16 weeks for practical's.			

Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework							
Knowledge Area	**Name of Course**	**Credit Hours** (Th+Lab)	**Weekly Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
				As per Scheme of Studies	**As per Framework**	**As per Scheme of Studies**	**As per Framework**
Computing	Information and Communication Technology	1+1=2	1+3=4	8	6	3	3
	Computer Programming	1+2=3	1+6=7				
	Data Structures and Algorithms	1+2=3	1+6=7				
Computer Engineering Technology (Foundation)	Technical Drawing	0+1=1	0+3=3	19	20	7	10
	Electric Circuits	2+2=4	2+6 =8				
	Electronic Devices and Circuits	2+1=3	2+3 =5				
	Computer Hardware Systems	1+1=2	1+3=4				
	Digital Logic Design	2+1=3	2+3=5				
	Operating Systems	2+1=3	2+3=5				
	Signals and Systems	2+1=3	2+3=5				
Computer Engineering Technology (Breadth)	Embedded Systems	1+1=2	1+3=4	20	24	8	6
	Instrumentation and Data Acquisition	1+1=2	1+3=4				
	Network Technologies	2+1=3	2+3=5				
	Mobile Application Development	1+2=3	1+6=7				
	Web Technologies	1+2=3	1+6=7				
	Systems and Network Administration	1+1=2	1+3=4				
	Database Applications	1+1=2	1+3=4				
	Cloud Computing	1+2=3	1+6=7				
Computer Engineering Technology (Depth)	Depth Elective -1	1+2=3	1+6=7	15	14	5	5
	Depth Elective -2	1+2=3	1+6=7				
	Depth Elective -3	1+2=3	1+6=7				
	Depth Elective -4	2+1=3	2+3=5				
	Depth Elective -5	2+1=3	2+3=5				
	IDTE-I	2+1=3	2+3=5	6	5	2	2

IDTE	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	0+16=16	0+48=48	16		0	
Total Credit Hours and Courses for Engineering Technology Domain		34+56 = 90	34+168 = 202	**Credit Hours 90**		**Courses 27**	

Non-Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework								
Knowledge Area	**Sub Area**	**Name of Course**	**Credit Hours** (Th+Lab)	**Weekly Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
					As per Scheme of Studies	**As per Framework**	**As per Scheme of Studies**	**As per Framework**
Humanities and Social Sciences	English, Language and Foundational Soft Skills	Functional English	3+0=3	3+0=3	12	6	4	2
		Foreign Language	3+0=3	3+0=3				
		Communication Skills	3+0=3	3+0=3				
		Technical Report Writing	3+0=3	3+0=3				
	Culture	Islamic Studies / Ethics	2+0=2	2+0=2	4	6	2	2
		Pakistan Studies	2+0=2	2+0=2				
	Social Sciences Electives	Technology, safety and the Environment	2+0=2	2+0=2	4	9	2	3
		Professional Ethics	2+0=2	2+0=2				
Management Sciences	Management Sciences	Organizational Behavior	3+0=3	3+0=3	6	6	2	3
		Technopreneurship	3+0=3	3+0=3				
Natural Sciences	Math	Calculus and Analytical Geometry	3+0=3	3+0=3	6	6	2	2
		Linear Algebra	3+0=3	3+0=3				
	Physics	Applied Physics	2+1=3	2+3=5	3	4	1	1
University Electives		GE- Elective -1	3+0=3	3+0=3	6	0	2	0
		GE- Elective -2	3+0=3	3+0=3				
Total Credit Hours and Courses for Non-Engineering Technology Domain					**Credit Hours 41**		**Courses 15**	

4. Admission Criteria

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

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

(2) Entrance Test

(3) Weightage:

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

5. Semester-wise Scheme of Studies

Semester-wise scheme of studies for the Bachelor of Computer Engineering Technology program spanning 4 years, spread over 8 semesters, and totaling 131 credit hours is presented below, along with weekly contact hours for each course.

SEMESTER-I				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
CPH-111	Functional English	Art & Humanities-I	3+0	3+0
CPN-112	Applied Physics	Natural Sciences-I	2+1	2+3
CPN-113	Calculus and Analytical Geometry	Natural Sciences-II	3+0	3+0
CPH-114	Islamic Studies / Ethics	Art & Humanities-II	2+0	2+0
CPC-115	Information and Communication Technologies	Computing-I	1+1	1+3
CPT-116	Electric Circuits	Computer Engineering Technology Foundation-I	2+2	2+6
	Subtotal		**13+4 =17**	**13+12 =25**
SEMESTER-II				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
CPC-121	Computer Programming	Computing-II	1+2	1+6
CPT-122	Electronic Devices and Circuits	Computer Engineering Technology Foundation-II	2+1	2+3
CPT-123	Technical Drawing	Computer Engineering Technology Foundation-III	0+1	0+3
CPN-124	Linear Algebra	Natural Sciences-III	3+0	3+0
CPH-125	Pakistan Studies	Art & Humanities-III	2+0	2+0
CPH-126	Communication Skills	Art & Humanities-IV	3+0	3+0
	Subtotal		**11+4 =15**	**11+12 =23**

SEMESTER-III				Weekly Contact Hrs. (Th+Lab)
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
CPT-211	Operating Systems	Computer Engineering Technology Foundation-IV	2+1	2+3
CPT-212	Signals and Systems	Computer Engineering Technology Foundation-V	2+1	2+3
CPC-213	Data Structures and Algorithms	Computing-III	1+2	1+6
CPH-214	Technical Writing	Art & Humanities-V	3+0	3+0
UGE-215	GE- Elective -1	University Elective – I	3+0	3+0
CPT-216	Digital Logic Design	Computer Engineering Technology Foundation-VI	2+1	2+3
	Subtotal		**13+5 =18**	**13+15 =28**
SEMESTER-IV				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
CPT-221	Computer Hardware Systems	Computer Engineering Technology Foundation-VII	1+1	1+3
CPT-222	Instrumentation and Data Acquisition	Computer Engineering Technology Breadth Core-I	1+1	1+3
CPT-223	Web Technologies	Computer Engineering Technology Breadth Core-II	1+2	1+6
CPH-224	Foreign Language	Art & Humanities-VI	3+0	3+0
CPT-225	Mobile Application Development	Computer Engineering Technology Breadth Core-III	1+2	1+6
CPT-226	Database Applications	Computer Engineering Technology Breadth Core-IV	1+1	1+3
	Subtotal		**8+7 =15**	**8+21 =29**

SEMESTER-V				Weekly Contact Hrs. (Th+Lab)
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
CPT-311	Embedded Systems	Computer Engineering Technology Breadth Core-V	1+1	1+3
CPT-312	Systems and Network Administration	Computer Engineering Technology Breadth Core-VI	1+1	1+3
CPT-313	Network Technologies	Computer Engineering Technology Breadth Core-VII	2+1	2+3
CPM-314	Organizational Behavior	Management Sciences-I	3+0	3+0
CPT-315	Depth Elective -1	Computer Engineering Technology Depth Elective-I	1+2	1+6
CPT-316	Depth Elective -2	Computer Engineering Technology Depth Elective-II	1+2	1+6
	Subtotal		**9+7 =16**	**9+21 =30**
SEMESTER-VI				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
CPT-321	Depth Elective -3	Computer Engineering Technology Depth Elective-III	1+2	1+6
CPT-322	Depth Elective -4	Computer Engineering Technology Depth Elective-IV	2+1	2+3
IDE-323	IDTE - 1	Inter Disciplinary Elective-I	2+1	2+3
CPM-324	Technopreneurship	Management Sciences-II	3+0	3+0
CPH-325	Professional Ethics	Art & Humanities-VII	2+0	2+0
CPT-326	Project-1	Senior Design Project-I	0+3	0+9
	Subtotal		**10+7 =17**	**10+21 =31**

SEMESTER-VII				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
CPT-411	Cloud Computing	Computer Engineering Technology Breadth Core-VIII	1+2	1+6
IDE-412	IDTE – 2	Inter Disciplinary Elective-II	2+1	2+3
UGE-413	GE- Elective -2	University Elective-II	3+0	3+0
CPT-414	Depth Elective -5	Computer Engineering Technology Depth Elective-V	2+1	2+3
CPH-415	Technology, Safety and the Environment	Art & Humanities-VIII	2+0	2+0
CPT-416	Project-2	Senior Design Project-II	0+3	0+9
	Subtotal		**10+7=17**	**10+21 =31**
SEMESTER-VIII				**Weekly Contact Hrs. (Th+Lab)**
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
CPT-421	**Supervised Industrial Training (Compulsory)**	Computer Engineering Technology Domain Industrial Training	**16**	**40 (Per Week)**
	Subtotal		**0+16= 16**	**0+48= 48**
Total Credit Hours & Contact Hours in Four Years			**74+57 = 131**	**74+171=245**
Theory vs Practical with respect to Contact Hours			Theory Practical	74 (30.20%) 171 (69.80%)

6. Course Codes

Details pertinent to course code are presented below:

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

Digits in course-code are defined in table below:

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

Letters in course-code prefix are defined below:

- First two letters pertain to the program (e.g., CP for Computer)
- Third letter pertains to specifics of the course (e.g., T for technology, H for Humanities etc.)

Course Code Examples		
Sr.	**Course Code Prefix**	**Description**
1	CP**T**	Computer Engineering Technology Foundation/ Breadth/ Depth
2	CPH	Humanities and Social Sciences
3	CP**M**	Management Sciences
4	CP**N**	Natural Sciences
5	CP**C**	Computing
6	IDE	Inter Disciplinary Technology Elective
7	UGE	University General Elective

7. Elective Courses

The lists of elective courses, grouped across depth and inter-disciplinary technology (IDT) categories, are presented below, showing credit hours and weekly contact hours.

Computer Engineering Technology Electives -- Depth		**Weekly Contact Hours (Th+Lab)**
Name of Course	**Credit Hours (Th+Lab)**	
Hardware Description Language	1+2	1+6
Real-Time Operating Systems	2+1	2+3
Digital System Design	2+1	2+3
Network Switching and Routing	1+2	1+6
Blockchain Technology	2+1	2+3
Machine Learning and Data Analytics	1+2	1+6
Sensor Networks and Applications	2+1	2+3
Chip Design Technology	1+2	1+6
Multimedia and Animation	1+2	1+6
Fault-Tolerant Systems	2+1	2+3
Digital Forensics	2+1	2+3
Intelligent Systems and Robotics	2+1	2+3
Navigational Technologies	2+1	2+3
Smart Surveillance Systems	2+1	2+3
System Security	1+2	1+6
Software Construction	2+1	2+3
Virtual/Augmented Reality	2+1	2+3
Error Correction and Coding Techniques	1+2	1+6
*Any related course can be included with the approval of HEI's Statutory Bodies.		

Inter-Disciplinary Technology Electives (IDTE)		**Weekly Contact Hours (Th+Lab)**
Name of Course	**Credit Hours (Th+Lab)**	
Electromechanical Systems	2+1	2+3
Electrooptical Technology and Applications	2+1	2+3
HCI Technologies	2+1	2+3
Agricultural Technologies	2+1	2+3
Biomedical Technology	2+1	2+3
Biotechnologies	2+1	2+3
Bioinformatics	2+1	2+3
Automotive Technology	2+1	2+3
*Any related course can be included with the approval of HEI's Statutory Bodies.		

8. Course Contents

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

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

Course Content

8.1 Functional English

CODE & TITLE (CPH-111) **Functional English**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Art & Humanities-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** common errors made by the learners of English as a second language.	C-2	10
CLO-2	**Develop** and write proper and cohesive paragraphs.	C-3	10
CLO-3	**Write** essays, magazine, and newspaper articles, and effectively paraphrase and summarize written content.	C-3	10
CLO-4	**Make** presentations to large audiences using audio and visual aids.	A-2	10

Course Outline

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

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

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

Locate common errors usually made by the learners of English as second language.

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

Recommended Books

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

Course Content

8.2 Applied Physics

CODE & TITLE (CPN-112) **Applied Physics**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Natural Science-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** and apply the concepts of mechanics.	C-3	1
CLO-2	**Understand** and apply the concepts of electrostatics and magnetostatics.	C-3	1
CLO-3	**Validate** the theoretical concepts through relevant lab experiments.	C-3	2

Course Objectives

- Explain the fundamental physical principles.
- Apply these principles, together with logical and mathematical reasoning, to situations of the physical world.
- Analyze different physical problems using the laws of physics.
- Identify knowledge of constructing basic circuits and demonstration of relevant theorems using Resistors and Capacitors
- Differentiate classroom knowledge and laboratory techniques for learning of basic principle used in Magnetism

Course Outline for Theory

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

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

Lab Outlines

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

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

Course Content

8.3 Calculus and Analytical Geometry

CODE & TITLE (CPN-113) **Calculus and Analytical Geometry**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Natural Sciences-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the basic concepts of analytical geometry.	C-2	1
CLO-2	**Use** the concepts of limits and continuity.	C-3	1
CLO-3	**Apply** techniques of differentiation and integration to real world problems.	C-3	2
CLO-4	**Evaluate** and perform convergence analysis of sequences and series.	C-5	2

Course Objectives

- Explain the ideas of rate of change, derivatives and it basic Applications
- Apply the techniques of integration for solving and analyzing problems in integral calculus
- Describe the vector calculus and analytical geometry in multiple dimensions for investigation of different engineering problems.

Course Outline for Theory

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

Recommended Books

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

Course Content

8.4 Islamic Studies/Social Ethics

CODE & TITLE (CPH-114) **Islamic Studies/Social Ethics**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Art & Humanities-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Know** the fundamentals of Islam.	C-2	6
CLO-2	**Practice** ethical and moral values in life.	C-2	8
CLO-3	**Use** an analytical approach towards Islam and modernism.	C-3	6

Course Objectives

- Recite Holy Quran with correct pronunciation.
- Apply understanding of basic concepts of teaching of Islam (faith, pillars, Dawit, preaching and Seerat).
- Produce Compilation of the Holy Quran and Basic Concepts of Hadith.
- Present Islam as a complete code of life.

Course Outline

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

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

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

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

Recommended Books

1. A Guidebook for Muslims, by Syed. Abul Hasan Ali Nadvi. (Latest Edition)
2. An Introduction to Islam, by Dr. Muhammad Hameedullah. (Latest Edition)
3. What is Islam? by Maulana Manzoor Nomani. (Latest Edition)

4. Islamiat (A standard book for CSS), Prof. Dr. Arif Naseem. (Latest Edition)

Course Content

8.5 Information and Communication Technologies

CODE & TITLE (CPC-115) **Information and Communication Technologies**	**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** core components of computer organization and their interworking.	C-2	1
CLO-2	**Apply** knowledge of data, numbers, and information for representations.	C-3	1
CLO-3	**Understand** the basic principles of operation of the memory, I/O, CPU, and device level of a typical computer.	C-3	3
CLO-4	**Use** the instruction-set architecture for mapping onto the MIPS instruction-set and simulating on the MIPS simulator.	P-4	5

Course Objectives

- **Provide** an introduction to computers and features of computer systems
- **Introduce** data processing and data storage
- **Understand** word processors and operating systems
- **Grasp** number conversions and basics of networking.

Course Outline

Introduction: Data vs Information, Hardware vs Software, Computers and Society, Computer oriented society, Risk of Computer oriented society, differences in online communication.
Number System: Binary, octal, and Hexadecimal number system, Inter conversions of different number systems, Binary representation of negative numbers
Problem Solving: Algorithms, Pseudocode and flowchart, Branches, Loops
Program development: Program Development Life Cycle, Basic Computer languages and language translator
Computer Networks: Network Characteristics, Wired vs Wireless, Topologies, Architecture (Client-server, p2p), Size and coverage area, Data Transmission Characteristics, Bandwidth, Analog vs Digital
Internet and WWW: What is Internet, Evolution of internet, World wide web, Domain Name System and network addresses, Interaction of web clients and web servers.
Information Security, Computer Security, Internet Security. Unauthorized Access and Unauthorized Use.
Computer Sabotage: Botnets, Computer Viruses and Other Types of Malwares, Denial of Service (DoS) Attacks, Protecting against unauthorized access and use, Firewalls, Encryption, and Virtual Private Networks (VPNs), Additional Public Hotspot Precautions
Intellectual Property: Rights, Ethics, Health, Access, and the Environment, Intellectual property rights, Ethics, Environmental concerns

Database system and management: Introduction to database and database management system, Evolution of database management, Data Concepts and Characteristics, Data Hierarchy, Entities and Entity Relationships, Data Definition, Data Dictionary, Data Integrity, Security, and Privacy, Data Organization
Lab Outlines
Working with the internet, MS Office including (MS Word, MS Excel, MS Power Point, MS Access), Visio
Recommended Books
1. R. K. Livesley, "An introduction to automatic digital computers", Cambridge University Press, 2017, ISBN-13: 1316633306 or Latest edition. 2. Charles S. Parker, "Understanding Computers: Today and Tomorrow, Comprehensive", Cengage Learning, 15th edition, 2014, ISBN-13: 978-1285767277 or Latest edition. 3. Anita Goel, "Computer fundamentals", Pearson Education India, 2010, ISBN: 9788131770948 Latest edition. 4. Priti Sinha, Pradeep K. Sinha, "Computer Fundamentals: Concepts, Systems & Applications", BPB Publication, 8th edition, 2004, ISBN-13: 978-8176567527 or Latest edition.

Course Content

8.6 Electric Circuits

CODE & TITLE (CPT-116) Electric Circuits	CREDIT & CONTACT HOURS (2+2) 32 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Computer Engineering Technology Foundation-I	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** electric circuit principles and laws, and the characteristics of circuit elements and their combinations	C-4	1
CLO-2	**Apply** the acquired knowledge to analyze the elements of a circuit using nodal and mesh analysis techniques	C-3	2
CLO-3	**Understand** the working of different electric circuits in the lab.	P-2	4
CLO-4	**Work** effectively as an individual or in a team.	A-3	9

Course Objectives

- To Identify linear systems and represent those systems in schematic form
- To Apply Kirchhoff's current and voltage laws and Ohm's laws to circuit problems
- To Simplify circuits using series and parallel equivalents and using Thevenin and Norton equivalents
- To Perform node and loop analyses and set these up in standard matrix format
- To Identify and model first and second-order electric systems involving capacitors and inductors
- To Predict the transient behavior of first and second-order circuits

Course Outline for Theory

Electric quantities, electric signals, circuit elements. Resistance, Ohm's Law, series-parallel combination, voltage and current dividers, resistive bridges, Kirchhoff's laws. Superposition Theorem, Thevenin's Theorem, Nodal analysis, loop analysis, linearity and superposition, source transformation, power calculations. dependent sources, circuit analysis with dependent sources, Capacitance, inductance (including mutual inductance), natural response of RC, RL and RLC circuits. Response to DC forcing function, AC fundamentals; RMS or effective, average, and maximum values of current & voltage for sinusoidal signal waveforms.

Lab Outlines

Experiments related to verification of Ohm's law, Kirchhoff's current and voltage laws, mesh analysis, nodal analysis, Thevenin theorem, superposition theorem, ac fundamentals. Labs should involve both simulation and hardware.

Recommended Books

1. Charles Alexander, Matthew Sadiku, "Fundamentals of Electric Circuits", McGraw Hill; 7th edition, 2020, ISBN-13: 978-1260226409 or latest edition.
2. Mahmood Nahvi, Joseph Edminister, "Schaum's Outline of Electric Circuits", McGraw Hill; 7th edition, 2020, ISBN-13: 978-1260011968 or latest edition.

3. Robert L. Boylestad, Introductory Circuit Analysis, Pearson, 13th edition, 2016, ISBN-13: 978-0133923605 or latest edition.

Course Content

8.7 Computer Programming

CODE & TITLE (CPC-121) **Computer Programming**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** fundamental concepts of computer programming to solve a problem.	C-2	1
CLO-2	**Apply** concepts of functions and Structures in C++.	C-3	1
CLO-3	**Analyze** real life complex problems, and use programs and algorithms to solve them using arrays, functions, and pointers.	C-4	3
CLO-4	**Develop** a well-structured, robust computer program in Visual Studio using C++ programming language.	P-2	5

Course Objectives

- To familiarize students with syntaxes and usages of various programming constructs of the C++ language.
- To use concepts of branching, loops, functions, and arrays for problems.
- To use object-oriented programming concepts for effective modular programming.

Course Outline for Theory

Algorithms, flow chart, pseudo code, data types and declaration, header files and linkage, variables and constants, input/output, termination, comments, control structures (branching, conditional structures), repetition and loops, basic library functions, arrays, functions, structures, unions, pointers, objects and classes, member variables and member functions, access modifiers, constructors and destructors, object encapsulation, inheritance, polymorphism, operator overloading. The recommended programming environment is C++.

Lab Outlines

Writing simple programs dealing with data types, operators, and Expressions in C++. Branching, and repetition statements. Single and multidimensional arrays, functions, pointers, OOP concepts (access modifiers, inheritance, operator overloading, polymorphism).

Recommended Books

1. Boguslaw Cyganek, "Introduction to Programming with C++ for Engineers", Wiley-IEEE Press, 1st edition, 2021, ISBN-13: 978-119431107 or latest edition.
2. Marc Gregoire, "Professional C++", Wrox, 5th edition, 2021, ISBN-13: 978-1119695400 or latest edition.
3. Richard Baker, "Object Oriented Programming in C++: C++ Object Oriented Programming & Features of OOP's", Independently published, 2020, ISBN-13: 979-8690464622 or latest edition.

4. Behrouz A. Forouzan (Author), Richard Gilberg, “C++ Programming: An Object-Oriented Approach”, McGraw-Hill Education, 2019, ISBN-13: 978-1260547726 or latest edition.
5. Nathan Metzler, “C++ for Beginners: An Introduction to C++ Programming and Object-Oriented Programming with Tutorials and Hands-On Examples”, Independently published, 2018, ISBN-13: 978-1983229282 or latest edition.
6. Nathan Clark, “Computer Programming for Beginners: Fundamentals of Programming Terms and Concepts”, CreateSpace Independent Publishing Platform, 2018, ISBN-13: 978-1719439558 or latest edition.

Course Content

8.8 Electronic Devices and Circuits

CODE & TITLE (CPT-122) **Electronic Devices and Circuits**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** fundamental electronic devices such as diodes, BJTs, MOSFETs, and analyze the response of circuits comprising of these devices.	C-4	1
CLO-2	**Apply** different techniques to solve complex circuits for unknown quantities.	C-3	2
CLO-3	**Observe** the working of different electronic circuits in the lab.	P-2	4
CLO-4	**Demonstrate** ability to work effectively as an individual or in a team.	A-3	9

Course Objectives

- To analyze PN junctions in semiconductor devices under various conditions.
- To deal with electronic components like diodes, BJTs and MOSFETs.
- To design and analyze simple rectifiers and voltage regulators using diodes.
- To design and analyze amplifier circuits.

Course Outline for Theory

Semiconductor Devices: Semiconductors, Energy Levels, n-type and p-type materials, Semiconductor Diode, Characteristics of Diode, Diode Equivalent Circuits, Transitions, Recovery, Specification, Notations, Testing of Diode, Zener Diode, Light Emitting Diode latest edition.

Diode Applications: Load Line Analysis, Parallel and Series Configurations, Gates, Sinusoidal, Half Wave/Full Wave Rectifiers, Clipper and Clamper Circuits, Voltage-Multiplier Circuits and Applications. Bipolar Junction Transistors: Bipolar Junction Transistors, Construction and Operation, Amplification analysis, Common-Emitter, Common-Base and Common Collector Configurations of BJT, Limits of Operation, Specification, Testing, Casing and Terminal Identification of BJTs latest edition.

DC Biasing-BJTs: Operating Point, Fixed-Bias, Emitter Bias, Voltage Divider Bias Configurations, Collector Feedback, Emitter-Follower, Common-base and Miscellaneous Configurations, Design Operations, Current Mirror and Current Source Circuits, PNP Transistors, transistor Switching Networks, Bias Stabilization and latest edition.

BJT AC Analysis: AC Domain BJT Modeling, re-Model, CE-Fixed Configuration, Voltage Divider Bias, CE Emitter-Bias, Emitter-Follower, Common-Base, Collector Feedback and Collector Feedback Configurations, Current Gain, RL and RS, Two-Port Systems, Cascaded Systems, Darlington and Feedback Pair, Hybrid Equivalent Model, Hybrid π Model, Variations of Transistor Parameter, Numerical Problems. The operational amplifier, basic op-amp configurations, ideal op-amp circuit analysis, summing and difference amplifiers, amplifier types of latest edition.

Lab Outlines
Experiments related to the study of the characteristic curves of Silicon & Germanium diodes, Zener diode and voltage regulator, analysis of half-wave and full-wave rectifiers, limiters and clampers, characteristic response of various amplifier configurations.
Recommended Books
1. Theodore F. Bogart, Jeffrey S. Beasley, Guillermo Rico, “Electronic Devices and Circuits”, Pearson, 6th edition, 2019, ISBN-13: 978-0131111424 or latest edition. 2. Thomas L. Floyd, “Electronic Devices”, Pearson, 10th edition, 2018, ISBN-13: 978-1292222998 or latest edition. 3. Robert L. Boylestad, Louis Nashelsk, “Electronic Devices and Circuit Theory”, Pearson, 11th Edition, 2013, ISBN-13: 978-1292025636 or latest edition.

Course Content

8.9 Technical Drawing

CODE & TITLE (CPT-123) **Technical Drawing**	**CREDIT & CONTACT HOURS** (0+1) **0 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Use** basic knowledge and skills for drawings.	P-2	1
CLO-2	**Understand** and apply concepts of basic drawing techniques.	P-3	2
CLO-3	**Explain** drawings of plans, elevations, and cross-sections of machine parts.	P-3	3
CLO-4	**Apply** precision drafting tools and standard dimensions in AutoCAD to make accurate technical drawings.	P-3	3

Course Objectives

- To gain skills and knowledge in freehand sketching, lettering, and dimensioning.
- To develop imagination and the ability to represent the shape, size, and specifications of physical objects.
- To acquire knowledge of basic principles of technical drawing, sketching by using CAD software.

Lab Outlines

Introduction to Technical drawing and its significance in industry, Use of Pencil and Drawing Instruments, Drawing of basic geometric shapes, Line types and their application. Lettering and numbering. Dimensions and Scaling, Sheet Layout, Planning of Drawing Sheet, Orthographic projection method; Definition, significance and drawing applications, Isometric projection method; Definition, significance and drawing applications, Perspective projection method; Definition, significance and drawing application, Free hand sketching technique. Computer-Aided Drawing (CAD), Modifying Commands, Sketching, Sectional Drawing, Assembly Drawing, 3D Modeling, Geometric Construction, Engineering Curves

Recommended Books

1. Frederick Giesecke, Alva Mitchell, et al., "Technical Drawing with Engineering Graphics", Peachpit Press, 15th edition, 2016, ISBN-13: 978-0134306414 or latest edition.
2. James D. Bethune, "Engineering Graphics with AutoCAD 2017", Peachpit Press; 1st edition, 2016 or latest edition.
3. Sham Tickoo, "AutoCAD: A Problem-Solving Approach: 2013 and Beyond", Cengage Learning; 1st edition, 2013, ISBN-13: 978-1133946311 or latest edition.

Course Content

8.10 Linear Algebra

CODE & TITLE (CPN-124) **Linear Algebra**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Natural Sciences-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Solve** systems of linear equation using matrices.	C-3	1
CLO-2	**Evaluate** Eigen values, Eigen vector, and related problems.	C-3	1
CLO-3	**Evaluate** first and higher order differential equations.	C-5	2
CLO-4	**Carry** out Laplace Transform and Inverse Laplace transforms, including solution of initial value problems involving piece-wise continuous functions.	C-5	2

Course Objectives

- Explain basic definitions, properties, and theorems of linear algebra
- Illustrate the operations on matrices to solve systems of linear equations
- Apply linear transformations and applies matrix theory to model real-life situations

Course Outline for Theory

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

Recommended Books

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

Course Content

8.11 Pakistan Studies

CODE & TITLE (CPH-125) **Pakistan Studies**	**CREDIT & CONTACT HOURS:** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Art & Humanities-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the ideological and historical struggle in creation of Pakistan.	C-2	6
CLO-2	**Analyze** the significance of geopolitical position, and its implications for traditional and non-traditional security of Pakistani society.	C-4	6
CLO-3	**Understand** the importance of good governance, governance structures, economic systems, political processes, constitutional and legislative processes, and political culture of Pakistani society.	C-5	6
CLO-4	**Analyze** the importance of language and religion in Pakistan given its socio-cultural diversity, and ethno-sectarian structure, and consequent internal and external conflicts.	C-5	6

Course Objectives

- Describe the difference between ideological and non-ideological states.
- Discuss Pakistan Movement, political and constitutional history of Pakistan.
- Study current issues of Pakistan, their causes and solution.

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

8.12 Communication Skills

CODE & TITLE (CPH-126) **Communication Skills**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Art & Humanities-IV**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Prepare** official letters, memorandums and reports	C-2	10
CLO-2	**Demonstrate** the ability to produce these documents in a professional manner	C-3	10
CLO-3	**Participate** in communicative activities based on the learned rules	C-3	10
CLO-4	**Present** confidently in front of large audience using audio/ visual aids.	A-4	10

Course Objectives

- Acknowledge the importance and basic concepts of communications.
- Identify common errors usually made by learners of English as a second language
- Communicate effectively through technical writing and presentations, using basic- to-intermediate level English, and develop understanding of communication skills essentials.

Course Outline

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

Recommended Books

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

Course Content

8.13 Operating Systems

CODE & TITLE (CPT-211) **Operating Systems**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-IV**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the characteristics of different structures of the Operating Systems (such as microkernel, layered, virtualization, etc.), and identify core functions of Operating Systems.	C-2	1
CLO-2	**Explain** the principles of the algorithms on which the core functions of the Operating Systems are built upon.	C-2	1
CLO-3	**Analyze** and evaluate algorithms of the core functions of the Operating Systems and explain major performance issues regarding the core functions.	C-4	2
CLO-4	**Develop** parallel applications using techniques and tools available in modern systems (such as threads, system calls, semaphores, etc.).	C-4	3

Course Objectives

- To learn different types of operating systems and services provided.
- To understand process management and inter-process communication.
- To know the deadlock concepts & deadlock avoidance algorithms.
- To understand memory management and different file system organizations.

Course Outline for Theory

Introduction, services provided by OS, functions of OS, system calls. Process management-introduction, process control block, process states, process context switch, threads: user-level and kernel level.
CPU scheduling, goals of scheduling, CPU scheduling algorithms: FCFS, SJF, SRTF, RR, Priority-based. Inter-process communication: process cooperation and synchronization, race condition, critical section, mutual exclusion and implementation, semaphores, classical inter-process communication problems.
Deadlocks: System Model, deadlock characterization-necessary conditions, resource allocation graph (RAG), methods for handling deadlock-deadlock avoidance, deadlock detection, deadlock prevention, recovery from deadlock.
Memory management techniques-contiguous and non-contiguous, paging and segmentation, translation lookaside buffer (TLB) and overheads.
Virtual memory and demand paging, page faults, page replacement algorithms, thrashing and working set model.
File systems-introduction, disk space management and space allocation strategies, directory structures, disk caching, disk arm scheduling strategies: FCFS, SSTF, SCAN, CSACN, LOOK, CLOOK, File Organization: Sequential, Index, Index Sequential

Lab Outlines
Experiments dealing with installation of LINUX OS, basics of Linux command, write a shell script for simple programs, create process, scheduling algorithms, page replacement algorithms, case studies on advanced operating systems.
Recommended Books
1. Abraham Silberschatz, Greg Gagne, Peter B. Galvin, “Operating System Concepts”, Wiley, 10th edition, 2018, ISBN: 978-1-119-32091-3 or latest edition. 2. Remzi Arpaci-Dusseau, Andrea Arpaci-Dusseau, “Operating systems: Three easy pieces”, Arpaci-Dusseau Books LLC, 1st Edition, 2016. 3. Ann Mchoes and Ida M. Flynn, “Understanding Operating Systems”, Cengage Learning, 8th edition, 2018, ISBN13: 9781305674257 or latest edition. 4. William Stallings, “Operating Systems: Internals and Design Principles”, Pearson, 9th edition, 2018, ISBN-13: 9780134670959 or latest edition.

Course Content

8.14 Signals and Systems

CODE & TITLE (CPT-212) **Signals and Systems**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-V**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Possess** basic knowledge of signals and systems.	C-2	1
CLO-2	**Explain** transformations on signals.	C-3	2
CLO-3	**Use** appropriate signal transformations to analyze complex problems.	C-4	3
CLO-4	**Develop** computer programs to implement different signal processing algorithms.	P-2	5
CLO-5	**Work** effectively as an individual or in a team.	A-3	9

Course Objectives

- To understand the basic concepts for both continuous-time and discrete-time signals and systems.
- To analyze different signals and systems using Laplace transform, z-transform and Fourier transforms.

Course Outline for Theory

Signals and their Classification, Basic Continuous and Discrete-Time Signals, Operations on Signals Systems and Classification of Systems.

Linear Time-Invariant Systems- Response of a Continuous-Time LTI System and Convolution, Integral Properties of Continuous and Discrete-Time LTI System, Response of a Discrete-Time LTI System and Convolution Sum, Properties of Convolution, Systems Described by Difference and Differential Equations.

Laplace Transform, Laplace Transform of Some Common Signals, Properties of Laplace Transform, Inverse Laplace Transform, Solving Differential Equations by Using Laplace Transform.

z-Transform, z-Transform of some Common Signals, Properties of z-Transform, Inverse z-Transform, Solving Difference Equations by Using z-Transform.

Fourier Analysis of Continuous-Time Signals and Systems, Fourier Series Representations of Periodic Signals, Fourier Transform, Properties of Continuous-time Fourier Transform

Frequency Response of Continuous-Time LTI Systems.

Sampling Theorem, Discrete Fourier Series, Discrete-Time Fourier Transform (DTFT), Properties of Discrete-Time Fourier Transform, Frequency Response of Discrete-time LTI Systems

Discrete Fourier Transform (DFT), Properties of Discrete Fourier Transform (DFT), Circular Convolution Fast Fourier Transform (FFT).

Lab Outlines

Experiments related to generating various signals and sequences, Operations on signals and sequences, plot frequency responses of periodic and aperiodic continuous and discrete time signals. Correlation and convolution of two signals.
Recommended Books
1. Fawwaz T. Ulaby, Andrew E. Yagle, “Signals and Systems: Theory and Applications”, Michigan Publishing Services, 2018, ISBN-13: 978-1607854869 or latest edition. 2. Hwei Hsu, “Schaum's Outline of Signals and Systems”, McGraw-Hill, 4th edition, 2019, 978-1260454246 latest edition. 3. Alex Palamides, Anastasia Veloni, “Signals and Systems Laboratory with MATLAB”, CRC Press, 2010, ISBN 13: 9781439894293 or latest edition. 4. Simon Haykin, Barry Van, “Signals And Systems”, Wiley, 2nd edition, 20078, ISBN-13: 978-8126512652 or latest edition.Thomas L. Floyd, “Digital Fundamentals”, Pearson, 11th Edition, 2015, ISBN-13: 9780137506309 or latest edition.

Course Content

8.15 Data Structures and Algorithms

CODE & TITLE (CPC-213) **Data Structures and Algorithms**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** large C++ programs to determine bugs like dangling pointer, bad pointer, memory leakage and shallow copy etc. without using a Compiler.	C-4	2
CLO-2	**Use** linear and non-linear data structures, and implement algorithms for them: (stack, queue, linked lists, trees, graphs, heap, priority queue, hash tables, sorting algorithms, min-max algorithm etc.).	C-3	1
CLO-3	**Analyze** algorithms and data structures for performance comparison in terms of time and space complexity using Asymptotic Analysis.	C-4	2
CLO-4	**Solve** complex data organization problems in open-ended labs by applying appropriate data structures.	P-4	3
CLO-5	**Develop** a project that solves a real problem in an application domain (Networks, virtual hard disk, Data mining, machine learning etc.) by using data structures learnt in this course.	P-5	3

Course Objectives

- To implement several searching and sorting algorithms.
- To implement linear and non-linear data structures, tree, and graph traversal algorithms.
- To analyze and choose appropriate data structures to solve problems in the real world.

Course Outline for Theory

Pointers and Dynamic Memory Allocation, Dynamically Allocated Arrays, Structures and Unions, Stacks, Queues, Recursion,
Lists - Singly-linked lists, doubly linked lists and circular linked lists. Operations on linked list (Traversal, Deletion, Insertion).
Searching and Sorting Algorithms. Complexity Analysis.
Hash table, Trees - binary trees, binary tree basic algorithms and traversals (In-order, Pre-order, -Order).
Graphs - Binary Search Trees (BSTs) representation and traversal (insertion, deletion). Heaps and heap sort, spanning trees, topological sort, shortest path algorithm.

Lab Outlines
Writing programs dealing with multi-dimensional arrays, iteration, and recursion concepts, searching and sorting techniques, table operations, string handling, linked lists, queue, heaps, stacks, trees and graphs.
Recommended Books
1. Elliot B. Koffman, Paul A. T. Wolfgang, “Data Structures: Abstraction and Design Using Java”, Wiley, 4th edition, 2021, ISBN-13: 978-1119703617 or latest edition. 2. Jay Wengrow, “A Common-Sense Guide to Data Structures and Algorithms: Level Up Your Core Programming Skills”, Pragmatic Bookshelf, 2nd edition, 2020, ISBN-13: 978-1680507225 or latest edition. 3. Frank Carrano, Timothy Henry, “Data Structures and Abstractions with Java”, Pearson, 5th edition, 2018, ISBN-13: 978-0134831695 or latest edition. 4. Y. Liang, Y. Daniel Liang, “Introduction to Java Programming and Data Structures”, Pearson, 11th edition, 2017, ISBN-13: 978-0134670942 or latest edition. 5. Paul Deitel, Harvey Deitel, “Java How to Program, Early Objects”, Pearson, 11th edition, 2017, ISBN-13: 978-0134743356 or latest edition.

Course Content

8.16 Technical Report Writing

CODE & TITLE (CPH-214) **Technical Report Writing**	**CREDIT & CONTACT HOURS:** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Art & Humanities-V**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** technical writing, its importance, purpose, characteristics and how it is different from ordinary writing.	C-2	10
CLO-2	**Discuss** style, content, language, form, clarity, and consistency in technical and academic writing by analyzing user manuals, research proposals, technical papers, and project reports.	C-2	10
CLO-3	**Write** memorandums, covering letters in a variety of workplace genres including resumes, statement of purpose and, use technology to effectively present written messages.	C-3	10
CLO-4	**Have** sound presentation skills and demonstrate them effectively in the classroom.	A-3	10

Course Objectives

- Discuss the basic concepts in technical writing and use of standard word processing software along with referencing tools for report writing.
- Initiate technically correct statements, assignments, final year project report, project proposal, short reports, research paper and business/ professional correspondence.

Course Outline for Theory

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

Recommended Books

1. Technical Report Writing Today, by Daniel Riordan, 10th Edition (or Latest Edition)
2. Technical Writing and Professional Communication, Leslie Olsen and Thomas Huckin, 2nd Edition. (Or Latest Edition)
3. Communication for Engineering Students by J. W. Davies, (or Latest Edition)

4. Science Research Writing for Non-Native Speakers of English by Hilary Glassman-Deal, Imperial College Press. (Latest Edition)

Course Content

8.17 Digital Logic Design

CODE & TITLE (CPT-216) **Digital Logic Design**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Foundation-VI**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** and explain fundamental concepts of digital logic design including basic and universal gates, number systems, binary coded systems, basic components of combinational and sequential circuits.	C-2	1
CLO-2	**Use** the acquired knowledge and apply techniques related to the design and analysis of digital electronic circuits, including Boolean algebra and multi-variable Karnaugh map methods.	C-2	1
CLO-3	**Analyze** small and medium scale combinational and sequential digital circuits.	C-4	2
CLO-4	**Design** small scale combinational and synchronous sequential digital circuit using Boolean algebra and K-maps through experiments.	P-4	3

Course Objectives

- To understand basic concepts of digital and binary systems
- To design and analyze combinational and sequential logic circuits.
- To work with basic software tools for the design and implementation of digital circuits and systems.

Course Outline for Theory

Number Systems, Boolean Algebra, Logic Simplification, Combinational Logic, Sequential Logic, Latches, Flip-Flops, and their applications. Adders/Subtractors, Multiplexers/Demultiplexers, Encoders/Decoders, Counters, Shift Registers, and simple Arithmetic Logic Unit (ALU). Introduction to FPGA.

Lab Outlines

Experiments related to verification of logic gate outputs, implement truth tables, Implementation of Boolean functions using Logic Gates, implement Half adder, full adder, multiplexer, demultiplexer, decoder, encoder, flipflops, registers and counters circuits.

Recommended Books

1. M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog", Pearson, 6th Edition, 2018, ISBN-13: 9780134529561 or latest edition.

2. John F. Wakerly, “Digital Design: Principles and Practices”, Pearson, 5th Edition, 2018, ISBN-13: 9780137518791 or latest edition.
3. Ronald Tocci, Neal Widmer, Greg Moss, "Digital Systems: Principles and Applications". Prentice Hall. 12th Edition, 2017, ISBN-13: 9780137524723 or latest edition.
4. M. Morris R. Mano, Charles R. Kime, Tom Martin, “Logic & Computer Design Fundamentals”, Pearson, 5th Edition, 2016, ISBN-13: 9780134080161 or latest edition.
5. Thomas L. Floyd, “Digital Fundamentals”, Pearson, 11th Edition, 2015, ISBN-13: 9780137506309 or latest edition.

Course Content

8.18 Computer Hardware Systems

CODE & TITLE (CPT-221) **Computer Hardware Systems**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computer Engineering Technology Foundation-VII**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** hardware and software problems, and find cause of the problem such as a hardware failure or a software error, and then fix the problem	C-1	2
CLO-2	**Install** and configure hardware and software, such as printers, scanners, and network cards, as well as software applications, such as operating systems, office suites, and web browsers	C-3	5
CLO-3	**Secure** computer systems. This includes security measures to protect systems from unauthorized access, data breaches, and malware infections.	C-4	3
CLO-4	**Demonstrate** the ability to troubleshoot hardware and software problems.	P-2	2

Course Objectives

- To set up and configure a new computer for a custom configuration, to meet customer specifications or needs.
- To install or upgrade the operating system.
- To install, configure, and manage common peripheral devices and multifunction devices/printers.
- To troubleshoot common problems related to software and hardware.
- To install and configure a Small-Office/Home-Office (SOHO) wireless/wired router and apply appropriate settings.

Course Outline for Theory

Hardware Basics, Windows Basics, Linux Basics, MacOS Basics, Protection and Safety, PC Tools, Maintenance, Cases and For Factors, Power Supplies, Motherboards and Buses, Motherboard Troubleshooting, Processors, Processor Troubleshooting, Memory, Memory Troubleshooting, BIOS/UEF, Expansion Cards, Peripheral Devices, USB, Display Devices, Video Troubleshooting, Device Driver Management, Storage Devices, SATA, Optical Media, RAID, File Systems, File Creation, Storage Management, Storage Spaces, Disk Optimization, Storage Troubleshooting, Networking Overview, Network Hardware, Networking Media, Ethernet, IP Networking, IP Configuration, IP Version 6, Internet Connectivity, Network Utilities, Network Troubleshooting, Wireless, Infrared, Bluetooth and NFC, SOHO Configuration, Internet of Things, Wireless Network Troubleshooting, Windows System Tools, Preferences and Settings, Performance Monitoring, Active Directory, Users and Groups, Remote Services, Laptops, Laptop Components, Laptop Power

Management, Mobile Devices, Mobile Device Networking, Mobile Device Security, Component Selection, Windows Pre-installation, Windows Installation, Post-Installation, Virtualization.
Lab Outlines
Familiarization of various computer components and their working. Troubleshooting various issues in hardware and software. Set up a new computer in a simulator. Installing Operating Systems. File System. Storage Management. Wireless Network Troubleshooting.
Recommended Books
1. Mike Meyers, "CompTIA A+ Guide to Managing and Troubleshooting PCs", McGraw Hill, 6th edition, 2019, ISBN-13: 978-1260455069 or latest edition. 2. Dan Gookin, "Troubleshooting & Maintaining PCs All-in-One For Dummies", For Dummies (Computer/Tech), 4th edition, 2021, ISBN-13: 978-1119740308 or latest edition. 3. Scott Mueller, "Upgrading and Repairing PCs", Que Publishing, 22nd edition, 2016, ISBN-13: 978-0789756107 or latest edition.

Course Content

8.19 Instrumentation and Data Acquisition

CODE & TITLE (CPT-222) **Instrumentation and Data Acquisition**	**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** mathematical and scientific principles to analyze and solve complex problems in instrumentation and data acquisition.	C-3	1
CLO-2	**Design** and implement data acquisition systems using appropriate instrumentation techniques and methods.	C-4	3
CLO-3	**Demonstrate** proficiency in using measurement instruments, data acquisition tools, and software for data analysis.	P-4	5

Course Objectives

- Understand the principles of operation and limitations of common measuring Instruments.
- Model instruments and their operating conditions to use the instruments correctly.
- Program computers to automate the acquisition and processing of data.
- Design systems for the acquisition, analysis, and communication of data
- Gain awareness of economical and societal aspects of instrumentation systems and communication of data.

Course Outline for Theory

Measurement Systems, Static Characteristics, Basic circuits Dynamic Characteristics. Data Acquisition, DAQ Signal Transmission, DAQ Signal Conditioning, Sampling, DAQ Signal Acquisition Displacement, Velocity and Strain Measurement, Pressure Measurement, Force, Torque, and Power Measurement, Flow Measurement, Temperature Measurement, Radio Telemetry and Wireless Signal Transmission, Environmental Sensors

Lab Outlines

Introduction to Instrumentation and DAQ, Velocity Field Measurements of a Rectangular Jet, Flow Around a Circular Cylinder, Thermal Conduction, Temperature Sensors and Calibration, Extended Surface Heat Transfer, Rankine Cycle, Pipe Flow: Major and Minor Losses

Recommended Books

1. Instrumentation, Data Acquisition, and Applications in Ground Vehicle Design Book by Peijun Xu and Xiaobo Yang(2021) ISBN-13 : 978-1439880104 or latest edition.

2. Fast NMR Data Acquisition: Beyond the Fourier Transform (New Developments in NMR, Volume 11) 1st Edition by Mehdi Mobli and Jeffrey C Hoch(2017) ISBN-13: 978-1849736190 or latest edition.
3. Practical Data Acquisition for Instrumentation and Control Systems by John Park and Steve MacKay(2003) ISBN-13 ： 978-0750657969 or latest edition.

Course Content

8.20 Web Technologies

CODE & TITLE (CPT-223) **Web Technologies**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** fundamental concepts of web development.	C-2	1
CLO-2	**Analyze** and evaluate performance of web applications.	C-4	2
CLO-3	**Develop** responsive and interactive web interfaces.	C-5	3

Course Objectives

- Use front-end development framework to design interactive web interfaces
- Understand the basic architecture of a React application and to gain a deep understanding of JSX and the Virtual DOM.
- Understand common web technologies and design patterns to connect them together
- Create boilerplate starter projects with React, Redux, Express, flutter, and VueJS
- Master deployment techniques between the production and development environments

Course Outline for Theory

Website Structure, Designing your own website using HTML, DHTML, JavaScript, and Bootstrap, HTML basic and advanced topics, JavaScript concepts, CSS and Bootstrap concepts, Website Structure and Hosting, Selecting a web host company, Naming a website, Name registration for websites, Website Control Panel, web development tools, Creating web applications, Client-side versus Server-side Application Development, Features in Web Applications, Front-end development using any latest framework such as React JS. The contents for front-end development include an introduction to React JS, Components in React JS, Properties and Events, Form Components, Accessing DOM, React Router, Flux, Reflux.

Backend Development using any latest framework such as Node JS. The contents include Introduction and Installation of Node JS. Creating Server using Express, Connect with NoSql (Mongo DB) Database, Routers, Models in Database, CRUD Operations with APIs, Testing on Postman, Hosting your application.

Lab Outlines

Installation of XAMPP and WAMP servers. Using HTML to Create a table, Use tables to provide layout to HTML page, Use frames such that page is divided into frames, Embed Audio and Video into HTML web page, Create links on the words to link them to Wikipedia pages, Insert an image and create a link such that clicking on image takes user to other page, Using CSS to write an HTML page, Using Javascript to write java script programs, Develop and demonstrate

the usage of inline, internal and external style sheet using CSS, Write XML Files, Develop and demonstrate PHP script, Implement web applications using (a) PHP (b) Servlets (c) JSP, design patterns to connect them together Create boilerplate starter projects with React, Redux, Express, flutter, and VueJS
Recommended Books
1. Web Technology: Theory and Practice 1st Edition by Akshi Kumar (2018) ISBN-13 ： 978-1138550438 or latest edition. 2. Web Programming with HTML, CSS, Bootstrap, JavaScript, jQuery, PHP, and MySQL by Larry Sanchez (2017) ISBN-13 ： 978-1542604758 or latest edition. 3. HTML 5, CSS 3 & Bootstrap 4 All-in-One: a complete introduction to front end web development by Mike Ludo (2019) ISBN-13 ： 978-1777026769 or latest edition. 4. Wieruch, R. (2017). The road to react: Your journey to master plain yet pragmatic react. js. Robin Wieruch. Tsonev, K. (2015). Node. js by example. Packt Publishing Ltd or latest edition.

Course Content

8.21 Mobile Application Development

CODE & TITLE (CPT-225) **Mobile Application Development**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-III**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** Mobile Application Development fundamentals and flow on multiple devices.	C-2	1
CLO-2	**Develop** Mobile Application using basic functionality, framework, and packages as a prototype.	C-3	3
CLO-3	**Build** Mobile Application modules using software and hardware resources and evaluate its functionality.	P-3	5

Course Objectives

- describe Mobile Application Development fundamentals and flow on multiple devices and publish it online
- produce Mobile Application using provided assets with basic functionality
- make Mobile application that uses hardware and software resources like sensors and configuration etc. and evaluate functionality

Course Outline for Theory

The course is for designing and building mobile applications using platforms like Android open-source and related tools. It will be a combination of lecture and laboratory course which will help the student understand the philosophy of developing for selected platform through its main application development building blocks and their interaction with one another. The course demonstrates standard practices and tools used in the market to develop robust mobile applications. Topics include accessing device capabilities, industry standards, operating systems, UI design and programming for mobile applications.

Lab Outlines

Getting Started with mobile application development, designing User Interface, Using Services, Using Preferences, Sensor and Hardware Programming., App Publishing and Business Models.

Recommended Books

1. Android Programming for Beginners: Build in-depth, full-featured Android apps starting from zero programming experience by John Horton, 3rd Edition, 2021, ISBN: 978-1800563438 or latest edition.
2. Beginning App Development with Flutter: Create Cross-Platform Mobile Apps by Rap Payne, 1st Edition, 2019, ISBN: 978-1484251805 or latest edition.

3. Headfirst Android Development: A Learner's Guide to Building Android Apps with Kotlin by Dawn Griffiths, David Graffiths, 3rd Edition, 2022, ISBN: 978-1492076520 or latest edition.
4. Mobile Applications Development: with Python in Kivy Framework by Kamal Kant Hiran, Ruchi Doshi, Tarkeshwar Barua, 2020, ISBN: 978-3110689389 or latest edition.

Course Content

8.22 Database Applications

CODE & TITLE (CPT-226) **Database Applications**	**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-IV**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the basic concepts (Entity modelling, Data integrity, Relational modelling, Normalization etc.) of relational database management systems.	C-2	1
CLO-2	**Examine** end-user requirements to create a detailed database system design.	C-2	4
CLO-3	**Acquire** information from data and database objects using SQL.	C-2	3
CLO-4	**Design** and develop database systems using backend engines and UI tools that satisfies relational theory and provides users with business queries, business forms, and business reports.	C-3	5

Course Objectives

- To develop an understanding of the efficient process for designing a relational database, database conceptual model and logical model.
- To complete the database design, including controls to ensure its referential integrity and data integrity
- To apply database normalization methods to improve the initial design of a database
- To generate various kinds of reports and database reporting tool

Course Outline for Theory

Introduction To Database, Database Environment, Database Architectures and the Web, The Relational Model, Relational Algebra and Relational Calculus, SQL - Data Definition and Data Manipulation, Security and Administration, SQL - Data Definition and Data Manipulation, Advanced SQL, Transaction Management, Database System Development Lifecycle, Database Analysis, Normalization, Advanced Normalization, Distributed DBMS-Concept and Design, Entity-Relationship (ER) Modelling, Enhanced Entity-Relationship (ER) Modelling, Concurrency Control, Data Warehousing Concepts, Data Mining, NoSQL – MongoDB, Key-value store, Tabular, Document-based, Cassandra, Graph database.

Lab Outlines

Creating database objects, Modifying database objects. Manipulating the data, Retrieving the data from the database server, performing database operations in a procedural manner using pl/sql, performing database operations (create, update, modify, retrieve, etc.,), Design and Develop applications like banking, reservation system, etc.

Recommended Books
1. Database Systems: Design, Implementation, & Management by Carlos Coronel and Steven Morris (2018), ISBN-13: 978-1337627900 or latest edition. 2. Database System Concepts by Abraham Silberschatz, Henry Korth, et al. (2019), ISBN-13: 978-0078022159 or latest edition. 3. Database Design" by Adrienne Watt (2014) Publisher Bccampus or latest edition.

Course Content

8.23 Embedded systems

CODE & TITLE (CPT--311) **Embedded systems**	**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-V**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the organization, function, and operation of the microprocessor and microcontroller.	C-2	1
CLO-2	**Use** assembly language instruction-set of Intel's 80x86 series of microprocessors in solving practical problems.	C-4	1
CLO-3	**Interface** a microprocessor or a microcontroller with sensors, memory units and other peripheral devices.	C-2	3
CLO-4	**Design** and implement embedded systems using appropriate software and hardware tools.	P-4	3
CLO-5	**Incorporate** user requirements in the design of embedded systems.	C-4	2

Course Objectives

- Demonstrate an understanding of the general concepts and terminology in computer architecture, programmer's model, the memory organization, the various addressing modes, and the hardware components of a microprocessor.
- Evaluate different embedded system architectures and the performance of different hardware units used in embedded systems
- Analyze and design software/hardware in assembly and C languages for/ subsystems and interface them to microcomputer systems, analyze and program timer functions.
- Design interrupt service routines in Assembly and C languages, and Design and implement a major microcomputer-based system, including hardware-software integration.

Course Outline for Theory

Introduction to Microcomputer system architecture and embedded systems. Addressing modes, interrupts features, characteristics, application, design, microcontrollers used in embedded systems, interrupts, introduction of hardware-level programming of embedded systems, microcomputer interfaces, Digital IO, Serial IO, Analog to Digital Conversion, Pulse Width Modulation, Analysis and design software components in Assembly and C languages for microcomputer system, interfacing to a microprocessor, Interrupts and Resets, Timer functions, Analysis and design of hardware sub-systems and their interfacing with a microcomputer system.

Lab Outlines
8086 Microprocessor System: Interfacing the Clock Generator to the CPU, Designing the Bus System, Designing the Memory System, Interfacing I/O Ports, Testing the 8086 Microcomputer System Interface Experiments Using 8086 Microprocessor Kits & Application Boards, Flight 8086 Training Board, Conducting Simple I/O Operations Using Flight 86 Training Kit, Generating Timing Sequences, Analog To Digital & Digital To Analog Conversion, Controlling Dc Motors, Interfacing A Hyper Terminal To The Flight 86 Kit, Interrupts & Low-Power Modes, LCD Display, Advance Timer Features, Concurrency via Interrupts, Universal Asynchronous Receiver and Transmitter (UART), Inter-Integrated Circuit(I2C) Communication, Analog to Digital Converter (ADC), Serial Peripheral Interface (SPI) & LCD Pixel Display, ARM evaluation system, Interfacing ADC and DAC, interfacing LEC and PWM, real-time clock, serial port, EPROM, performance characteristics of ARM and FPGA, Zigbee protocol with ARM, Simulation Using Proteas, simulation of calculator using 8051 microcontroller in Proteus Software
Recommended Books
1. Microprocessors and Microcomputers by M.H. Hassan (2018) ISBN-13: 978-1791950750 or latest edition. 2. Embedded Microcomputer Systems: Real Time Interfacing 3rd Edition by Jonathan W. Valvano (2011) ISBN-13 : 978-1111426255 or latest edition. 3. STM32 Arm Programming for Embedded Systems by Muhammad Ali Mazidi, Shujen Chen and Eshragh Ghaemi (2018) ISBN-13: 978-0997925944 or latest edition. 4. Architecting High-Performance Embedded Systems: Design and build high-performance real-time digital systems based on FPGAs and custom circuits (2021) ISBN-13: 978-1789955965 or latest edition. 5. Embedded Systems by D.P. Kothari, K.V. Shiram, Sundaram (2014) ISBN-13: 978-1781830093 or latest edition.

Course Content

8.24 Systems and Network Administration

CODE & TITLE (CPT-312) **Systems and Network Administration**	**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-VI**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** proficiency in managing and configuring computer networks.	P-3	3
CLO-2	**Analyze** and troubleshoot network issues using appropriate tools.	C-4	2
CLO-3	**Design** and implement secure network architectures and protocols.	C-4	8

Course Objectives

- Demonstrate an understanding of the principles and practices in systems and network administration, with an emphasis on small-scale computing environments.
- Practically manage a local area network consisting of servers, clients, network devices, and associated software services and tools running on multiple platforms.
- Evaluate and critique a design for systems and network solution

Course Outline for Theory

Introduction to network and system administration, server environment (Microsoft and Linux), Comparative analysis of most demanded OS, Linux installation and verification, Managing and administrating the users and groups, Services and management, software management in Linux, Managing network services and network establishment in VM, managing permissions in Linux, monitoring of network resources securing network traffic, logs handling and log management, Installation of Remote Desktop Server, Installation and Configuration of web server, Installation and Configuration of FTP server, Installation, managing and maintaining active directory, Access to Directory information through LDAP and access directory services through JNDI

Lab Outlines

Installation of operating system, Installation of office productivity software (MS Office/ Open Office), User Management, Directory management commands, Startup & Shutdown scripts, Process management commands and their execution, Firewall Configuration, Study of Important LINUX Services, Study and measure voltages of SMPS, Drawing the motherboard layout (any latest processor) and studying the chipset through data books or Internet, CMOS setup of any latest PC, Fault findings: (a) Problems related to CPU (b) Problems related to RAM, Disassembly and Assembling of PC and Installation of Operating System a) Windows b) Linux. Perform dual booting also, Learn parallel port, serial port and USB port testing and Installation of Scanner, Printers and ADSL/DSL Modems, Crimping of RJ45: Straight and Cross. a) Punching Cat 6 cable to I/O Box. Use punching tool. b) Check connectivity using LAN tester, install

a Switch and Wireless router, Study different IP classes (A, B, C) addressing. (Manual & Dynamic). Check connectivity for peer-to-peer and client-server, Windows Server & also install the following services a) Active directory b) DNS c) DHCP, Visit any industry / institutes (Engineering colleges, university campuses, etc.)
Recommended Books
1. Mastering Windows Server 2019: The complete guide for system administrators to install, manage, and deploy new capabilities with Windows Server 2019, 3rd Edition 3rd ed. Edition by Jordan Krause (2021) ISBN-13 ： 978-1801078313 or latest edition. 2. Study guide for Practice of System and Network Administration by Thomas A. Limoncelli, Cram101; 2nd Edition (2011). ISBN-10: 1428851755 or latest edition. 3. Linux Administration: A Beginner's Guide, Seventh Edition 7th Edition by Wale Soyinka (2015) ISBN-13 ： 978-0071845366 or latest edition. 4. Active Directory: Designing, Deploying, and Running Active Directory Fifth Edition by Barian Desmond (2013) ISBN-13 ： 978-1449320027

Course Content

8.25 Network Technologies

CODE & TITLE (CPT-313) **Network Technologies**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-VII**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** layered architecture of computer networks.	C-2	1
CLO-2	**Rank** and criticize network protocols and algorithms for suitability and effectiveness in different scenarios.	C-5	2
CLO-3	**Explain** security measure used in computer networks and identify basic security threats.	C-2	3
CLO-4	**Build** multi-party network applications using best practices for TCP/IP applications development.	P-5	3

Course Objectives

- An understanding of the fundamental concepts of computer networking, routing and switching, and an overview of layered architecture, layered based networking models such as TCP/IP and OSI.
- gaining practical experience in installation, monitoring, and troubleshooting of current LAN systems.
- Familiarity with usage of networking tools, commands, & software through they can get practical exposure.

Course Outline for Theory

Basics of Data Communication, Types of Computer Networks, Network Topologies, International standards, OSI model, TCP/IP Protocol Suit, Fundamentals of Analog and Digital Signals, Signal conversions, Transmission Impairments, Line Coding, Multiplexing and its types, Transmission Media, Switching, Error Detection and Correction, Flow and Error Control, Data Link Layer Protocols, Ethernet Protocols and evolution, Synchronous Optical Network (SONET), Wireless LANs, Connecting Devices, Vlans, and related fundamental concepts of Physical and Data Link Layer. Describe other pieces of hardware and software which make networks more efficient, faster, more secure, easier to use, able to transmit several simultaneous messages, and able to interconnect with other networks. Understand the basic technical concepts of Computer Networks. Be familiar with the various types of network configurations. Understand how to design networks by using manual or hand calculations. Define the differences between protocols, software, and network architecture. Define the concept of local area networks and describe their use. Describe how a local area network is installed, its typologies and protocols. Understand why networks need security and control, what errors might occur, and how to control network errors.

Lab Outlines

Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool, Study of Network Devices in Detail. Study of network IP, Connect the computers in Local Area Network, Study of basic network command and Network configuration commands, Performing an Initial Switch

Configuration Performing an Initial Router Configuration Configuring and Troubleshooting a Switched Network, Connecting a Switch, Configuring WEP on a Wireless Router, Using the Cisco IOS Show Commands, Examining WAN Connections, Interpreting Ping and Traceroute Output, Demonstrating Distribution Layer Functions, Placing ACLs, Exploring Different LAN Switch Options, Implementing an IP Addressing Scheme, Examining Network Address Translation (NAT), Observing Static and Dynamic Routing, Configuring Ethernet and Serial Interfaces, Configuring a Default Route, Configuring Static and Default Routes, Configuring RIP, Planning Network-based Firewalls, Configuring a Cisco Router as a DHCP Server
Recommended Books
1. Emerging Wireless Communication and Network Technologies: Principle, Paradigm and Performance by Karm Veer Arya (2019) ISBN-13: 978-9811344053 or latest edition. 2. Multimedia Networking Technologies, Protocols, & Architectures (Artech House Communications and Network Engineering) by Iván Vidal (2019) ISBN-13 : 978-1630813789 or latest edition. 3. Computer Networking Problems and Solutions: An innovative approach to building resilient, modern networks 1st Edition by Russ White (2017) ISBN-13: 978-1587145049

Course Content

8.26 Technopreneurship

CODE & TITLE (CPM-324) **Technopreneurship**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Management Science-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Prepare** business models and plans.	C-3	9
CLO-2	**Understand** the business environment and describe factors leading to green-innovation.	C-2	7

Course Objectives

- Demonstrate the understanding of entrepreneurship concept as a whole and the role of entrepreneurship in economic development.
- Compare the role and importance of small and medium sized enterprises in the economy.
- Apply the ability to find an attractive market and apply the understanding of business planning concept for new business creation and growth.

Course Outline for Theory

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

Recommended Books

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

Course Content

8.27 Professional Ethics

CODE & TITLE (CPH-325) **Professional Ethics**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Art & Humanities-VII**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Comprehend** importance of professional ethics.	C-2	8
CLO-2	**Solve** ethical dilemmas using ethical values in life.	C-3	12
CLO-3	**Discuss** established ethical trends from a professional perspective.	A-2	8

Course Objectives

- 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.
- Acquire knowledge of various roles of engineering technologist in applying ethical principles at various professional levels.
- Resolve the ethical dilemmas using common ethical values and identify possible actions to be taken in response.

Course Outline for Theory

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

Recommended Books

1. Engineering Ethics Concepts & Cases by Charles E Harris, 5th Edition, Cengage 2014, (or Latest Edition)
2. Kenneth Blanchard, Professional Ethics, 4th Edition (or Latest Edition)
3. Ethics in Engineering 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005. (or Latest Edition)
4. The Seven Habits of Highly effective people by Stephan r. Covey (Latest Edition)
5. Engineering Ethics: Concepts and Cases, 4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008 (or Latest Edition)

6. Professional Ethics: R. Subramanian, Oxford University Press, 2015. (or Latest Edition)
7. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015. (or Latest Edition)

Course Content

8.28 Project-I

CODE & TITLE CPT-326) **Project-1**	**CREDIT & CONTACT HOURS** (0+3) **0 Theory + 144 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Senior Design 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 technology fundamentals to the Project idea and compare with earlier related projects.	C-3	1
CLO-2	**Analyze** the problem statement through research and literature review.	C-4	2
CLO-3	**Defend** the impact of Project idea in societal and environmental contexts, and its sustainability.	C-5	10
CLO-4	**Use** latest design tools and technical skills to develop a prototype that has passed through the design, implementation, testing and evaluation stages.	C-6	3
CLO-5	**Integrate** solutions to a Broadly Defined Engineering Technology Problem for improvement of Society and the environment.	A-4	7
CLO-6	**Practice** ethical values and avoid Plagiarism in report writing.	A-5	7
CLO-7	**Exhibit** effectiveness as an individual and in a team.	A-4	8
CLO-8	**Display** good communication skills through presentations, technical reports, and posters.	A-5	9
CLO-9	**Explain** results of hardware component testing which could be used for SDP.	P-5	5

Course Content

8.29 Project-II

CODE & TITLE (CPT-324) **Project-II**	**CREDIT & CONTACT HOURS** (0+3) **0 Theory + 144 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Senior Design Project-II**	
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** the proposed design using modern technology for solution of a Broadly Defined Engineering Technology Problem.	C3	5
CLO-3	**Investigate** and analyze the results obtained from the design.	C4	4
CLO-4	**Practice** ethical values and avoid Plagiarism in report writing	A5	7
CLO-5	**Exhibit** effectiveness as an individual and in a team.	A4	8
CLO-6	**Display** good communication skills through presentations, technical reports, and posters.	A5	9
CLO-7	**Possess** management skills as a member or leader in managing the Project.	A4	10
CLO-8	**Alter** and revise conventional solutions by adopting modern technology.	P6	11

Course Content

8.30 Cloud Computing

CODE & TITLE (CPT-411) **Cloud Computing**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Breadth Core-VIII**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** the fundamental concepts and existing core technologies on which the cloud is built (e.g., clustering, grid computing, virtualization etc.)	C-2	1
CLO-2	**Understand** cloud delivery and deployment models and summarize the core key-enabling technologies of contemporary modern-day clouds.	C-4	2
CLO-3	**Identify** fundamental cloud security concepts, threats, and attacks common to public cloud environments. Highlight the various off-the-shelf (OTS) cloud technologies to provide IT solutions in specific runtime functions.	C-4	2
CLO-4	**Manipulate** learned cloud technology on commercial, or some standard cloud computing platform (such as OpenStack).	P-3	5

Course Objectives

- Understand Cloud Computing Architecture and Learn fundamental concepts of cloud computing.
- Distinguish between traditional and cloud computing models in terms of business value.
- Identify technical challenges and mitigation measures involved in cloud computing.
- Analyze Security threats and challenges in private and public cloud buildup and Security management in cloud including identity and access management, next-generation security protection and application programming interface (API) based security.
- Explore Design considerations for scalability, high availability, and security.

Course Outline for Theory

Traditional computing challenges and concerns, Cloud Computing concepts, Cloud reference architecture, Advantage of Cloud business model, Delivering services from the cloud, Types of cloud public, private and hybrid, Categorizing service types, comparing vendor cloud products, Virtualization-the backbone of cloud computing, hypervisor, vSphere Virtual Infrastructure, Network basics for cloud computing, network architecture for virtualization, creating virtual machines in vSphere, Storage Virtualization basics, Cloud computing emerging trends/ technologies, Role of cloud in digital transformation, OpenStack architecture, Virtual Machine Management, Security threats and challenges in cloud computing, architectural concepts of cloud security and design requirements, Security management in cloud computing, Next-generation security using NGFW in cloud computing. Amazon Web Services (AWS) Architecture and different models of Cloud Computing. Computer Services: AWS Lambda, Elastic Beanstalk, AWS EC2, Auto Scaling, and Load Balancing. Storage Services: Amazon EBS, Amazon S3, Amazon EFS, Amazon Glacier, Amazon Global Accelerator, Amazon FSx, and Storage Gateway.

Lab Outlines
Install VirtualBox/VMware Workstation with different flavors of Linux or Windows OS on top of windows, install a compiler in the virtual machine created using virtual box and execute Simple Programs, Install Google App Engine. Create hello world app and other simple web applications using python/java, Use GAE launcher to launch the web applications. AWS: Create Your First Amazon EC2 Instance (Windows), Working with Amazon EC2 Auto Scaling Groups and Network Load Balancer, Create Your First Amazon S3 Bucket, Create Your First Amazon RDS Database, Storing and Rotating RDS Credentials in Secrets Manager, Introduction to Virtual Private Cloud (VPC), Develop and Deploy an Application with AWS CodeStar, Introduction to CodeCommit
Recommended Books
1. The Cloud Computing Book: The Future of Computing Explained by Douglas Comer (2021) ISBN: 978-0367706807 or latest edition. 2. Amazon Web Services Bootcamp: Develop a Scalable, Reliable, and Highly Available Cloud Environment with AWS by Sunil Gulabani (2018) ISBN: 978-1788294454 or latest edition. 3. Building Event-Driven Microservices: Leveraging Organizational Data at Scale 1st Edition by Adam Bellemare (2020) ISBN-13: 978-1492057895 or latest edition.

Course Content

8.31 Error Correction and Coding Techniques

CODE & TITLE (CPT-000) **Error Correction and Coding Techniques**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** error correction techniques to detect and correct data errors.	C-3	3
CLO-2	**Design** and implement coding schemes for reliable data transmission.	C-4	3
CLO-3	**Evaluate** the performance of error correction and coding algorithms.	C-4	4

Course Objectives

- To get introduced with error correction coding mechanism that allows the detection and correction of errors occurring during the transmission of data in digital communication systems.
- To get introduced to both classical and modern coding theory
- To implement various coding techniques in real-time applications like cryptography.

Course Outline for Theory

Introduction of Coding theory; Types of codes; Classical coding theory; Hamming code; BCH code; Reed-Solomon code; Reed-Muller codes; convolutional codes; Modern codes and decoding methods; Turbo codes, LDPC codes; repeat-accumulate codes; space-time codes; factor graphs; soft-decision decoding; iterative decoding.

Lab Outlines

Implementation and evaluation of Hamming codes, CRC codes, BCH and R-S codes, convolutional codes, turbo codes, and LDPC codes.

Recommended Books

1. T. K. Moon, Error Correction Coding: Mathematical Methods and Algorithms. John Wiley & Sons, 2020 or latest edition.
2. S. Lin and J. Li, Fundamentals of Classical and Modern Error-Correcting Codes. Cambridge University Press, 2021 or latest edition.
3. G. G. L. Guardia, Quantum Error Correction: Symmetric, Asymmetric, Synchronizable, and Convolutional Codes. Springer Nature, 2020 or latest edition.

Course Content

8.32 Hardware Description Language

CODE & TITLE (CPT-000) **Hardware Description Language**	CREDIT & CONTACT HOURS (1+2) **16 Theory + 96 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** Hardware Description Language (HDL) to describe and model digital logic circuits.	C-3	3
CLO-2	**Design** and simulate complex digital systems using Hardware Description Language (HDL).	C-4	3
CLO-3	**Implement** and verify digital logic circuits using Hardware Description Language (HDL).	P-4	2

Course Objectives

- To provide the foundation of Hardware Description Languages, specifically VHDL and Verilog.
- To learn VHDL and Verilog for their use for design entry and verification.
- To learn current HDL software tools for FPGA development, and practice with several programming examples

Course Outline for Theory

Basics of the VHDL language; VHDL logic design techniques; VHDL Identifiers, Data Types, and Operators; Introduction to Pre-Synthesis Simulation, Testbenches, and Design Verification; Basics of the Verilog language; Verilog & System Verilog Design Techniques; Behavioral and Register Level VHDL Modeling for Simulation and Synthesis; Basic VHDL I/O

Lab Outlines

Simulation vs. Synthesis/Implementation HDL Models for Digital Systems; VHDL Identifiers, Data Types, and Operators; Pre-Synthesis Simulation and Design Verification; Design Verification Using CAD Software; PLA, PAL, CPLD, and FPGA Architectures; Behavioral and Register Level VHDL Modeling; Structural Level VHDL Modeling; Detailed Software Simulation, Synthesis, and Implementation Steps and Processes.

Recommended Books

1. D. C. Bhargava and D. R. Sarma, Hardware Description Language Demystified: Explore Digital System Design Using Verilog HDL and VLSI Design Tools. BPB Publications, 2020 or latest edition.
2. S. L. Tripathi, S. Saxena, and S. K. Mohapatra, Advanced VLSI Design and Testability Issues. CRC Press, 2020 or latest edition.
3. V. K. Vagga, Verilog (HDL) Tutorial and Programming: With Program Code Examples. Independently Published, 2019 or latest edition.

Course Content

8.33 Machine Learning and Data Analytics

CODE & TITLE (CPT-000) **Machine Learning and Data Analytics**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** machine learning algorithms and techniques to analyze and interpret large datasets for solving real-world engineering technology problems.	C-4	2
CLO-2	**Design** and implement data pre-processing techniques to clean and transform raw data for machine learning applications.	C-3	3
CLO-3	**Develop** and evaluate machine learning models using appropriate evaluation metrics and performance optimization techniques.	C-4	5

Course Objectives

- To get introduced to Machine Learning and Data Analytics in a hands-on manner.
- To get introduced with the state-of-the-art techniques in data analytics and machine learning using Python and R
- To explore the use of basic statistics, regressions, uncertainty modeling, simulation and optimization for data analysis and machine learning.

Course Outline for Theory

Introduction to data science and analytics; Data Pre-processing; Python and / or R programming; Data science software; Modeling techniques; Regression; Data visualization and visual analytics; Cognitive computing

Lab Outlines

Using R/ Phyton for Data Pre-processing; Regression Models; Models creations; Reinforcement Learning; Association Rule Learning; Natural Language Processing; Introduction to other tools like RapidMiner and Weka

Recommended Books

1. F. Hutter, L. Kotthoff, and J. Vanschoren, Automated Machine Learning: Methods, Systems, Challenges. Springer, 2019 or latest edition.
2. F. Nwanganga and M. Chapple, Practical Machine Learning in R. John Wiley & Sons, 2020 or latest edition.
3. G. S. Venkateswaran C. Jothi, R Programming: An Approach to Data Analytics. MJP Publisher, 2019 or latest edition.
4. C. D. Larose and D. T. Larose, Data Science Using Python and R. John Wiley & Sons, 2019 or latest edition.

Course Content

8.34 Multimedia and Animations

CODE & TITLE (CPT-000) **Multimedia and Animations**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Express** basic concepts related to multimedia, categories of applications, their benefits, and limitations regarding design and development.	C-2	1
CLO-2	**Design** multimedia products by planning and developing storyboards regarding multimedia and animated products.	C-5	3
CLO-3	**Develop** static and dynamic images, sounds and graphics, and prepare animations on audio-visual materials using animation software.	C-5	5

Course Objectives

- Develop competencies in designing and creating multimedia applications
- Use appropriate tools for the design, development and creation of digital media artefacts.
- Analyze instructional and informational media (print materials, audio/visual materials and/or web-based materials, games/simulations, etc.)
- Plan the development of an idea into the realization of a multimedia product.

Course Outline for Theory

This course introduces students to the design and production process of developing multimedia systems, a combination of text, sound, graphics, animation, and video. It is a hands-on course where a variety of applications are used for audio and video production, multimedia presentations, animations & image editing.
The course covers multimedia systems, elements of multimedia and animation, and their use. It will also explain the various image file formats, the concept of morphing, 2D and 3D animation principles and techniques, animation file formats, animation tools for World Wide Web, and professional development. Production techniques, planning and costing, media management & marketing, delivering.

Lab Outlines

Graphics and illustration, Image editing, Transparency, Gradients, Patterns, and Special Effects. 2D and 3D animation techniques. Audio/Video editing, Pre and Postproduction. Render & Export.

Recommended Books

1. Multimedia and Animation by A. P. Godse, Dr. D. A. Godse, 2020, ISBN: 978-9333223355 or latest edition.

2. Adobe Illustrator Classroom in a Book by Brian Wood, 1st Edition, 2021, ISBN: 978-0136805533 or latest edition.
3. Hands-On Unity 2021 Game Development: Create, customize, and optimize your own professional games from scratch with Unity 2021 by Nicolas Alejandro Borromeo, 2nd Edition, 2021, ISBN: 978-1801071482 or latest edition.
4. Learning Blender: A Hands-On Guide to Creating 3D Animated Characters by Oliver Villar, 2nd Edition, 2021, ISBN: 978-0134663463 or latest edition.

Course Content

8.35 System Security

CODE & TITLE (CPT-000) **System Security**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Possess** advanced knowledge of common vulnerabilities, attack mechanisms, and methods against computer and information systems	C-2	1
CLO-2	**Use** knowledge of theory and methods underlying access control and information flow policies; and analyze security techniques and methods applied in operating systems	C-4	4
CLO-3	**Apply** relevant methods for security modelling and analysis of software applications and information systems.	C-3	2
CLO-4	**Analyze,** evaluate, and enhance the security of information systems independently by identifying potential threats, and propose countermeasures.	C-4	5

Course Objectives

- To provide both theory and practical fundamentals and principles of cryptography and network security.
- To explore the current practices of cryptography and network security.
- To cover advanced topics like HTTPS, Secure Shell (SSH) and wireless network security

Course Outline for Theory

Introduction; System intrusion; Security Trends; Models for Network Security; Operating system security; Internet security; Intranet security; Application security; LAN security; Wireless network security; Classical Encryption Techniques

Lab Outlines

Tools to explore Operating system security; Internet security; Intranet security; Application security; LAN security; Wireless network security; Implementing Encryption Techniques; Implementing Public-Key Cryptography; Implementing RSA

Recommended Books

1. R. Vacca, Network and System Security. Elsevier, 2013 and latest edition.
2. S. / Marchesini, The Craft of System Security. Pearson Education India, 2008 or latest edition.

3. K.-P. Mehdi D. B. A., Advanced Methodologies and Technologies in System Security, Information Privacy, and Forensics. IGI Global, 2018 or latest edition.
4. Chopra and M. Chaudhary, Implementing an Information Security Management System: Security Management Based on ISO 27001 Guidelines. Apress, 2019 or latest edition.
5. Thomas, P. Fraga-Lamas, and T. M. Fernández-Caramés, Computer Security Threats. BoD – Books on Demand, 2020 or latest edition.

Course Content

8.36 Network Switching and Routing

CODE & TITLE (CPT-000) **Network Switching and Routing**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** knowledge of routing and switching terminology, access various router components, remotely access routers, and test network connectivity.	C-3	1
CLO-2	**Demonstrate** knowledge of the operation and configuration of switches and routers including protocols and addressing.	C-3	2
CLO-3	**Design** and implement a hierarchical IPv4 and IPv6 addressing and subnetting schemes.	C-5	3
CLO-4	**Understand** protocols such as Spanning Tree Protocol (STP), RIP, IGRP, and configure Virtual LANs (VLANs) in a switched LAN.	C-3	5

Course Objectives

- To get introduced with the fundamental and advanced switching technologies
- To explore the role of router along with its operations
- To get introduced with the deployment of wireless local area networks (WLAN) along with security challenges.

Course Outline for Theory

Introduction to Networks; Routing and Switching Essentials; Path Determination algorithms; Routing Protocol; Switching Basics and basic switch configuration; Connecting Networks and Link protocols in WANs like HDLC, Point-to-point (PPP) protocols and Frame Relay; Network monitoring and troubleshooting; Data centers and virtualization.

Lab Outlines

Configuring VLSM, DHCP, NAT, VLSM subnetting; Exploring RIP and RIPv2; Exploring EIGRP, OSPF, Spanning Tree Protocol (STP); Configuring Virtual LANs and frame-tagging; Routing between VLANs; Securing network devices using packet filters and firewall; Implementing Access Control Lists (ACL); Network monitoring and troubleshooting using syslog, SNMP, and NetFlow.

Recommended Books
1. C. N. Academy, Switching, Routing, and Wireless Essentials Companion Guide (CCNAv7). Cisco Press, 2020 or latest edition. 2. L. IOAN, G. Niculescu, and M. Vochin, TRANSMISSION, SWITCHING and ROUTING in communication networks. Editura Politehnica Press, 2021 or latest edition. 3. J. Aweya, IP Routing Protocols: Fundamentals and Distance-Vector Routing Protocols. CRC Press, 2021 or latest edition.

Course Content

8.37 Chip Design Technology

CODE & TITLE (CPT-000) **Chip Design Technology**	CREDIT & CONTACT HOURS (1+2) **16 Theory + 96 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** general concepts of chip design methodologies.	C-2	1
CLO-2	**Identify** and formulate different Front-End/Back-End techniques in chip design technology.	C-4	2
CLO-3	**Design** solutions for Front-End/Back-End IC problems.	C-5	3

Course Objectives

- To learn end-to-end system on chip (SoC) design philosophy
- To get introduced with the design methodology and the design environment.
- To learn the modern SoC development tools

Course Outline for Theory

System on Chip (SOC) Design; SOC Constituents; VLSI Logic Design and HDL; SOC Synthesis; Static Timing Analysis (STA); SOC Design for Testability (DFT); SOC Design Verification; SOC Physical Design; SOC Physical Design Verification; SOC Packaging

Lab Outlines

Simulation vs. Synthesis/Implementation HDL Models for Digital Systems; VHDL Identifiers, Data Types, and Operators; Pre-Synthesis Simulation and Design Verification; Design Verification Using CAD Software; PLA, PAL, CPLD, and FPGA Architectures; Behavioral and Register Level VHDL Modeling; Structural Level VHDL Modeling; Detailed Software Simulation, Synthesis, and Implementation Steps and Processes.

Recommended Books

1. V. S. Chakravarthi, A Practical Approach to VLSI System on Chip (SoC) Design: A Comprehensive Guide. Springer Nature, 2019 or latest edition.
2. R. W. Keyes and M. Y. Lanzerotti, Introductory Semiconductor Device Physics for Chip Design and Manufacturing. Wiley, 2018 or latest edition.
3. E. Iannone, Labs on Chip: Principles, Design and Technology. CRC Press, 2018 or latest edition.

Course Content

8.38 Digital System Design

CODE & TITLE (CPT-000) Digital System Design	CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective	
After completion of this course, students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Build** basic blocks of digital systems using hardware description language (Verilog HDL) on field programmable gate arrays (FPGAs).	C-3	5
CLO-2	**Review** the architecture of basic building blocks of a digital design.	C-2	1
CLO-3	**Design** effective mapping of software algorithms and applications on dedicated application specific hardware.	C-3	3
CLO-4	**Design** and implement micro-coded state machine for application-specific design problems.	C-5	3
CLO-5	**Design** digital systems to solve open-ended lab sessions and term-end projects.	P-4	3

Course Objectives

- To get introduced with the design of sequential digital logic circuits
- To get introduced with the design of combinational digital logic circuits
- To introduce the use of computer-aided design tools for prototyping designs and development of complex digital circuits.

Course Outline for Theory

High-level digital design methodology using Verilog, Design, Implementation, and Verification; Application requiring HW implementation, Floating-Point to Fixed-Point Conversion; Architectures for Basic Building Blocks, Adder, Compression Trees, and Multipliers; Transformation for high-speed using pipelining, retiming, and parallel processing; Dedicated Fully Parallel Architecture; Time shared Architecture; Hardwired State Machine based Design; Micro Program State Machine based Design

Lab Outlines

Explore Xilinx Design Suite for configuring FPGAs using Verilog HDL; Design a Full Adder circuit using structural modeling; Design and simulation of Decoders; Design and simulation of light switch; Design of ALU; Design and simulation of Finite State Machine; Design of Shift register; Design and simulation of RWM cell

Recommended Books
1. G. Donzellini, L. Oneto, D. Ponta, and D. Anguita, Introduction to Digital Systems Design. Springer, 2018 or latest edition. 2. B. J. LaMeres, Introduction to Logic Circuits & Logic Design with Verilog. Springer, 2019 or latest edition. 3. Digital System Design with Verilog and VHDL (second Edition). Dian zi gong ye chu ban she, 2018 or latest edition. 4. Sachan, Digital Electronics & Microprocessor: Principle, Design and Programing. Amazon Digital Services LLC - KDP Print US, 2019 or latest edition. 5. A. Belous and V. Saladukha, High-Speed Digital System Design: Art, Science and Experience. Springer Nature, 2019 or latest edition.

Course Content

8.39 Digital Forensics

CODE & TITLE (CPT-000) **Digital Forensics**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** digital evidence using forensic tools and techniques to identify and recover electronic artifacts from various sources.	C-4	4
CLO-2	**Apply** methods and procedures for preserving and maintaining integrity of digital evidence during forensic investigation.	C-3	7
CLO-3	**Know** legal and ethical considerations in digital forensics and adhere to professional code of conduct.	C-2	8

Course Objectives

- To get an overview of the principles and practices of digital investigation.
- To learn different techniques, procedures and tools to perform a digital investigation.
- To get introduced all the major phases of digital investigation such as preservation, analysis and acquisition of artifacts from hard disks and random-access memory.

Course Outline for Theory

Principles of Digital Forensics; Digital Forensics and Fraud Investigations; Digital Forensic Examination Process; Digital Documents; Correspondence and Communication; Network Intrusions; Cyber Crime; Memory acquisition; Email & database forensics

Lab Outlines

Exploring various Digital Forensic software; Data Acquisition of physical storage devices; Study of different file systems including Microsoft Windows & Linux Systems; File System Analysis & file recovery; File carving & document analysis; Information hiding & steganography; Time, registry recovery

Recommended Books

1. G. Gogolin, Digital Forensics Explained. CRC Press, 2021 and latest edition.
2. C. Easttom, Digital Forensics, Investigation, and Response. Jones & Bartlett Learning, 2021 or latest edition.
3. J. Kävrestad, Fundamentals of Digital Forensics: Theory, Methods, and Real-Life Applications. Springer Nature, 2020 or latest edition.
4. N. A. Hassan, Digital Forensics Basics: A Practical Guide Using Windows OS. Apress, 2019 or latest edition.

Course Content

8.40 Navigational Technologies

CODE & TITLE (CPT-000) **Navigational Technologies**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** and evaluate navigational technologies used in engineering technology applications and their operating principles.	C-4	1
CLO-2	**Design** and develop solutions using navigational technologies to address engineering technology problems in a multidisciplinary context.	C-3	3
CLO-3	**Honor** ethical and societal considerations in using navigational technologies.	C-2	6

Course Objectives

- To provide a thorough understanding of the basic principles and techniques of navigational technologies
- To analyze the different types of navigational systems w.r.t to working and usage.
- To provide an insight into the techniques, trends, and applications of navigational technologies

Course Outline for Theory

Overview of navigational technologies; Concepts of latitude and longitude as determined by the direction of gravity; Functional segments of navigational technologies; Relationships between coordinates; Working principle of navigational technologies; Signals and range determination; Errors and accuracy issues; Positioning methods; Introduction to common map projections; uses of different map projections; Augmentations and other navigations applications; Security systems on GPS satellites

Lab Outlines

Working with Astronomical latitude and longitude; Geodetic latitude and longitude; Dead-reckoning; true and magnetic bearings; use of celestial bodies; use of secants for position fixes; Vector approach to spherical trigonometry.

Recommended Books

1. B. Bhatta, Global Navigation Satellite Systems: New Technologies and Applications. CRC Press, Taylor & Francis Group, 2021 or latest edition.
2. Y. J. Morton, F. van Diggelen, J. J. S. Jr, B. W. Parkinson, S. Lo, and G. Gao, Position, Navigation, and Timing Technologies in the 21st Century: Integrated Satellite Navigation, Sensor Systems, and Civil Applications, Volume 1. John Wiley & Sons, 2021 or latest edition.

3. J. G. Webster and H. Eren, Measurement, Instrumentation, and Sensors Handbook: Two-Volume Set. CRC Press, 2018 or latest edition.

Course Content

8.41 Real-Time Operating Systems

CODE & TITLE (CPT-000) **Real-Time Operating Systems**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** the principles and concepts of real-time operating systems and their application in solving computer engineering technology problems.	C-4	1
CLO-2	**Design** and develop real-time operating systems to meet specified needs, considering factors such as safety, performance, and reliability.	C-3	3
CLO-3	**Apply** ethical and professional standards in the design and implementation of real-time operating systems and evaluate their societal impact.	C-2	6

Course Objectives

- To provide fundamental and principles for programming of real-time operating systems.
- To get introduced with programming languages developed for real-time operations.
- To understand how a real-time system works constitute of a real-time network, use of real-time system programming language and a real-time operating system

Course Outline for Theory

Programming languages intended for real-time systems, support in ordinary programming languages, e.g. "Ada tasking"; Real-time operating system (RTOS); System support: scheduling, resource handling; Design and analysis of real-time system software; Modelling and verification of real-time systems; Reliability and fault tolerance; Interrupts; Fault recovery; Distributed real-time systems; Real-time communication; Real-time systems for multiprocessor systems

Lab Outlines

Working with RTOS; Real-time operating system kernel (thread switching and synchronization); Cooperative and preemptive schedule; Periodic and switch interrupts, semaphores; priority scheduling; performance measures; dumping RTOS profile data to the PC; file system; Memory management; process creation and linking; IO operations

Recommended Books

1. C. Walls, Embedded RTOS Design: Insights and Implementation. Elsevier Science, 2020 or latest edition.
2. G. Bloom, J. Sherrill, T. Hu, and I. C. Bertolotti, Real-Time Systems Development with RTEMS and Multicore Processors. CRC Press, 2020 or latest edition.

3. Koubaa, Robot Operating System (ROS): The Complete Reference (Volume 3). Springer, 2018 or latest edition.
4. J. Cooling, Real-Time Operating Systems Book 1: The Foundations. Independently Published, 2018 or latest edition.

Course Content

8.42 Fault-Tolerant Systems

CODE & TITLE (CPT-000) **Fault-Tolerant Systems**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Use** fault-tolerant systems to analyze and solve computer engineering technology problems related to system reliability and resilience.	C-4	1
CLO-2	**Design** fault-tolerant solutions for computer systems, considering factors such as fault detection, fault recovery, and fault prevention.	C-3	3
CLO-3	**Evaluate** the societal and environmental impact of fault-tolerant systems and apply ethical principles in design and implementation.	C-2	6

Course Objectives

- To get introduced with the concept and implementation of reliable computing systems.
- To learn the design principles of fault-tolerant hardware and software
- To learn the analysis and fault-tolerance techniques for fault-tolerant computing systems w.r.t both hardware and software.

Course Outline for Theory

Preliminaries; Reliability Theory; Hardware Fault Tolerance; Information Redundancy; Fault-Tolerant Networks; Software Fault Tolerance; Checkpointing; Fault-Tolerance in Cyber-Physical Systems (CPS); Case Studies

Lab Outlines

Exploring various hardware and software Fault diagnostic tools; Modeling of Information Redundancy; working for Fault-Tolerant Networks; Working for Software Fault Tolerance; Implementing Checkpointing

Recommended Books

1. G. D. Natale, D. Gizopoulos, S. D. Carlo, A. Bosio, and R. Canal, Cross-Layer Reliability of Computing Systems. Institution of Engineering and Technology, 2020 or latest edition.
2. M. Raynal, Fault-Tolerant Message-Passing Distributed Systems: An Algorithmic Approach. Springer International Publishing, 2018 or latest edition.
3. H. Pham, Reliability and Statistical Computing: Modeling, Methods and Applications. Springer Nature, 2020 or latest edition.
4. J. Henkel and N. Dutt, Dependable Embedded Systems. Springer Nature, 2020 or latest edition.

Course Content

8.43 Intelligent Systems and Robotics

CODE & TITLE (CPT-000) **Intelligent Systems and Robotics**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** and solve problems in the field of intelligent systems and robotics.	C-4	1
CLO-2	**Design** and develop intelligent systems and robotic solutions that meet specified needs, considering factors such as performance, safety, and ethics.	C-3	3
CLO-3	**Demonstrate** effective communication and collaboration skills in the context of intelligent systems and robotics, both orally and in written form.	C-3	10

Course Objectives

- To provide an understanding for the development of Intelligent Systems encompasses computational intelligence techniques.
- To explore fuzzy logic, neural networks, CI optimization and knowledge-based systems being used for intelligent systems design.
- To apply the learned knowledge in various areas such as robot control and games development.

Course Outline for Theory

Preliminaries; Computational Intelligence; Fuzzy Logic; Natural Language Processing; Computational Intelligence Optimization (CIO); Artificial Neural Networks and Deep Learning; Applied Computational Intelligence; Intelligent Mobile Robots; Case Studies

Lab Outlines

Understanding and implementation of Fuzzy Logic; Understanding and implementation of Natural Language Processing; Understanding and implementation of Computational Intelligence Optimization (CIO); Understanding and implementation of Artificial Neural Networks and Deep Learning; Understanding and implementation of Applied Computational Intelligence.

Recommended Books

1. M. Wilamowski and J. D. Irwin, Intelligent Systems. CRC Press, 2018 or latest edition.

2. G. Hulten, Building Intelligent Systems: A Guide to Machine Learning Engineering. Apress, 2018 or latest edition.
3. M. A. Resources Information, Intelligent Systems: Concepts, Methodologies, Tools, and Applications: Concepts, Methodologies, Tools, and Applications. IGI Global, 2018 or latest edition.
4. R. M. Association, Intelligent Systems: Concepts, Methodologies, Tools, and Applications. IGI Global, 2018 or latest edition.

Course Content

8.44 Blockchain Technology

CODE & TITLE (CPT-000) **Blockchain Technology**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** and evaluate the principles and concepts of blockchain technology, including its underlying cryptographic techniques.	C-4	1
CLO-2	**Design** and develop secure and decentralized applications using blockchain technology, considering ethical and legal aspects.	C-3	3
CLO-3	**Demonstrate** effective communication skills to explain blockchain concepts and applications to technical and non-technical audiences.	C-2	10

Course Objectives

- To learn underlying technical principles and implementations of blockchain along with the theoretical and technical foundations.
- To comprehend the concept of decentralization, its impact and relationship with blockchain technology.
- To grasp the inner workings of blockchain and relevant mechanisms in various domain application like financial exchanges, Lending, Insurance, Real estate, Secure personal information, voting, etc.

Course Outline for Theory

Blockchain Foundations; Distributed systems; Cryptocurrencies; Consensus Mechanisms; Smart Contracts; Storage technologies; Intercommunication Protocol; Privacy and Anonymity; Cryptography Foundations; Blockchain Cryptography; Real-World Applications

Lab Outlines

Exploring Ethereum and / or other blockchain software; Implementing smart contracts; Exploring multiple consensus mechanisms; Working with storage technologies; Working with secure transactions; Exploring multiple intercommunication protocol; Working with privacy and security; Working with cryptography; development of blockchain application.

Recommended Books

1. Lipton and A. Treccani, Blockchain And Distributed Ledgers: Mathematics, Technology, And Economics. World Scientific Publishing Company, 2020 or latest edition.
2. D. Hellwig, G. Karlic, and A. Huchzermeier, Build Your Own Blockchain: A Practical Guide to Distributed Ledger Technology. Springer Nature, 2020 or latest edition.

3. R. Wattenhofer, Blockchain Science: Distributed Ledger Technology. Independently Published, 2019 or latest edition.

Course Content

8.45 Sensor Network and Application

CODE & TITLE (CPT-000) **Sensor Network and Application**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** knowledge of sensor network architectures and protocols to analyze and design efficient and reliable solutions.	C-4	1
CLO-2	**Develop** and implement sensor network applications using appropriate tools and programming techniques.	C-3	3
CLO-3	**Demonstrate** effective teamwork skills in designing, deploying, and managing sensor network systems.	P-2	9

Course Objectives

- To develop an understanding of sensor network technologies
- To understand the working of sensor networks from three different perspectives: sensing, communication, and computing.
- To learn the development and simulation of sensor network applications.

Course Outline for Theory

Attributes of sensor networks; Wired and wireless sensors; Sensors and networks design and deployment issues; Bandwidth and energy constraints aware techniques for network discovery; Network control and routing; Collaborative information processing; Offloading processing and data management tasks; Tasking and programming sensor networks; sensor fusion and aggregation, graph signal processing; Standards that provide the models and schema encoding for defining the geometric, dynamic and observational characteristics of a sensor; Applications.

Lab Outlines

Use of OMNET++ simulation environment or similar environment, and the MATLAB S/W for modeling of Wired and wireless sensors; Optimization of network for Bandwidth and energy constraints; Simulating Network control and routing; Simulating Collaborative information processing; Simulating Offloading processing; Simulating sensor fusion and aggregation, graph signal processing.

Recommended Books

1. S. Yellampalli, Wireless Sensor Networks: Design, Deployment and Applications. BoD – Books on Demand, 2021 or latest edition.

2. B. Nayak, S. K. Pani, T. Choudhury, S. Satpathy, and S. N. Mohanty, Wireless Sensor Networks and the Internet of Things: Future Directions and Applications. Apple Academic Press, 2021 or latest edition.
3. M. Ilyas and I. Mahgoub, Smart Dust: Sensor Network Applications, Architecture and Design. CRC Press, 2018 or latest edition.

Course Content

8.46 Smart Surveillance System

CODE & TITLE (CPT-000) **Smart Surveillance System**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Depth Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** and evaluate the principles and techniques used in smart surveillance systems for various applications.	C-4	1
CLO-2	**Design** and develop smart surveillance systems considering factors such as public safety and ethical concerns.	C-3	3
CLO-3	**Demonstrate** proficiency in operating and maintaining smart surveillance systems through hands-on practice.	P-2	5

Course Objectives

- To get introduced with the techniques for visual monitoring including video surveillance and human activity understanding.
- To learn the basic techniques of video processing like Object detection and tracking.
- To examine system design and specific problems in visual surveillance, such as the use of multiple and moving cameras along with planning and maintenance.

Course Outline for Theory

Understand the surveillance system; Functions of video surveillance (face detection, trajectory analysis and object classification); Types of Cameras & their functions; Lens & sensors; DVR; Principles of remote accessing; Survey, planning & maintenance

Lab Outlines

Working with Different CCTV cameras and related accessories; Installation of CCTV cameras; Setup, maintenance and recovery of CCTV Surveillance system; Understanding video surveillance function of face detection; Understanding video surveillance function of trajectory analysis; Understanding video surveillance function of object classification; Understanding smart video surveillance functions

Recommended Books

1. M. H. Kolekar, Intelligent Video Surveillance Systems: An Algorithmic Approach. CRC Press, 2018 or latest edition.
2. R. Simmons, Surveillance Systems: Design, Applications and Technology. Nova Science Publishers, Incorporated, 2017 and latest edition.

3. L. Sharma and P. K. Garg, From Visual Surveillance to Internet of Things: Technology and Applications. CRC Press, 2019 or latest edition.

Course Content

8.47 Electro-optical Technology and Applications

CODE & TITLE (IDE-000) **Electro-optical Technology and Applications**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **IDTE Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** the principles and theories of electro-optical technology to analyze and solve engineering technology problems related to optical systems.	C-4	1
CLO-2	**Design** and develop electro-optical systems and components considering societal, health, safety, and environmental aspects.	C-3	3
CLO-3	**Demonstrate** proficiency in the operation, calibration, and maintenance of electro-optical equipment and conduct experiments to collect reliable data.	P-2	4

Course Objectives

- Know the basic characteristics of the Optical Technologies which are mainly utilized in Computer Engineering.
- Understand how the peculiar features of Optical Technologies are exploited within Computer Systems and Smart Grids, for Communications, Monitoring and Sensing applications.

Course Outline for Theory

Optical Fiber and its properties. Silica and Plastic Optical Fibers. Optical Fiber as Transmission Channel for Telecommunications and as Distributed Sensor for Monitoring. Aspects of the Transmission of the Electromagnetic Field in Optical Fiber systems, Optical Transmitters, Receivers and Components. General properties and required characteristics for Computer Engineering applications. System Design Considerations. Digital and Analog Optical Fiber systems. Topologies utilized in Telecommunication scenarios that can be adopted within Smart Grid contexts. Smart Grid Monitoring and Control through Optical Fiber Systems. Advantages over other possible communication technologies (e.g. Power Line, Wireless, Digital Subscriber Line). Examples of Supervisory Control and Data Acquisition Systems exploiting the Optical infrastructure. Fiber optics sensors in Power Grids. Quantities to be monitored and sensing technologies utilized. Optical Time and Frequency Domain Reflectometry for Optical Fiber System monitoring, Transmission of Electrical Power through Optical Fiber Systems: The Power over Fiber (PoF) technique Technical Characteristics and advantages of the PoF technique. Examples of distribution of the electrical power through the PoF technique within applicative scenarios.

Recommended Books
1. Physics of Optoelectronic Devices by Shun Lien Chuang latest edition. 2. Verdeyen, Laser Electronics (3rd edition), Prentice Hall latest edition.

Course Content

8.48 Electromechanical Systems

CODE & TITLE (IDE-000) **Electromechanical Systems**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **IDTE Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** and solve complex problems related to electromechanical systems.	C-4	1
CLO-2	**Design** and develop solutions for electromechanical systems that meet specified needs while considering societal and environmental factors.	C-3	3
CLO-3	**Demonstrate** hands-on proficiency in operating, maintaining, and troubleshooting electromechanical systems.	C-2	5

Course Objectives

- Demonstrate knowledge, techniques, and skills required for the development of an electromechanical system
- Demonstrate knowledge in selecting mechanical, electrical, and computer software components and materials for development of an electromechanical system
- Use computer software and hardware tools to understand integration of the components for developing an electromechanical system

Course Outline for Theory

Introduction to electromechanical systems, Brushed direct-current motors, Brushless motors, Induction motors, Stepper motors, Related motors and actuators, Introduction to Transformers and AC Machinery Fundamentals, Synchronous Generators, AC Motors, Power systems, Controllers for automation, Cyber-Physical Systems and Security

Recommended Books

1. Electric Drives and Electromechanical Systems: Applications and Control by Richard Crowder, 2nd Edition, Elsevier, ISBN: 9780081028841, 2019 or latest edition.
2. Electromechanical Systems by Chad Davis, 1st Edition, 2018 or latest edition.
3. Electromechanical Systems and Devices, Sergey Edward Lyshevski, CRC Press, ISBN: 1420069721, 2008 or latest edition.

Course Content

8.49 HCI Technologies

CODE & TITLE (IDE-000) **HCI Technologies**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **IDTE Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** and design human-computer interaction (HCI) technologies and systems.	C-4	1
CLO-2	**Conduct** user research, usability evaluations, and user-centered design processes for HCI technologies.	C-3	3
CLO-3	**Develop** and implement interactive prototypes and interfaces using appropriate tools and technologies for effective human-computer interaction (HCI).	P-4	5

Course Objectives

- Demonstrate the basic physiological, perceptual, and cognitive components of human learning/memory.
- Gain the theoretical knowledge of and practical experience in the fundamental aspects of implementing user interfaces.
- Analyze interaction problems from a technical, cognitive, and functional perspective; and develop an awareness of the range of general human-computer interaction
- Explore the multimodal displays for conveying and presenting information; and evaluate the quality of user interfaces and spatial displays.

Course Outline for Theory

History and Foundations of HCI, The Design Process, User Models and Task Models, Social and Embodied Interfaces, Computer-Supported Collaborative Work, Speech Interface, Games, Crowdsourcing, Information Visualization, Ubiquitous Computing, Assistive and Accessible Interfaces, Data Collection/Analysis, Groupware, Virtual and Augmented Reality, Hypertext and Multimedia, Advanced HCI Technologies, Future of HCI

Recommended Books

1. Designing the User Interface: Strategies for Effective Human-Computer Interaction by Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Niklas Elmqvist, Nicholas Diakopoulos, Sixth Edition, Pearson Publishers, ISBN: 978-0134380384, 2016 or latest edition.
2. Human–Computer Interaction: Fundamentals and Practice by Gerard Jounghyun Kim, First Edition, Auerbach Publications, 2015 or latest edition.
3. Research Methods in Human-Computer Interaction by Jonathan Lazar, Jinjuan Heidi Feng, Harry Hochheiser, Morgan Kaufmann, Second Edition, 2017 or latest edition.

Course Content

8.50 Automotive Technology

CODE & TITLE (IDE-000) **Automotive Technology**	**CREDIT & CONTACT HOURS** (1+2) **16 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **IDTE Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** and solve complex problems related to automotive technology.	C-4	1
CLO-2	**Design** and develop automotive systems, components, or processes within safety standards.	C-3	3
CLO-3	**Apply** modern tools and techniques to diagnose, repair, and maintain automotive systems and equipment.	P-4	5

Course Objectives

- Demonstrate basic overview of information about automotive systems.
- Identify the major automotive systems and describe how they work and interrelate to each other.
- Classify the various types of automotive employment opportunities in the transportation industry and demonstrate the ability to apply for an entry-level job.

Course Outline for Theory

Automotive Technology basic concepts, Introduction and safety, History of automotive technology, Four-stroke cycle engine operation, Engine construction, Engine lubrication, Engine cooling system, Diesel engine principles, Fuel supply systems, Forced air injection, Electricity and electronics, Starting and charging systems, Ignition systems, Brakes, Chassis and suspension, Transmission and drivelines, Tires and wheels, Emission controls, Fuel Injection, Introduction to Hybrid and Electric Vehicles, Autonomous Vehicles, Computer-aided in-vehicle applications, Introduction to career opportunities in the automotive industry

Recommended Books

1. Automotive Technology: A Systems Approach by Jack Erjavec, Seventh Edition, Cengage Learning Publisher, ISBN: 978-1337794213, 2019 or latest edition.
2. Automotive Technology: Principles, Diagnosis, and Service by James Halderman, Sixth Edition, Pearson Publishers, ISBN: 978-0135257272, 2020 or latest edition.
3. Auto Fundamentals by Martin W. Stockel, Martin T. Stockel, James E. Duffy, Chris Johanson; Twelfth Edition, ISBN: 978-1635636604, 2019 or latest edition.Thomas L. Floyd, "Digital Fundamentals", Pearson, 11th Edition, 2015, ISBN-13: 9780137506309 or latest edition.

Course Content

8.51 Bioinformatics

CODE & TITLE (IDE-000) **Bioinformatics**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **IDTE Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** bioinformatics algorithms and tools to analyze biological data and extract meaningful insights and patterns.	C-4	5
CLO-2	**Design** and develop bioinformatics solutions to address complex biological problems using computational approaches.	C-3	3
CLO-3	**Proficiently** use bioinformatics software and databases for data retrieval, analysis, and interpretation.	C-2	5

Course Objectives

- Give theoretical background and a working knowledge of the techniques employed in bioinformatics.
- Familiarize with a variety of currently available genomics, search and retrieve information from genomic and proteomic databases, and to analyze their search results using software.
- Learn how to compare and analyze biological sequences and how to interpret the results of their analyses.
- Perform elementary comparative genomic analysis.

Course Outline for Theory

Introduction, Review of DNA replication, transcription, and translation, Genome Organization, Review of molecular biology methods, Introduction to DNA and protein databases, data storage, file formats, information retrieval, Database queries, sequence retrieval, Creation of restriction endonuclease maps, Dot plots, Sequence alignment, Local alignment, Global alignment, Multiple alignments, Sequence alignments continued, Alignment scores, Statistical significance of database searches, Microarrays and the transcriptome, Introduction to proteomics, Prediction of protein structure and function, Navigating the NCBI website, Performing keyword searches of the Online Mendelian, Comparison of sequences using Basic Local Alignment Search Tool (BLAST), Interpretation of BLAST search results, Local Alignment using L-Align, Global Alignment using MatGAT, Multiple Alignment using Clustal, Gene prediction, Prediction of protein structure and function, Comparative genomics continued, Future directions of bioinformatics

Recommended Books

1. Introduction to Bioinformatics by Arthur Lesk, Fifth Edition, Oxford University Press, ISBN: 978-0198794141, 2019 or latest edition.

2. Bioinformatics with Python Cookbook: Learn how to use modern Python bioinformatics libraries and applications to do cutting-edge research in computational biology by Tiago Antao, 2nd Edition, Packet Publishing, ISBN: 978-1789344691, 2018 or latest edition.

Course Content

8.52 Agriculture Technologies

CODE & TITLE (IDE-000) **Agriculture Technologies**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **IDTE Elective**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Design** and implement advanced agricultural technologies and systems.	C-4	3
CLO-2	**Analyze** and evaluate the environmental impact of agricultural technologies and propose sustainable solutions for resource management.	C-3	7
CLO-3	**Proficiently** use modern agricultural tools and equipment for efficient farming practices.	P-2	5

Course Objectives

- Provides an overview of agriculture technologies concepts and the tools. Discusses economic and environmental benefits of agriculture technologies.
- Demonstrate proper usage of various agriculture hardware technologies.
- Analyze data utilizing various agriculture software technologies.
- Make use of agriculture technologies for decision-making.

Course Outline for Theory

Agricultural GPS applications, GIS applications in Production agriculture, Agricultural GIS software programs, Remote Sensing applications in agriculture, Soil Variability and Soil Mapping, Sensors for Gathering agriculture data and Information, Types of soil and crop sensors and operating procedures, Yield Monitoring Systems, Crop Health Monitoring, Crop Disease Detection Systems, Plant phenotyping, Robotic platforms for Agri-business, Trends in Agriculture Technology

Recommended Books

1. Introduction To Agricultural Engineering Technology: A Problem-Solving Approach by Field, H. L., & Long, J. M., Fourth Edition, Springer, ISBN: 978-3319696782, 2018 or latest edition.

9. Supervised Industrial Training

9.1 Background

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

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

9.2 Objectives:

Through the SIT, students will:

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

9.3 Responsibility of HEI: Placement in SIT Program

During 8th semester, Bachelor of Computer Engineering Technology students will be undergoing continuous SIT of 16 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 weeks so that all stakeholders and the students are aware and assured of undergoing SIT training in 8th semester according to a scheduled timeline.

9.4 Student Responsibilities

a. Bachelor of Computer Engineering Technology students shall get enrolled for SIT during the 7th semester and before commencement of 8th semester.
b. Students shall have to undergo continuous training of 16 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.

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 for genuine reasons. The leave shall only be used to cater for emergencies, with prior sanction from the training Administrator/Coordinator.
i. Leave will be deducted from training hours and required to be made up later.
j. Unsanctioned leaves shall be treated as "absent", and liable to disciplinary action.
k. Public holidays and leave should not be counted as working hours.

9.5 Training Progress Assessment and Review by HEI

Every HEI should appoint a focal person as SIT Administrator/Coordinator for each program who will monitor progress randomly through site visits, phone calls or emails to the industrial organization's 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 [See Section 8.8].
e. The Logbook must be submitted along with the Industrial Training Report.

9.8 Industrial Training Report

An Industrial Training Report will be submitted upon completion of SIT. The Report must describe student's learning and development in technical knowledge, engineering practices and professional skills acquired through practical experience. The Industrial Training Report should also reflect student's ability in communication skills and understanding of engineering practices. Students should seek advice from their on-the-job Trainer at site, to ensure that no confidential materials are included in the report. The report shall be submitted to the Training Administrator. The student may present a copy of the report to the prospective employer. Any references made in preparation of the report should be recognized using standard referencing formats. Students should refer to the Industrial Training Report Template as provided [See Appendix G] and guidelines given below in preparing the Report. The Daily Training Logbook should be submitted together with the Report.

9.9 Guidelines for Preparation of Industrial Training Report

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

9.9.1 Contents of Industrial Training Report

(a) Table of Contents

This section of the report shall consist of:

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

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

(b) Background & Profile of the Training Organization

Brief and concise description of the organization in which the student is undertaking the SIT. The main items are:

i. Backgrounds/profile of the organization
ii. Vision and Mission
iii. Organogram.
iv. Title and position of the supervisor in charge
v. Other necessary information only (not more than three pages)

(c) Schedule of Duties Performed as Trainee

This section briefly describes the time, duration and types of duties performed during the training. The description must follow the schedule of the training, i.e., in chronological order (for 16 weeks). The days when the student was not on duty must be properly recorded with cogent reasons.

(d) Experience During SIT

In this section, the student must fully describe the industrial training experience gained. Some suggested areas include:

i. Project (s) carried out, if any.
ii. Supervisory works
iii. Problems encountered
iv. Problems solving process or approach
v. Hands-on skills acquired.
vi. How productivity can be further enhanced.
vii. Quality Management system in place.
viii. Safety at work.

(e) Conclusion

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

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

(f) References

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

(g) Appendixes

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

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

(h) Figures and Tables

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

(i) Notations, Symbols & Acronyms

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

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

9.9.2 Format of the Report

(a) General

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

(b) Abstract or Preface

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

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

9.10 SIT Assessment

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

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

It is also be noted that:

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

9.11 Completion of Industrial Training

i. Upon completion of a 16-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 the Preliminary Meeting of NCRC

The preliminary Meeting of the NCRC was held on 16-11-2021 to 18-11- 2021 at Benazir Bhutto Shaheed University of Technology & Skill Development, Khairpur Mirs (BBSUTSD), Khairpur. The welcome session started with recitation of the Holy Quran, and it was chaired by Engr. Prof. Dr. Madad Ali Shah, Vice-Chancellor. Engr. Imtiaz Hussain Gilani, Chairman NTC delivered the inaugural speech through a video link. In the welcome speech, objectives, and arrangements for NCRC were presented. The Chairman NTC elaborated the importance of curriculum development for bachelor's degree in engineering technology programs with a sharp focus on hands-on training, keeping in view the national and international pivot and paradigm shift towards hands-on skills, market demand, societal needs, adhering to NTC guidelines, and substantially complying to the Sydney Accord. NTC representative Mr. Hafiz Ghulam Muhammad, provided logistic and other support.

In the preliminary session, Engr. Prof. Dr. Madad Ali Shah outlined the procedure and execution of the agenda in NCRC. Then he invited Members to nominate a Convener, a Co-Convener, a secretary, and a Co-Secretary of the NCRC for smooth functioning. He highlighted the agenda of this meeting and emphasized adoption of general rules of curriculum development and revision such as scope of the subject, program, horizontal and vertical alignment, flexibility, and adaptability. After discussions, Engr. Prof. Dr. Laiq Hasan was nominated as Convenor, and Engr. Dr. Muhammad Ali Qureshi, Engr. Prof. Dr. Muhammad Haroon Yousaf and Dr. Ghulam Mujtaba Sheikh were nominated as Co-Convener, Secretary and Co-Secretary for the NCRC, respectively.
The following nominated members represented various HEIs in the NCRC for Bachelor of Computer Engineering Technology:

Sr. No.	NCRC Members	Role
1	Engr. Prof. Dr. Laiq Hasan Professor, Department of Computer Systems Engineering, UET Peshawar.	Convener
2	Engr. Dr. Muhammad Ali Qureshi Chairman/Associate Professor, Department of Information and Communication Engineering, The Islamia University Bahawalpur.	Co-Convener
3	Engr. Prof. Dr. Muhammad Haroon Yousaf Professor, Department of Computer Engineering, UET Taxila.	Secretary
4	Dr. Ghulam Mujtaba Sheikh Associate Professor, Department of Computer Science IBA Sukkur University, Sukkur	Co-Secretary
5	Engr. Prof. Dr. Madad Ali Shah Vice-Chancellor, The Benazir Bhutto Shaheed University of Technology & Skill Development, Khairpur Mirs (BBSUTSD), Khairpur.	Member
6	Engr. Prof. Dr. Muhammad Ali Ismail Professor and Chairman, Department of Computer Systems Engineering, NED UET Karachi.	Member
7	Engr. Dr. Usman Qamar Head of Department, Department of Computer Engineering, NUST College of Electrical and Mechanical Engineering (CEME), Rawalpindi.	Member
8	Engr. Dr. Muhammad Akram Chairman, Department of Computer Engineering, BUITEMS Quetta.	Member

Sr. No.	NCRC Members	Role
9	Engr. Dr. Ahmed Sohaib Head of Department, Department of Computer Engineering, KFUEIT, Rahim Yar Khan	Member
10	Mr. Hafiz Ghulam Muhammad NTC, Pakistan	NTC Representative

After the nominated Members took charge, the Convenor, Engr. Prof. Dr. Laiq Hasan, chaired the meeting, and emphasized reflection of state-of-the-art technologies in curriculum and course titles, as well as developing a curriculum that provides a unified framework for offering a degree under the title of computer engineering technology. In continuation of the above guidelines, Members shared their prior knowledge and experience in curriculum development and international practices for computer engineering technology. The material related to best practices across the globe was shared among Members to grasp the core idea in computer engineering technology program and curriculum structure.

In the second session, the Committee focused on devising a detailed program structure for the computer engineering technology program. Initially, the committee focused on the list of courses in both technical and non-technical domains. Courses in different knowledge areas were discussed and the Committee finalized lists of courses in all knowledge areas, along with credit and contact hours.

The Committee ensured the NEQF and NTC guidelines were met in devising the curriculum. After long deliberations, the Committee proposed the curriculum framework, the duration of the program, number of semesters, number of weeks per semester, the total number of credit hours, weightage of technical and non-technical domain courses, and weightage of theory and practical courses. Furthermore, the list of courses (core and elective), and semester-wise breakup of courses were finalized. Supervised Industrial Training (SIT) was discussed in detail, and HEIs were allowed the option of offering SIT in 7th and 8th Semesters, or in 8th Semester (mandatory) only, with optional courses in the 7th Semester, along with number of credit hours and other related issues.

The preliminary curriculum draft was discussed and reviewed under the guidance of Engr. Prof. Dr. Madad Ali Shah. The Program Summary and Computer Engineering Technology Program Structure were unanimously endorsed by all Committee members.

Keeping in view the experience and expertise of NCRC members, a list of courses in different knowledge areas was distributed among the Sub-Committees. These Sub-Committees reviewed course objectives, contents, lab outlines, assessment strategy, references, and suggested textbooks. The Secretary, Engr. Prof. Dr. Muhammad Haroon Yousaf, shared the course outline template with Members. Following were the Sub-Committees to propose course outlines along with assigned knowledge areas:

Sr. No.	Sub-Committee Members	Knowledge Area
1	1. Engr. Dr. Muhammad Ali Qureshi 2. Engr. Dr. Ahmed Sohaib	Computing and Technology Foundation
2	1. Dr. Ghulam Mujtaba Sheikh 2. Engr. Dr. Muhammad Akram	Computer Engineering Technology CORE (Breadth)
3	1. Engr. Prof. Dr. Muhammad Ali Ismail 2. Engr. Dr. Usman Qamar	Computer Engineering Technology (Depth)
4	1. Engr. Prof. Dr. Laiq Hasan 2. Engr. Prof. Dr. Muhammad Haroon Yousaf	Inter-Disciplinary Technology Elective (IDTE)

After conclusion of the Preliminary Meeting, the Sub-Committees submitted the proposed course outlines of each course to the Secretary. The first draft was compiled by the Engr. Prof. Dr. Muhammad Haroon Yousaf, Secretary NCRC,

and distributed to Members for review. Considering the significance of the curriculum, the Committee also decided to have an internal peer-review of the course outlines before the Final NCRC Meeting. The Committee members were assigned 4-5 course outlines for internal peer-review, along with the peer-review proforma. After internal peer-review, the preliminary draft was submitted to NTC, and sent to international peer-reviewers.

APPENDIX E: Minutes of the Final Meeting of NCRC

The Final Meeting of the NCRC was held from 17-01-2022 to 19-01-2022 at the HEC Regional Centre Karachi. The inaugural session started with the recitation of the Holy Quran, and it was chaired by Engr. Prof. Dr. Madad Ali Shah, Vice-Chancellor. He appreciated the efforts made by Members and highlighted their valuable contribution to the national cause in setting standards for quality of education in the computer engineering technology domain.

The following members attended the Final Meeting:

Sr. No.	NCRC Members	Role
1	Engr. Prof. Dr. Laiq Hasan Professor, Department of Computer Systems Engineering, UET Peshawar.	Convener
2	Engr. Dr. Muhammad Ali Qureshi Chairman/Associate Professor, Department of Information and Communication Engineering, Islamia University Bahawalpur.	Co-Convener
3	Engr. Prof. Dr. Muhammad Haroon Yousaf Professor, Department of Computer Engineering, UET Taxila.	Secretary
4	Engr. Prof. Dr. Madad Ali Shah Vice-Chancellor, The Benazir Bhutto Shaheed University of Technology & Skill Development, Khairpur Mirs (BBSUTSD), Khairpur.	Member
5	Engr. Prof. Dr. Muhammad Ali Ismail Professor and Chairman, Department of Computer Systems Engineering, NED UET Karachi.	Member
6	Engr. Dr. Muhammad Akram Chairman, Department of Computer Engineering, BUITEMS Quetta.	Member
7	Engr. Prof. Dr. Asim Imdad Wagan Dean of Engineering, MAJU Karachi Chief Innovation Officer (CIO), AKSIQ Pvt. Ltd.	Invited Member (Industry Representation)
8	Engr. Prof. Dr. Muhammad Ghazanfar Ullah Khan Professor, Department of Electrical Engineering Usman Institute of Technology (UIT) Karachi.	Invited Member
9	Mr. Hafiz Ghulam Muhammad NTC, Pakistan	NTC Representative

After the introductory session, deliberation on the agenda of the Final Meeting formally commenced which was headed by Convener Engr. Prof. Dr. Laiq Hasan, Co-Convener Engr. Dr. Muhammad Ali Qureshi, and the Secretary Engr. Prof. Dr. Muhammad Haroon Yousaf. The honorable members were informed that valuable feedback was received from the following International Experts.

1. Tauseef Ali
   Co-Founder & CTO, Croptimize.ai
   United Kingdom
2. Muhammad Asim,
   Director, HIT Standardization Strategy, Philips Intellectual Property & Standards (IP&S)
   Eindhoven, The Netherlands

The international experts appreciated the efforts made by NCRC for developing a balanced and standardized curriculum for Bachelor of Computer Engineering Technology. In the introductory session, all the comments and points raised by the international experts were discussed and incorporated accordingly in the curriculum.

The Secretary, Engr. Prof. Dr. Muhammad Haroon Yousaf, also received feedback from the Committee members on the course outline through the internal peer-review exercise devised in the Preliminary Meeting. The observations on the course objectives, contents, lab outline, textbooks and assessment strategies were shared with the sub-committee. Then, the convener, Engr. Prof. Dr. Laiq Hasan directed the Sub-Committees to revise the course outlines considering comments received through internal peer-review evaluation. The Sub-Committees were directed to suggest the latest textbooks for each course.

The Committee also got feedback from two invited experts i.e., Engr. Prof. Dr. Asim Imdad Wagan and Engr. Prof. Dr. Muhammad Ghazanfar Ullah Khan. Both experts gave insight into the need for computer engineering technologists and market requirements. Dr. Asim shared the industry demand, academic and industry perspectives for engineering technologists. The Committee incorporated their feedback in the program structure, and the corresponding course outlines.

The Convener, Engr. Prof. Dr. Laiq Hasan, proposed the preface, vision, mission, rationale, and scope of the curriculum in the second session. The Committee deliberated on these and finalized them. The final draft was compiled by Secretary Engr. Prof. Dr. Muhammad Haroon Yousaf. After review by Members, and with the approval of Convener Engr. Prof. Dr. Laiq Hasan and Co-Convener Engr. Dr. Muhammad Ali Qureshi, it was submitted to NTC.

APPENDIX F: Supervised Industrial Training Logbook Sample Format

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

Course of Study:
Year/Semester of Study:

Training Start Date:
Training End Date:

Training Organization Details:

Name of Organization:
Address:

Contact Person:
Contact Number:

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

Daily Training Log

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

Training Week: _____

Date	Time	Training Log

Declaration:

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

_____
Student signature with date

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

APPENDIX G: Supervised Industrial Training Report Sample Format

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