

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION  
ENGINEERING**

**BACHELOR OF TECHNOLOGY  
IN  
ELECTRONICS AND COMMUNICATION ENGINEERING**

**CURRICULUM AND SYLLABUS**

**IIITUGECE20**



**2020-2021**

**SCHOOL OF ELECTRONICS  
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA,  
HIMACHAL PRADESH**

# **B. TECH.CURRICULUM**

**Academic Year: 2020-21**

## **SCHOOL OF ELECTRONICS**

**DEPARTMENT OF ELECTRONICS AND  
COMMUNICATION ENGINEERING**

**IIITUGECE20**



**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA  
TRANSIT CAMPUS - II, CHANDPUR, HAROLI, UNA – 177220**

## **Personal Details**

Name of the Student :

Parent/ Guardian :

Roll Number :

Batch :

Residential Address :

Contact Number :

E-mail :

Blood Group :

Aadhar Card No. :

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## History of School of Electronics

Program	Description
UG in B.Tech. (Electronics and Communication Engineering)	<ul style="list-style-type: none"><li>Started with 30 seats in 2014</li><li>Intake increased to 66 in 2020</li></ul>

## Institute Vision and Mission

### Institute Vision

- To build a vibrant multicultural learning environment founded on value based academic principles, wherein all involved shall contribute effectively, efficiently, and responsibly to the national and global community.

### Institute Mission

- To achieve academic excellence in engineering, technology and science by imparting quality and value-based education.
- To inspire our students to become responsible citizens and competent professionals with high ethical values.

## School of Electronics: Vision and Mission

### School Vision

- To impart up to date technical knowledge of Electronics and equip the students to handle the global challenges.

### School Mission

- To educate the students with strong theoretical and practical knowledge by imparting quality education.
- To increase the research activity through constant interaction with research organizations and industry.
- To encourage students to entrepreneurship, teamwork, and professional ethics.

## Design of Curriculum

The B.Tech. Curriculum has been designed conforming to the recommendations of the Senate and guidelines of AICTE. It is mandatory for the student to register for four theory and three lab courses from I to V semester. The student should undergo industrial training/ internship for a minimum period of five months during the VI semester. In the VII semester, student will register for four theory courses and a lab course, while in the VIII semester three theory courses are mandatory. Project Work will be carried out in the V, VII, and VIII semesters.

Design of curriculum consists of the following components of study:

- **General Institute Requirement (GIR)**

This group of courses consists of Mathematics, Physics, Chemistry, Biology, Professional Communication, Basic Environmental Science and Engineering, Humanities, Signals and Systems, and Computer Programming. Students may choose a Management elective subject out of total four subjects mentioned in the curriculum.

- **Program Core (PC)**

The PC consists of 9 theory courses out of which 7 courses comprise labs. The PC comprises a total number of 43 credits (29 Theories + 14 Labs). All the PC courses will be covered in first two years which covers almost the GATE syllabus.

- **Program Elective (PE)**

The total number of 6 PE will be offered in V, VII, and VIII semesters. Students will have to choose one out of two subjects as per their choice. The PE consists of six theory courses out of which three courses comprise labs. The PE comprises a total number of 24 credits (18 Theories + 6 Labs).

- **Stream Elective (SE)**

The Institute offers common SE to all the departments. School of Electronics is offering two streams i.e., Signal Processing and Communication, and VLSI and Electronic Systems. Moreover, Applications, Artificial Intelligence and Machine Learning, Database and Networking, and Security streams are offered by the School of Computing. A total number of 30 subjects will be offered in V, VII, and VIII semesters. The subjects are grouped into six streams and further, each elective comprises five number of subjects, one from each stream. Students will have to choose one out of six subjects as per their choice.

- **Internship (IN)**

The curriculum has the support for internship in the adjoining V semester for a minimum period of five months in any of the reputed Industries/ Academic Institutes/ R&D Organizations. Students may identify the Industries considering their career choice. Evaluation will be conducted as per the Clause 10.2 of Academic Rules. Attachment with an academic institution within the country (IISc/IITs/NITs/IIITs and CFTIs) or foreign universities are also permitted in lieu of industrial training.

- **Practicum (PM)**

This is a semester project work included in I to IV semester, having 3 credits in each semester. It consists of a practical problem or a project based on the combination of different labs studied in a corresponding semester.

- **Project Work (PW)**

The PW is designed as a single project for a total duration of three semesters, involving detailed literature survey, implementation plan, and experimentation plan. The percentage of overall project work should be approximately 15 and 35 in V and VII semester respectively. Remaining 50% of the work has to be completed or demonstrated in VIII semester. Evaluation will be conducted as per the Clause 10.3 of Academic Rules.

- **Online Courses (OC)**

- **Honors Online Courses**

The courses are optional for students who opt for B.Tech. Honors. The student should have maintained a SGPA of 8.0 and above in the first four semesters. Moreover, the student should have maintained a SGPA of 8.5 and above in the last four semesters with overall CGPA 8.5. They can choose a course from NPTEL/SWAYAM/MOOCs, etc. They should undergo the online courses completely and submit assignment, project work etc., and appear for the final exam conducted by the online instructor. The awarded grade must be submitted for the award of a suitable letter grade in this course. The credit will not be counted for the calculation of SGPA/CGPA but will appear in Grade Cards/Transcript.

- **Optional Online Courses**

This course is optional and open for all the students in any/all semesters from V to VIII. They can choose a course from NPTEL/SWAYAM/MOOCs, etc. They should undergo the online courses completely and submit assignment, project work etc., and appear for the final exam conducted by the online instructor. The awarded grade must be submitted for the award of a suitable letter grade in this course. The credit will not be counted for the calculation of SGPA/CGPA but will appear in Grade Cards/Transcript.

### **L-T-P-C Notation**

L-T-P-C => Lecture – Tutorial – Practicum/Practical – Credits

Credit structure of each course is given in L-T-P-C form (e.g. 2–1–0–3). The numbers corresponding to L, T and P denote the contact hours per week for Lecture, Tutorial and Practical/Practicum respectively, and that of C denotes the total number of credits for that course in a semester.

## General Institute Requirements

S. No.	Course Name
1	Engineering Mathematics
2	Engineering Physics *
3	Engineering Chemistry *
4	Introduction to Biotechnology*
5	Professional Communication*
6	Basic Environmental Science and Engineering
7	Humanities
8	Basics of Programming in C *
9	Basic Electrical and Electronics Engineering *
10	Electronics/ Computer/ IT Workshop
11	Internship
12	Project Work
13	Technical Clubs/ Sports/ Cultural/ Yoga/ NCC/ NSS
14	Industrial/ Expert Lectures

**\*Includes Lab**

## Program Core Subjects

S. No.	Course Name
1	Electrical Circuits and Networks*
2	Electronic Devices and Circuits*
3	Digital Circuits and Systems*
4	Electromagnetic Field Theory
5	Communication Systems*
6	Microwave Engineering*
7	Control Systems*
8	Microprocessors and Microcontrollers*
9	Electronic Instrumentation and Measurements

**\*Includes Lab**



## Curriculum Components

S. No.	Course Component	Total Credits	Curriculum Content (% of Credits)
1	GIR Theory	32	20
2	PC Theory	29	19
3	PE Theory	18	11
4	GIR Lab	12	08
5	PC Lab	14	09
6	PE Lab	06	04
7	SE	15	10
8	IN	00	00
9	PW	18	11
10	PM	12	08
11	OC (Honors/Optional)	12	07

**The curriculum supports approximately 60% Theory and 40% Lab including PW and PM. Online courses are optional.**

## **B.Tech. (ECE) – Curriculum (IITUGECE20)**

### **Semester-wise Curriculum**

#### **I Semester**

S. No.	Course Code	Course Name	L	T	P	C
1	MAC121	Mathematics - I	3	1	0	4
2	PHC121	Electricity, Magnetism, and Quantum Mechanics	3	0	4	5
3	EVC103	Basic Environmental Science and Engineering	3	0	0	3
4	ECC104	Electrical Circuits and Networks	3	0	4	5
5	ENC125	Communication Skills	3	0	4	5
6	ECL106	Practicum-I	0	0	6	3
<b>Total</b>			<b>15</b>	<b>1</b>	<b>18</b>	<b>25</b>

#### **II Semester**

S. No.	Course Code	Course Name	L	T	P	C
1	MAC221	Mathematics - II	3	1	0	4
2	CYC222	Engineering Chemistry	2	0	4	4
3	BIC203	Introduction to Biotechnology	3	0	0	3
4	CSC204	Basics of Programming in C	3	0	4	5
5	EEC205	Signals and Systems	3	1	4	6
6	ECL206	Practicum-II	0	0	6	3
<b>Total</b>			<b>14</b>	<b>2</b>	<b>18</b>	<b>25</b>

#### **III Semester**

S. No.	Course Code	Course Name	L	T	P	C
1	ECC301	Electronic Devices and Circuits	3	0	4	5
2	ECC302	Digital Circuits and Systems	3	0	4	5
3	ECC303	Electromagnetic Field Theory	3	0	0	3
4	ECC304	Communication Systems	3	1	4	6
5	ECL305	Practicum-III	0	0	6	3
<b>Total</b>			<b>12</b>	<b>1</b>	<b>18</b>	<b>22</b>

### IV Semester

S. No.	Course Code	Course Name	L	T	P	C
1	ECC401	Microwave Engineering	3	0	4	5
2	ECC402	Control Systems	3	0	4	5
3	ECC403	Microprocessors and Microcontrollers	3	1	4	6
4	ECC404	Electronic Instrumentation and Measurements	3	0	0	3
5	ECL405	Practicum-IV	0	0	6	3
<b>Total</b>			<b>12</b>	<b>1</b>	<b>18</b>	<b>22</b>

### V Semester

S. No.	Course Code	Course Name	L	T	P	C
1	XXXXXX	Program Elective - I	3	0	4	5
2	XXXXXX	Program Elective - II	3	0	4	5
3	XXXXXX	Program Elective - III	3	0	0	3
4	XXXXXX	Stream Elective - I	3	0	0	3
5	ENL501	Professional Communication and Soft Skills	0	0	4	2
6	ECL502	Project Phase - I	0	0	6	3
7	ECO503	Honors Online Course - I*	5	1	0	3
		Optional Online Course - I*	5	1	0	0-3
Total			12	0	18	21

### VI Semester

S. No.	Course Code	Course Name	L	T	P	C
1	ECL601	Internship	0	0	0	0
2	ECO602	Honors Online Course - II*	5	1	0	3
		Optional Online Course - II*	5	1	0	0-3
Total			0	0	0	0

\*NPTEL/ SWAYAM/ MOOCs, etc.

## VII Semester

S. No.	Course Code	Course Name	L	T	P	C
1	XXXXXXX	Program Elective - IV	3	0	4	5
2	XXXXXXX	Program Elective - V	3	0	0	3
3	XXXXXXX	Program Elective - VI	3	0	0	3
4	XXXXXXX	Stream Elective - II	3	0	0	3
5	HMC701	Professional Ethics	1	0	0	0
6	ECL702	Project Phase - II	0	0	12	6
7	ECO703	Honors Online Course - III*	5	1	0	3
		Optional Online Course - III*	5	1	0	0-3
Total			13	0	16	20

## VIII Semester

S. No.	Course Code	Course Name	L	T	P	C
1	XXXXXXX	Stream Elective - III	3	0	0	3
2	XXXXXXX	Stream Elective - IV	3	0	0	3
3	XXXXXXX	Stream Elective - V	3	0	0	3
4	HMEXX	Management Elective	3	0	0	3
5	ECL801	Project Phase - III	0	0	18	9
6	ECO802	Honors Online Course - IV*	5	1	0	3
		Optional Online Course - IV*	5	1	0	0-3
Total			12	0	18	21

## Summary

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	25	25	22	22	21	00	20	21	<b>156</b>

\*NPTEL/ SWAYAM/ MOOCs, etc.

## List of Program Electives

S. No.	Course Name
1	Digital Signal Processing*
2	Artificial Neural Networks and Optimization*
3	Statistical Signal Processing*
4	Linear Integrated Circuits*
5	Fiber Optic Communication-I
6	Low Power VLSI
7	Fiber Optic Communication-II*
8	Power Electronics*
9	Antenna and Wave Propagation
10	Renewable and Sustainable Energy Systems
11	Data Communication and Networks
12	Radar Communication

## Semester-wise Program Electives

### V Semester

S. No.	Program Elective	Code	Course Name
1	I	ECPE11	Digital Signal Processing*
		ECPE12	Artificial Neural Networks and Optimization*
2	II	ECPE21	Statistical Signal Processing*
		ECPE22	Linear Integrated Circuits*
3	III	ECPE31	Fiber Optic Communication-I
		ECPE32	Low Power VLSI

**\*Includes Lab**

## VII Semester

S. No.	Program Elective	Code	Course Name
1	IV	ECPE41	Fiber Optic Communication-II*
		ECPE42	Power Electronics*
2	V	ECPE51	Antenna and Wave Propagation
		ECPE52	Renewable and Sustainable Energy Systems
3	VI	ECPE61	Data Communication and Networks
		ECPE62	Radar Communication

**\*Includes Lab**

## List of Stream Electives

S. No.	Stream	Department
1	Applications	IT
2	Artificial Intelligence and Machine Learning	CSE
3	Database and Networking	CSE
4	Security	IT
5	Signal Processing and Communication	ECE
6	VLSI and Electronic Systems	ECE

### • Stream –I: Applications

S. No.	Course Code	Course Name	Expected Prior Study
1	ITSE11	Mobile Applications Development	Computer Networks
2	ITSE12	Cloud Computing	Computer Networks
3	ITSE13	Internet of Things	Computer Networks
4	ITSE14	Big Data Analytics	Database Management System
5	ITSE15	Computer Vision	Probability and Random Process, Linear Algebra, Digital Image Processing

- **Stream –II: Artificial Intelligence and Machine Learning**

S. No.	Course Code	Course Name	Expected Prior Study
1	CSSE11	Natural Language Processing	Linear Algebra, Probability, Programming language (any high level)
2	CSSE12	Artificial Intelligence	-
3	CSSE13	Soft Computing	Linear Algebra, Probability, Programming language (any high level), Algorithms
4	CSSE14	Machine Learning	Linear Algebra, Probability, Programming language (any high level)
5	CSSE15	Deep Learning	Linear Algebra, Probability, Programming language (any high level)

- **Stream – III: Database and Networking**

S. No.	Course Code	Course Name	Expected Prior Study
1	CSSE21	Relational Database Management Systems	Database Management System
2	CSSE22	Advanced Database Management Systems	Database Management System
3	CSSE23	Database Security	Advanced Database Management System, Computer Networks
4	CSSE24	Mobile Computing and Communication	Computer Networks
5	CSSE25	Wireless Sensor Networks	Computer Networks

- **Stream – IV: Security**

S. No.	Course Code	Course Name	Expected Prior Study
1	ITSE21	Information Security	-
2	ITSE22	Principles of Cryptography	Discrete Structures
3	ITSE23	Network Security	Computer Networks
4	ITSE24	Applied Cryptography	Discrete Structures, Principle of Cryptography, Graph Theory
5	ITSE25	Cyber-Physical Systems	-

• **Stream – V: Signal Processing and Communication**

S. No.	Course Code	Course Name	Expected Prior Study
1	ECSE11	Information Theory and Coding	Probability and Random Processes
2	ECSE12	Digital Speech Processing	Signals and Systems
3	ECSE13	Wireless Communication	Analog and Digital Communication
4	ECSE14	Biomedical Signal Processing	Signals and Systems
5	ECSE15	Satellite Communication	Analog and Digital Communication

• **Stream –VI: VLSI and Electronic Systems**

S. No.	Course Code	Course Name	Expected Prior Study
1	ECSE21	Digital VLSI Design	Digital Circuits and Systems
2	ECSE22	Embedded Systems	Microprocessors and Microcontrollers
3	ECSE23	MEMS and Sensor Design	Digital VLSI Design
4	ECSE24	Introduction to Robotics	Microprocessors and Microcontrollers
5	ECSE25	Introduction to Nano-electronics	Electronic Devices and Circuits

## Semester-wise Stream Electives

### V Semester

#### Stream Elective-I

S. No.	Code	Course Name	Stream
1	ITSE11	Mobile Applications Development	Applications
2	CSSE11	Natural Language Processing	Artificial Intelligence and Machine Learning
3	CSSE21	Relational Database Management Systems	Database And Networking
4	ITSE21	Information Security	Security
5	ECSE11	Information Theory and Coding	Signal Processing and Communication
6	ECSE21	Digital VLSI Design	VLSI and Electronic Systems



## VII Semester

### Stream Elective-II

S. No.	Code	Course Name	Stream
1	ITSE12	Cloud Computing	Applications
2	CSSE12	Artificial Intelligence	Artificial Intelligence and Machine Learning
3	CSSE22	Advanced Database Management Systems	Database And Networking
4	ITSE22	Principles of Cryptography	Security
5	ECSE12	Digital Speech Processing	Signal Processing and Communication
6	ECSE22	Embedded Systems	VLSI and Electronic Systems

## VIII Semester

### Stream Elective-III

S. No.	Code	Course Name	Stream
1	ITSE13	Internet of Things	Applications
2	CSSE13	Soft Computing	Artificial Intelligence and Machine Learning
3	CSSE23	Database Security	Database and Networking
4	ITSE23	Network Security	Security
5	ECSE13	Wireless Communication	Signal Processing and Communication
6	ECSE23	MEMS and Sensor Design	VLSI and Electronic Systems

### Stream Elective-IV

S. No.	Code	Course Name	Stream
1	ITSE14	Big Data Analytics	Applications
2	CSSE14	Machine Learning	Artificial Intelligence and Machine Learning
3	CSSE24	Mobile Computing and Communication	Database And Networking
4	ITSE24	Applied Cryptography	Security
5	ECSE14	Biomedical Signal Processing	Signal Processing and Communication
6	ECSE24	Introduction to Robotics	VLSI and Electronic Systems

### Stream Elective-V

S. No.	Code	Course Name	Stream
1	ITSE15	Computer Vision	Applications
2	CSSE15	Deep Learning	Artificial Intelligence and Machine Learning
3	CSSE25	Wireless Sensor Networks	Database and Networking
4	ITSE25	Cyber-Physical Systems	Security
5	ECSE15	Satellite Communication	Signal Processing and Communication
6	ECSE25	Introduction to Nano-electronics	VLSI and Electronic Systems

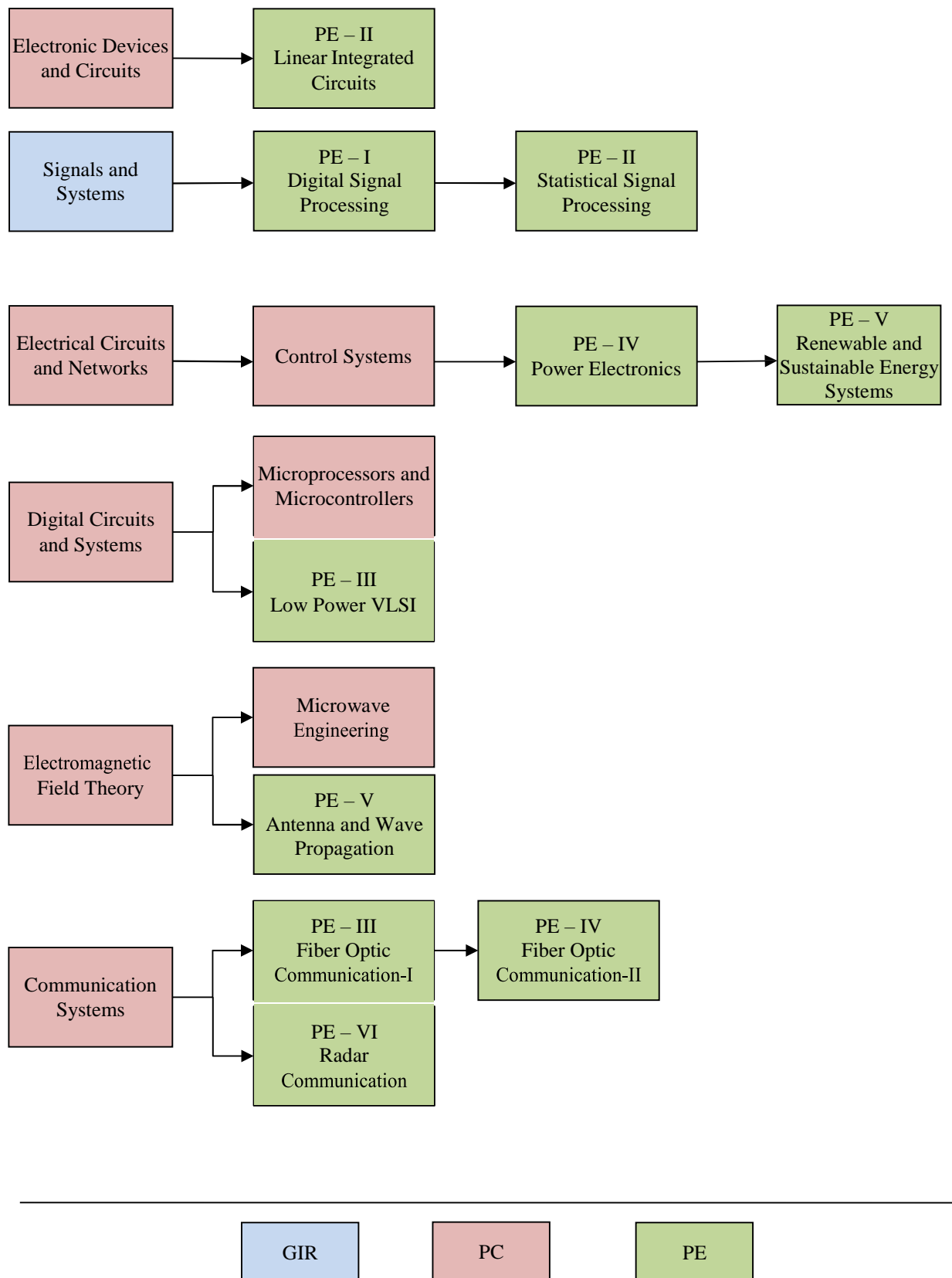
### List of Management Elective

S. No.	Code	Course Name
1	HME861	Organizational Behavior
2	HME862	Entrepreneurship Development
3	HME863	E-commerce and Digital Marketing
4	HME864	Usability Analysis

# STUDY CHART

Semester-I	Semester-II	Semester-III	Semester-IV	Semester-V	Semester-VI	Semester-VII	Semester-VIII
Mathematics-I	Mathematics-II	Electronic Devices and Circuits *	Microwave Engineering*	Professional Communication and Soft Skills	Internship	PE – IV Fiber Optic Communication-II* Power Electronics*	SE -III
Electricity, Magnetism, and Quantum Mechanics*	Engineering Chemistry*	Digital Circuits and Systems*	Control Systems*	PE – I Digital Signal Processing* Artificial Neural Networks and Optimization*		PE – V Antenna and Wave Propagation Renewable and Sustainable Energy Systems	SE -IV
Basic Environmental Science and Engineering	Introduction to Biotechnology	Electromagnetic Field Theory	Microprocessors and Microcontrollers*	PE – II Statistical Signal Processing* Linear Integrated Circuits*		PE – VI Data Communication and Networks Radar Communication	SE - V
Electrical Circuits and Networks*	Basics of Programming in C*	Communication Systems*	Electronic Instrumentation and Measurements	PE – III Fiber Optic Communication-I Low Power VLSI		SE -II	Management Elective
Communication Skills*	Signals and Systems*			SE -I		Professional Ethics	
Practicum-I	Practicum-II	Practicum-III	Practicum-IV	Project Phase-I		Project Phase-II	Project Phase-III
GIR	PC	PE	SE	Internship	Practicum	Project	*Includes Lab

# DEPENDENCY CHART



## FIRST SEMESTER

Course Code	MAC121
Course Title	Mathematics -I
Number of Credits	3-1-0-4
Type of Course	GIR

### Course Objective

- To learn mathematical concepts and methods to acquire fundamental knowledge.

### Course Contents

**Unit I - Matrices:** Matrices, Related matrices, Complex matrices (Hermitian and skew-Hermitian matrices, Unitary matrix), Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Vectors, Linear dependence, Consistency of a linear system of equations, Rouché's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of Eigen values, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form.

**Unit II - Infinite series:** Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, Comparison test, D'Alembert ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test (without proofs), Alternating series and Leibnitz's rule, Power series, Radius and interval of convergence.

**Unit III - Elementary calculus:** Zeno's Paradox, Limit, Continuity and Differentiability, Uniform continuity, Maxima and Minima, Mean value theorem, Partial Derivatives, Integration.

**Unit IV - Vector Spaces:** Vector spaces, Sub Spaces, Linear Dependences and Independences of Vectors, Span, Bases and Dimensions, Direct Sum.

**Unit V - Linear Transformations:** Linear Transformations, Linear Variety, Range Space and Rank, Null Space and Nullity, Homomorphism, Matrix of Linear Transformations, Matrix Representation of a linear transformation, Structure of the solutions of the matrix equation  $Ax = b$ , Change of bases.

### Course Outcomes

- Able to solve all the related problems
- Able to solve industrially applicable problems.

### Text Books

1. Jain, R. K. and Iyengar, S. R. K., "*Advanced Engineering Mathematics*", 5<sup>th</sup> edition, Narosa Publications, 2016.
2. Ram, P., "*Engineering Mathematics through Applications*", 2<sup>nd</sup> edition, CBS Publications, 2015.
3. K. Hoffman and R. Kunze, "*Linear Algebra*", Prentice Hall, 2008.
4. G. Strang, "*Linear Algebra and its Applications*", 4th Edition, Thomson, 2006.

### Reference Book

1. Wilfred Kaplan, "*Advanced Calculus*", Pearson, 2003.
2. Wylie, C. R. and Barrett, L. C., "*Advanced Engineering Mathematics*", 6<sup>th</sup> edition McGraw-Hill, 2003.

<b>Course Code</b>	PHC121
<b>Course Title</b>	Electricity, Magnetism, and Quantum Mechanics
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	GIR

### Course Objectives

- To equip students with a deeper understanding of fundamental laws and principles.
- To provide an advance level modern Physics i.e. Quantum Mechanics.

### Course Contents

**Unit I - Classical Mechanics:** Review of Newtonian Mechanics, Motion, Conservation Principles. Introductory ideas about Lagrangian and Hamiltonian and their simple applications. **Special Theory of Relativity:** Michelson-Morley Experiment, Postulates of STR, Galilean Transformation, Lorentz Transformation, Length Contraction, Time Dilation, Relativistic Addition of Velocities, Mass-Energy Equivalence.

**Unit II - Modern Physics Basics of Quantum Physics:** Origin of Quantum Theory, Wave-Particle Duality, Group and Phase Velocity, Heisenberg's Uncertainty Principle, Schrödinger Wave Equation and its application, Physical interpretation of Wave Function, Elementary Idea of Operators, Particle in a three Dimensional Box, Degenerate States. **Quantum Statistics:** Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics, Density of States, Applications of B-E statistics: LASER Systems, Free Electron Model of electrons in metals, Fermi Energy, Band Theory of Solids.

**Unit III - Physics of Materials: Structure of Materials:** Space Lattice and Unit Cells, Crystal System, Symmetry Operation, Miller Indices, Packing Fractions, Structure Determination using X-ray Diffraction, Bragg's Law. **Semiconductor:** Direct and indirect band gap semiconductors, Electron and Hole concentrations, Doping n-type, p-type, temperature variation of carrier concentration, Fermi level, Zener Diode, Tunnel Diodes, Photodiodes, LEDs. Hall Effect, Super-conductors. **Magnetic and Dielectric Properties of Materials:** Origin of Magnetism, Dia, Para, Ferro, Anti-Ferro and Ferri- magnetism, Soft and Hard Magnetic Materials.

**Unit IV - Fiber Optics:** Fermat's Principle and Snell's Law, Optical Fiber, Principle and Construction, Acceptance Cone, Numerical Aperture, V-Number, Types of Fibers, Fabrication: Double Crucible Technique, Fiber Optic Communication Principle.

**Unit V - Electrodynamics: Electrostatics:** Coulomb's Law, Gauss's Law, Electrostatic Field in Matter: Dielectric Polarization, polarizability and susceptibility, Polarization, Claussius-Mosotti Equation. **Magetostatics:** Lorentz Force, Equation of Continuity, Biot-Savart Law, Ampere's Law, Torques and forces on magnetic dipoles, Magnetization, Induction, Maxwell's Equations, Propagation of EM Waves in Free Space.

### Course Outcomes

- Able to understand fundamentals of Electrodynamics and semiconductor physics
- Get an exposure to modern physics topics like STR, Quantum Mechanics, etc.

### Text Books

1. Kleppner, D. and Kolenkow, R., "An Introduction to Mechanics", 1<sup>st</sup> edition, McGraw-Hill, 2017.
2. Griffiths, D. J., "Introduction to Quantum Mechanics", 2<sup>nd</sup> edition, Pearson Education, 2014.
3. Kittel, C., "Introduction to Solid State Physics", 8<sup>th</sup> edition, Wiley, 2012.
4. Griffiths, D. J. "Introduction to Electrodynamics", 4<sup>th</sup> edition, Pearson Education, 2005.

### Reference Books

1. Beiser, A., Mahajan. S., and Choudhury. S. R., "Concepts of Modern Physics", McGraw-Hill, 2017.
2. Puri, R. K. and Babbar V. K., "Solid State Physics", S. Chand & Co., 2010.
3. Goldstein, H., Poole, C., and Safko, J., "Classical Mechanics", 3<sup>rd</sup> edition, Addison-Wesley, 2002.

## **ELECTRICITY, MAGNETISM, AND QUANTUM MECHANICS LAB**

### **Lab Objectives**

- To make the students gain practical knowledge to co-relate with the theoretical studies.
- To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments.

### **List of Experiments**

Fly Wheel, Hall Effect, Planck's Constant, Michelson Interferometer, Newton's Ring, Magnetic Field along the Axis of a Coil, Young's Double Slit Experiment, B-H Hysteresis Curve, Superconductivity- Measurement of Transition Temperature, Resonance in LCR Circuit, Radiation from a Black Body, Charging and Discharging of a Capacitor, I-V Characteristic of a Solar Cell, Polarization of Light, Time Constant of an R-C Circuit, Energy Gap of a Material of P-N Junction, Compton Scattering of Gamma-ray using  $^{137}\text{Cs}$  Source, Rutherford Scattering of Alpha Particles in Gold, Dielectric Constant, Frank-Hertz Experiment, Determination of  $e/m$  of Electron, Wavelength of LASER using Diffraction Grating, GM Counter Experiment.

### **Lab Outcomes**

- Develop skills to impart practical knowledge in real time solution.
- Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
- Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoretical problems.
- Understand measurement technology, usage of new instruments and real time applications in engineering studies.

### **Reference Books**

1. Physics Laboratory Manual, School of Basic Sciences, IIT Una, 2019.
2. Srivastava, A. and Shukla, R. K., "*Practical Physics*" New Age International, 2<sup>nd</sup> edition, 2018.

<b>Course Code</b>	EVC103
<b>Course Title</b>	Basic Environmental Science and Engineering
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	GIR

### Course Objectives

- To teach the principal renewable energy systems.
- To explore the environmental impact of various energy sources and the effects of different types of pollutants.

### Course Contents

#### A. Energy Component

**UNIT 1: Introduction to non-conventional energy sources:** Present Energy resources in India and its sustainability, Different type of conventional Power Plant, Energy Demand Scenario in India, Advantage and Disadvantage of conventional Power Plants, Conventional vs Non-conventional power generation, Environment issues of various power plants, Industrial and transport emissions- impacts.

**UNIT 2: Environmental impact of various energy sources:** Basics of Solar Energy, Solar thermal energy, Solar photovoltaic-advantages and disadvantages, Power and energy from wind turbines, India's wind energy potential, Types of wind turbines-Off Shore Wind energy, Fossil fuels energy, Biomass energy, Geothermal energy, Ocean energy, Chemical energy sources, Thermonuclear fusion energy.

#### B. Environmental Engineering Component

**UNIT 3: Introduction to Environment and Pollution:** Introduction to the Environment: Physical environment; biotic environment; biotic and abiotic interactions, Environmental pollution (water, air, soil and noise): Sources, effects, control, Air quality standards, International Standards for Drinking Water, Greenhouse gases effect, Acid rain

**UNIT 4: Impact of Organisms on the Environment:** History (scientists and discoveries), Classification and nomenclature of microorganisms, Structural organization and multiplication of Microbes, Microscopic examination of microorganisms: light, fluorescent, dark field, phase contrast, and electron microscopy, Stains and staining techniques, Microbial nutrition and growth, Control of microorganisms.

**UNIT 5: Applications of Environmental Technology:** Aerobic wastewater treatment, Anaerobic wastewater treatment, Bioremediation of contaminated land and water, Biofertilizers, Biopesticides, Biosensors.

### List of Text and Reference Books:

#### Text Books for Energy:

1. B.H. Khan, Non-Conventional Energy Resources, 3<sup>rd</sup> ed. Chennai: The McGraw Hill Education, 2017.
2. G. D. Rai, Non-conventional Energy Sources, 6<sup>th</sup> ed. New Delhi: Khanna Publishers, 2018.

#### Reference Books for Energy:

1. G. Sargsyan, M. Bhatia, S.G. Banerjee, K. Raghunathan, and R. Soni, Unleashing the Potential of Renewable Energy in India, World bank report, 2011.
2. Everett, G. Boyle, S. Peake, and J. Ramag, Energy Systems and Sustainability. Power for a sustainable future. 2<sup>nd</sup> ed. Oxford: Oxford University press, 2011.



**Text Books for Environmental Engineering:**

1. D. Balasubramanian, C.F.A. Bryce, K. Jayaraman, J. Green, and K. Dharmalingam, Concepts in Biotechnology, 6<sup>th</sup> ed. Hyderabad: Universities Press, 2005.
2. M.J. Pelczar, E.C.S. Chan, N. R. Krieg, Microbiology, 6<sup>th</sup> ed. McGraw Hill, India, 2018.
3. I.S. Thakur, Environmental Biotechnology: Basic Concepts and applications, 2<sup>nd</sup> ed. New Delhi: I.K. International Publishing House Pvt. Ltd., 2019.

**Reference Books for Environmental Engineering:**

1. G.G. Evans, and J. Furlong, Environmental Biotechnology: Theory and Application, 2<sup>nd</sup> ed. New Delhi: Wiley, 2018.
2. L.K. Wang, J.-H., Tay, S.T.L. Tay, and Y.T. Hung, (Eds.) Environmental Bioengineering, 1<sup>st</sup> ed. Totowa: Humana Press, 2010.

<b>Course Code</b>	ECC104
<b>Course Title</b>	Electrical Circuits and Networks
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	PC

### Course Objective

- To make the students understand concepts of graph theory, two port networks, and network synthesis.

### Course Contents

**Unit I - Introduction To Networks:** KCL, KVL, Node and Mesh analysis, Graph, Tree and link branches, Network matrices and their relations, Choice of linearly independent network variables, Topological equations for loop current and topological equation for nodal voltage, Duality.

**Unit II - Network Theorems:** Source transformation, Superposition Theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Reciprocity theorem and Maximum power transfer theorem as applied to A.C. circuits, Compensation theorem, Tellegen's theorem and their applications.

**Unit III - Two Port Networks:** Two port network description in terms of open circuits impedance, Short circuit admittance, Hybrid and inverse hybrid, ABCD and inverse ABCD parameters, Inter-connection of two port network, Indefinite admittance matrix and its applications.

**Unit IV - Network Functions:** Concepts of complex frequency, Transform impedance, Networks function of one port and two port network, concepts of poles and zeros, property of driving point and transfer function.

**Unit V- Passive Network Synthesis:** Introduction, Positive Real Functions : Definition, Necessary and sufficient conditions for a function to be positive real, Elements of circuit synthesis, Foster and Cauer forms of LC Networks, Synthesis of RC and RL networks.

### Course Outcomes

1. Understanding the various laws and theorems related to electric networks.
2. Understanding the concept of two port networks.
3. Familiarization with network synthesis.

### Text Books

1. Valkenberg, V., "*Network Analysis*", 3<sup>rd</sup> edition, Pearson Education, 2015.
2. Hayt, W. H. and Kemmerly, J., "*Engineering Circuit Analysis*", 8<sup>th</sup> edition, McGraw-Hill Education, 2013.

### Reference Books

1. Sudhakar, A. and Palli, S. S., "*Circuits and Networks: Analysis and Synthesis*", McGraw-Hill Education, 2017.

## **ELECTRICAL CIRCUITS AND NETWORKS LAB**

### **Lab Objectives**

- To make the students capable of analyzing any given electrical network.
- To make the students learn how to synthesize an electrical network from a given impedance/admittance function.

### **List of Experiments**

- Verification of Kirchhoff's current law and voltage law.
- Verification of mesh analysis and nodal analysis
- Determination of average value, rms value, form factor, peak factor of sinusoidal wave, square wave.
- Verification of super position theorem and reciprocity theorem.
- Verification of maximum power transfer theorem and Thevenin's theorem
- Verification of Norton's theorem and compensation theorem
- Verification of series resonance and parallel resonance
- Verification of self inductance and mutual inductance
- Verification of Tellegen's theorem for two networks of the same topology.
- Determination of transient response of current in RL and RC circuits with step voltage input.
- Determination of transient response of current in RLC circuit with step voltage input for under damp, critically damp and over damp cases
- Determination of frequency response of current in RLC circuit with sinusoidal ac input
- Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters.
- Above experiments are to be simulated through PSPICE.

### **Lab Outcomes**

- Apply the knowledge of basic circuit law and simplify the network using reduction techniques
- Analyze the circuit using Kirchhoff's law and Network simplification theorems
- Infer and evaluate transient response, Steady state response, network functions
- Obtain the maximum power transfer to the load, and Analyze the series resonant and parallel resonant circuit.

<b>Course Code</b>	ENC125
<b>Course Title</b>	Communication Skills
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	GIR

### Course Objectives

- Develop the awareness of forms of communication & social behavior.
- Explore the typical problems arise during communication and learn the skills to overcome these.

### Course Contents

**Unit I - The Process of Communication:** Introduction, Barriers to communication, Different types, Written vs. oral communication, Face-to-Face interactions, characteristics and conventions Conversational problems of second foreign language users, difference between conversation and other speech events, Synonyms and Antonyms; Homophones, Homonyms & Declamation. Telephone Techniques: Speaking and listening commonly used phrases, Vocabulary, Writing and Listening, Leaving a message, grammar and usage: the perfect tense.

**Unit II - Job Applications and Interviews:** Reading, vocabulary, apply for a job, curriculum vitae, language focus: study skills: preparing for an interview, listening, speaking, writing. Group Discussions: Reading, writing, listening: how to be successful in a group discussion, language facts, vocabulary, pronunciation and one word substitutes.

**Unit III - Managing Organizational Structure:** Warm up, value to influence and lead, reading: the role of a manager, vocabulary: leadership. Speaking and listening, language focus, degree of probability Grammar: modals, writing reports, pronunciation. Meetings: Reading, speaking: one to one meetings, language focus: opening, middle and close, study skills, editing, listening, criteria for successful meetings, vocabulary, grammar, reporting verbs, writing: memos, pronunciation, stress.

**Unit IV - Taking Notes and Preparing Minutes:** Taking notes, the note-taking skill: the essential components, the note-taking skill: an example preparing minutes, format of minutes, language and style of minutes, grammar, using the passive voice.

**Unit V - Presentation Skills & Negotiation Skills:** Reading, structure of presentation, verbs often required, language focus, importance of body language in presentation, preparing an outline of a presentation, ending the presentation, language focus, podium panic, pronunciation. Language focus, idiomatic expressions, process of negotiation, grammar: phrasal verbs, listening effective negotiations, speaking, writing.

### Course Outcomes

- Application of the knowledge of human communication and language.
- Evaluation of the approaches used in the interdisciplinary field of communication.

### Text books

1. Rizvi, M. A., “*Effective Technical Communication*”, 2<sup>nd</sup> edition, McGraw Hill Education, 2017.
2. Mohan, K. and Banerji, M., “*Developing Communication Skills*”, 2<sup>nd</sup> edition, Laxmi Publications, 2009.

### Reference Books

1. Bhattacharya, I., “*An Approach to Communication Skills*”, Dhanpat Rai & Co., 2007.

## COMMUNICATION SKILLS LAB

### Lab Objectives

- Enable learners to develop their communicative competence.
- Facilitate them to hone communicative skills.
- Equip them with the ability to enhance their prospect of placement.
- Enable students to use language appropriately for interviews, group discussions and public speaking.

### List of Experiments

- Introduction to Phonetics
- The Phonemic Alphabet in English
- Introduction to Speech Sounds; Vowels
- Introduction to Speech Sounds; Consonants
- Structure of Syllables
- Extempore; Public Speaking
- Words and Phrasal Stress
- Stress and Rhythm
- Rhythms from Mainland
- Telephonic Conversation
- Resume and Presentation Skills
- Group Discussion
- Interview Skills

### Lab Outcomes

- Usage of the appropriate language for group discussion, interview and public speaking.
- Sensitization of the students to the nuances of English speech sounds, word accent, intonation and rhythm.
- Enhancement of the independent language learning.
- Amelioration in the fluency of spoken English and neutralization of the mother tongue influence

### References Books

1. Evans, D., “*Decision maker*”, Cambridge University Press, 1997.
2. Thorpe, E., and Thorpe, S., “*Objective English*”, Pearson Education, New Delhi, 2007.
3. Fisher, D., “*Communication in Organizations*”, Jaico Publishing House, 2004.

## SECOND SEMESTER

Course Code	MAC221
Course Title	Mathematics - II
Number of Credits	3-1-0-4
Type of Course	GIR

### Course Objective

- To learn mathematical concepts and methods to acquire fundamental knowledge.

### Course Contents

**Unit I - Ordinary differential equations:** Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Applications of differential equations of first order (Orthogonal trajectories). Linear differential equations with constant co-efficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficients (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficients, Applications of linear differential equations in engineering.

**Unit II - Integral transforms:** Laplace Transforms of standard functions and their properties, Inverse Laplace Transforms, General Properties of inverse Laplace transforms and Convolution Theorem, Laplace Transforms of periodic functions, Bessel functions, Error function, Dirac-delta Function, Heaviside's Unit Function, Applications to linear simultaneous differential equations.

**Unit III - Fourier series:** Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even periodic functions, Expansion of odd and even periodic functions, Half-range series, Typical wave-forms, Parseval's formula, Practical harmonic analysis.

**Unit IV - Fourier transforms:** Periodic functions, Fourier transforms, Finite Fourier Sine and Cosine Transforms, Properties of Fourier Transforms, Applications of Integral Transforms to simple engineering problems differential Equations in Electric Circuits.

**Unit V - Probability & distributions:** Introduction to Random variables & probability, Conditional Probability, Probability density function, Discrete and continuous distribution, Mean, medium, mode and standard deviations of standard distributions, Central Limit theorem, Generating functions, correlation and regression analysis, Independent trials, Baye's Rule, Bernoulli Trials, Binomial, Gaussian, Rayleigh, exponential, geometrical and uniform distributions and their density functions.

### Course Outcome

- Able to solve industrially applicable problems.

### Text Books

1. Ram, P., "*Engineering Mathematics through Applications*", 2<sup>nd</sup> edition, CBS Publications, 2015.
2. Kreyszig, E., "*Advanced Engineering Mathematics*", 10<sup>th</sup> edition, Wiley, 2015.

### Reference Book

1. Veerarajan, T., "*Probability, Statistics and Random. Processes*", 3<sup>rd</sup> edition, McGraw-Hill Education, 2017.

<b>Course Code</b>	CYC222
<b>Course Title</b>	Engineering Chemistry
<b>Number of Credits</b>	2-0-4-4
<b>Type of Course</b>	GIR

### Course Objectives

- To learn the fundamentals and applications of chemical sciences in the field of Engineering.
- To explore and apply the concepts of chemical science to solve daily life problems.

### Course Contents

**Unit I - Water & its treatment:** Sources, hard & soft water, estimation of hardness by EDTA method, softening of water, boiler feed water, treatment methods, specifications for drinking water, BIS & WHO standards, desalination processes.

**Unit II - Polymer&Composites:** Introduction, functionality, classification, mechanism of polymerization, molecular weight, structure property relationship, moulding techniques, synthesis, properties and application of commercially important polymers, conducting polymers; Composites: Introduction classification, constituents, advantages.

**Unit III - Engineering materials:** Introduction to nanochemistry, synthesis, characteristics and applications of carbon nanostructures; Fuels- Classification, types of coal, determination of calorific value of solid fuels, Bomb calorimeter, theoretical oxygen, proximate & ultimate analysis of coal, manufacture of metallurgical coke, flue gas analysis; Lubricants- theories, characteristics, additives to lubricants, solid lubricants.

**Unit IV - Characterization techniques:** Introduction to spectroscopy; UV-Visible spectroscopy- Principle, Instrumentation and application; IR spectroscopy: Principle and applications; NMR- Principle, Instrumentation, applications of NMR; Thermal method- Instrumentation, fundamental principles and applications of TGA, DTA and DSC; Introduction to chromatographic techniques.

### Course Outcomes

- Apply the fundamentals of chemical sciences in daily life.
- Implement the principles of chemistry for solving problems of engineering fields.

### Text Books

1. Palanna, O. G., “*Engineering Chemistry*”, 2<sup>nd</sup> edition, McGraw-Hill Education, 2017.
2. Vairam, S., “*Engineering Chemistry- A textbook of chemistry for engineers*”, Wiley, 2018.

### References Book

1. Dara, S. S., Umare, S. S., “*A Text Book of Engineering Chemistry*”, S. Chand & Co., 2011.

## ENGINEERING CHEMISTRY LAB

### Lab Objectives

- To enhance and develop scientific and analytical skills
- To relate concepts learned in chemistry and engineering to the real-world situations.
- To acquire skills to perform laboratory experiments, demonstrate safe and proper use of standard chemistry glassware and equipment.

### List of Experiments

**Volumetric analysis (Titrations):** To determine the total hardness of the given hard water using EDTA titration method; To estimate of total; To determine the carbonate, non-carbonate and total hardness in the given water sample by EDTA method; To determine the strength of given solution of Mohr's salt; To estimate amount of chlorine present in given sample of bleaching powder; To determine free residual chlorine in sample water by iodometric titration; To determine the Cu present in given brass sample by iodometrically; To determine the iron content in the given salt.

**Colorimetric analysis:** To determine free residual chlorine content in given water sample To estimate ferric ions in aqueous solution using thiocyanate solution; To find out the concentration of given  $\text{KMnO}_4$  solution spectrophotometrically; To estimate the amount of ferrous iron present in the given sample of cement by colorimetry using ammonium thiocyanate as the reagent; To determine the concentration of Cr in unknown solution of  $\text{K}_2\text{Cr}_2\text{O}_7$  using calibration curve method.

**Physical Chemistry:** To determine the strength of an acid by pH –metric method; To determine the strength of hydrochloric acid solution by titrating against sodium hydroxide solution conductometrically; To identify given unknown liquid by surface tension measurement using Stalgmometer; To identify given unknown liquid by viscosity using Ostwald viscometer; To determine the viscosity coefficient of the given polymer PEG and find out the composition of unknown solution.

**Chromatography:** To separate the mixture of amino acids by thin layer chromatography.

**Lubricant analysis:** To determine the flash point and fire point of given lubricant using Abel's/Pensky Martin closed cup apparatus; To determine the acid value of oil/fat sample.

**Organic synthesis:** To prepare polymer of Bakelite; To prepare urea formaldehyde resin; To prepare a pure sample of Aspirin

### Lab Outcomes

- Ability to relate concepts learned in chemistry to the real-world situations.
- Enhanced the ability to identify, analyze and interpret the results.

### References

1. Selvaraj, S., “*Practical Engineering Chemistry: Laboratory Manual*”, LAP LAMBERT Academic Publishing, 2016.
2. *Engineering Chemistry Lab Manual*, IIIT Una, 2019.



<b>Course Code</b>	BIC203
<b>Course Title</b>	Introduction to Biotechnology
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	GIR

### Course Objectives

- To give an introduction to Bio-technology and its applications in our daily life.
- To get familiarized with various techniques that are used routinely towards this.

### Course Contents

**Unit I - Introduction to Biotechnology:** History of biotechnological developments with major milestones.

Basic biology: Brief introduction to genes and genomes.

**Unit II - DNA Technology:** Introduction to recombinant DNA technology and its application to genomics. Introduction to proteins and their products.

**Unit III -** Microbial biotechnology, Plant biotechnology and Animal biotechnology.

**Unit IV -** Bioremediation and environmental biotechnology. Medical biotechnology.

**Unit V -** Biotechnology regulations and ethics.

### Course Outcomes

- Determine the protein function from sequence through analyzing data.
- Analysis and development of models for better interpretation of biological data to extract knowledge.

### Text Books

1. William J. Thieman and Michael A. Palladino, "Introduction to Biotechnology", Pearson New International Edition, 3rd Edition, 2014.

### Reference

1. Reinhard Renneberg, Arnold L. Demin and Tom Papoport, "*Biotechnology for Beginners*", Academic Press, Annotated Edition, 2007.
2. Ratledge Colin and Kristiansen Bjorn, "*Basic Biotechnology*" Cambridge University Press, 3<sup>rd</sup> Edition, 2006.

<b>Course Code</b>	CSC204
<b>Course Title</b>	Basics of Programming in C
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	GIR

### Course Objectives

- To learn the fundamentals of computers, problem solving techniques by writing algorithms and procedures.
- To learn the syntax and semantics of C programming language.

### Course Contents

**Unit I - Introduction to computers:** Computer Organization, Characteristics, Hardware and Software, Modes of operation, Types of programming languages, developing a program. Algorithms, Characteristics, Flowcharts, Principles of Structured programming, Sequential, selective structures, Repetitive structures, Bounded, Unbounded and Infinite iterations – Examples for each.

**Unit II- Introduction to C:** C character set, Identifiers and Keywords, Data types, Constants, Variables, Declarations, Expressions, Statements, Symbolic constants, Operators, Library functions, Data input and output: Single character input and output, entering input data, Writing output data, gets and puts functions.

**Unit III - Control statements, branching, if-else, looping:** while do-while for, Nested control structures, switch statement, break statement, continue statement, comma operator, goto statement, Modular Programming, Functions and Procedures, Examples, Parameter passing methods. Arrays, defining an array, processing an array, Multidimensional arrays, Pointers, Variable definitions and initialization, Pointer operators, Pointer expressions and arithmetic, Pointers and one-dimensional arrays.

**Unit IV - Functions, Defining a function, Accessing a function, Function prototypes, Passing arguments to a function, Passing arrays to a function, Passing pointers to a function, Recursion. String Handling, Introduction to Strings, Sample Program, Standard String Library Functions, Array of String.**

**Unit V - Structures and Unions, Declaring and Instantiating Structures, Structures as Parameter and Pointer to Structures, Enumerated Data Types, Union, Bit Fields File Processing. Concept of Files, File Opening in Various Modes and Closing of a File, Reading from a File, Writing onto a File.**

### Course Outcomes

- Ability to write algorithms for problems.
- Ability to code a given logic in C language.

### Text Books

1. Deital, P. and Deital, H., “*C How to Program*”, 8<sup>th</sup> edition, Prentice Hall London, 2015.
2. Kernighan, B. W. and Ritchie, D. M., “*The C Programming Language*”, 2<sup>nd</sup> edition, Prentice Hall, 2012.

### Reference Books

1. Hanly, J.R. and Koffman, E.B., “*Problem Solving and Program Design in C*”, 6<sup>th</sup> edition, Pearson Education, 2009.

## **BASICS OF PROGRAMMING IN C LAB**

### **Lab Objectives**

- To the field of programming using C language.
- Ability to enhance their analyzing.
- Problem solving skills and use the same for writing programs in C.

### **List of Experiments**

- Programs using sequence construct.
- Programs using selection construct.
- Programs using Iterative construct.
- Programs using nested for loops.
- Programs using functions with Pass by value.
- Programs using functions with Pass by reference.
- Programs using recursive functions.
- Program using one dimensional and two dimensional arrays.
- Program using Pointers and functions.
- Program using Pointers and Arrays.
- Program using Structure and Union.
- Program using File Processing.

### **Lab Outcomes**

- Ability to write C programs using logic.
- Ability to solve small real world problems using C programs.

### **Reference Book**

1. Kernighan, B. W. and Ritchie, D. M., "*The C Programming Language*", 2<sup>nd</sup> edition, Prentice Hall, 2012.

<b>Course Code</b>	EEC205
<b>Course Title</b>	Signals and Systems
<b>Number of Credits</b>	3-1-4-6
<b>Type of Course</b>	GIR

### Course Objectives

- To provide detailed description of various types of signals and systems.
- To familiar with the concepts of Fourier series, Fourier Transform, and Laplace transform.

### Course Contents

**Unit I - Signals:** Signal classification (analog-digital, energy-power, even-odd, periodic-aperiodic, deterministic-random etc.), standard signals (unit step, unit impulse, ramp, exponential, sinusoids), transformations of the independent variable (shifting, scaling, reversal). Discrete exponential functions and their properties. Discrete unit step and impulse signals and their properties.

**Unit II - Systems:** System classifications (linearity, time invariance, memory, analog/digital, continuous /discrete time, causality). Discrete time convolution. Continuous time convolution. System properties via the impulse response (Causality, memory, stability, invertibility, unit step response).

**Unit III - Fourier series of periodic functions:** History of Fourier series, Euler to Fourier. Response of LTI systems to complex exponentials and Fourier series representation of continuous time periodic signals. Fourier series representation of sawtooth, square and triangular waves, Gibbs phenomena. Properties of Fourier series and examples. Convergence of Fourier series. Fourier series and LTI systems; filtering.

**Unit IV - Fourier Transform:** Introduction of the continuous time Fourier transform by taking the limit of a periodic signal (i.e. making it aperiodic). Fourier transforms of periodic signals. Properties of continuous time Fourier transforms. Convolution property of Fourier transforms. Brief introduction to sampling theorem.

**Unit V- Laplace Transform:** Introduction to Laplace transform; region of convergence. Inverse Laplace transform. Properties of Laplace transforms, initial/final value theorems. Laplace transforms and LTI systems, causality/stability. Laplace transforms and block system diagrams. Unilateral Laplace transform and initial value problems.

### Course Outcomes

- Able to use various signals in real world applications.
- Able to evaluate Fourier series, Fourier transform, and Laplace Transform of signals.

### Text Books

1. Oppenheim, A. V., Willsky, A. S., and Nawab, S. H., “*Signals and Systems*,” 2<sup>nd</sup> edition, Pearson Education, 2015.
2. Lathi, B. P., “*Principles of Linear Systems and Signals*,” 2<sup>nd</sup> edition, Oxford, 2009.

### Reference Books

1. Haykin, S., “*Signals and Systems*,” 2<sup>nd</sup> edition, Wiley, 2008.

# SIGNALS AND SYSTEMS LAB

## Lab Objectives

- To provide detailed description of various types of signals and systems.
- To familiar with the concepts of Fourier series, Fourier Transform, and Laplace transform.

## List of Experiments

- Write a program to generate the discrete sequences (i) unit step (ii) unit impulse (iii) ramp (iv) periodic sinusoidal sequences. Plot all the sequences.
- Find the Fourier transform of a square pulse .Plot its amplitude and phase spectrum.
- Write a program to convolve two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation.
- Write a program to find the trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings.
- Write a program to find the trigonometric and exponential fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal.
- Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
- Write a program to find the autocorrelation and cross correlation of sequences.
- Plot the histogram and the probability function for any sequence. Compute the mean and variance of any random signal.
- Write a program to generate a random sinusoidal signal and plot four possible realizations of the random signal.
- Compute the autocorrelation of any sequence.

## Course Outcomes

- Able to use various signals in real world applications.
- Able to evaluate Fourier series and Fourier transform of signals.

### THIRD SEMESTER

Course Code	ECC301
Course Title	Electronic Devices and Circuits
Number of Credits	3-0-4-5
Type of Course	PC

#### Course Objectives

- To analyze different types of semiconductor devices.
- To understand the operation and design of multistage amplifier.

#### Course Contents

**Unit I - Introduction to Semiconductors Devices:** Semiconductors, Conductor and Insulators, Energy band gap of semiconductor, Conductivity and mobility, Intrinsic and extrinsic semiconductor, Current components in semiconductors, Continuity equations, p-n junction, Current-Voltage characteristics of a p-n junction diode, Rectifiers-half wave and full wave, Special purpose diodes - Zener diode, Tunnel diode and Varactor diode, Photo diode, clippers-single and two level, clampers, their analysis with ideal and practical diodes.

**Unit II - Bipolar Junction Transistor:** Transistors-construction, operation, characteristics, parameters, Transistor as an amplifier at low frequency, Hybrid model and  $r_e$  model of BJT, Analysis of amplifier using Hybrid model and  $r_e$  model, Amplifier types-CE,CB,CC. DC operating point, Biasing circuits-fixed bias, emitter bias, voltage divider bias, bias stabilization.

**Unit III - Field-Effect Transistor:** The junction FET - construction, operation, characteristics, parameters, JFET as an amplifier, FET as a VVR and MOSFET-construction, operation, characteristics, parameters.

**Unit IV - Power and Multistage Amplifiers:** Power Amplifiers, Types, analysis of Class A, B,C, AB; Multistage Amplifiers, Types of multistage couplings. Feedback Amplifier and Oscillators: Feedback concept, Analysis of various configurations of feedback in amplifiers, Criterion for oscillation and Oscillator based on RC and LC feedback circuits, crystal oscillator.

**Unit V - Introduction to op-amps:** Op-amp- analysis, Ideal op-amp building blocks, Open loop op-amp configurations, Practical op-amp- Offset voltage, Input bias and offset current, CMRR, Block diagram representations and analysis of configurations using negative feedback. Applications of op-amp.

#### Course Outcomes

- Design and analyze the basic operations of BJT, FET and MOSFET.
- Know about the multistage amplifier using BJT and FET in various configuration.

#### Text Books

1. Sedra, A. S., Smith, K. C., and Chandorkar, A. N., “*Microelectronic Circuits: Theory and Applications*”, 7<sup>th</sup> edition, Oxford University Press, 2017.
2. Boylestad, R. L. and Nashelsky, L., “*Electronic Devices and Circuits theory*”, 11<sup>th</sup> edition, Pearson Education, 2015.

#### Reference Book

1. Milliman, J., Halkias, C., and Jit, S., “*Electronics Devices and Circuits*”, 2<sup>nd</sup> edition, McGraw Hill Education, 2008

## **ELECTRONIC DEVICES AND CIRCUITS LAB**

### **Lab Objectives**

- To provide students engineering skills by way of breadboard circuit design with electronic devices and components.
- To design and analyze various Electronic circuits so that students are able to understand the practical aspects of basic electronics theory.

### **List of Experiments**

- Study and use of Oscilloscope, signal generator to view waveforms and measure amplitude and frequency.
- V-I characteristics of PN Junction and Zener diodes, and determining its DC and AC resistance.
- Studies on half-wave and full-wave rectifier circuits without and with capacitor filter.
- Studies on clipper and clamper circuits.
- I-V characteristic of an n-p-n and p-n-p transistors, DC biasing the transistor in common-emitter configuration and determination of its operating point (i.e., various voltages and currents).
- Study on BJT fixed bias, self bias, and voltage divider bias configurations.
- Transfer and Drain Characteristics of JFET (Find  $g_m$ ,  $r_d$  and  $\mu$  from characteristics).
- Study on FET fixed bias, self bias configurations.
- Darlington Emitter Follower Amplifier.
- Differential Amplifier using Bipolar Junction Transistors.
- Single staged RC coupled current series emitter coupled feedback amplifier, Two stage RC coupled transistor Amplifier.
- Study of MOSFET in common source configuration.
- Study of OP-AMP in inverting, non-inverting configuration, summing amplifier, integrator, and differentiator.

### **Lab Outcomes**

- Memorize schematic symbol and Recognize basic concepts of electronic components and circuits.
- Explain the functionality of various devices including several types of Diode, BJT and FET.

<b>Course Code</b>	ECC302
<b>Course Title</b>	Digital Circuits and Systems
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	PC

### Course Objectives

- Foundation in design and analysis of the operation of digital gates.
- Design and implementation of combinational and sequential logic circuits.

### Course Contents

**Unit I - Number System:** Introduction to various number systems and their Conversion. Boolean Algebra and Logic Gates: Basic Logic Operations, Basic Identities, Algebraic Laws, Useful Boolean Identities, Algebraic Reductions, Complete Logic Sets, IEEE Logic Gate Symbols.

**Unit II - Combinational Logic Design:** Canonical Logic Forms, Logic Arrays, BCD and 7 Segment Displays, Karnaugh Maps. Digital Hardware: Voltages as Logic Variables, Digital Integrated Circuits, Logic Delay Times, Transmission Lines, Logic Families, the Hardware Designer.

**Unit III - First Concepts in VHDL:** Defining Modules in VHDL, Structural Modelling, Learning VHDL. CMOS Logic Circuits: NOT Function in CMOS, Complex Logic Gates in CMOS.

**Unit IV - Logic Components:** Concept of a Digital Component, BCD Validity Detector, Line Decoders, Multiplexers, Demultiplexers, Binary Adders, Subtraction, Multiplication, Transmission Gate Logic. Memory Elements and Arrays: General Properties, Latches, Clock and Synchronization, Master-Slave and Edge-Triggered Flip-Flops, Registers, RAM, ROM.

**Unit V - Sequential Logic Networks:** Concept of a Sequential Network, Sequential Network Design, Binary Counters, Importance of State Machines. Shift registers: Principle of 4-bit shift registers. Shifting principle, Timing Diagram, SISO, SIPO, PISO and PIPO registers.

### Course Outcomes

1. Design methodologies for combinational and sequential digital systems.
2. Knowledge of VHDL for system modelling and simulation.
3. Implementation of digital systems on reconfigurable programmable logic devices.

### Text Books

1. Mano, M. M., and Ciletti, M. D., “*Digital Design: With an Introduction to the Verilog HDL, VHDL and System Verilog*”, 6<sup>th</sup> edition, Pearson Education, 2018.
2. Uyemura, J. P., “*A First Course in Digital Systems Design*”, 1<sup>st</sup> edition, Cengage Learning, 2006.

### Reference Books

1. Perry, D. L., “*VHDL: Programming by Example*”, 4<sup>th</sup> edition, McGraw-Hill Education, 2017.
2. John, L. K. and Roth, C. H., “*Digital System Design Using VHDL*”, 2<sup>nd</sup> edition, Cengage Learning, 2012.



## **DIGITAL CIRCUITS AND SYSTEMS LAB**

### **Lab Objectives**

- To know the concepts of Combinational circuits, and understand the concepts of flip-flops, registers and counter.
- To design digital circuits using VHDL and implement digital circuits using CPLD/FPGA.

### **List of Experiments**

- Introduction of Digital Logic Gates: Investigate logic behavior of NOT, AND, OR, NAND, NOR, EX-OR, EX-NOR gates.
- Gate-level minimization: Two level and multi-level implementation of Boolean functions.
- Combinational Circuits design, assemble and test: adders and subtractors.
- Code Converter: BCD to Excess-3 code converter, gray code to binary converter, and binary to gray code converter.
- Design of multiplexers and de-multiplexers.
- Design of encoders and decoders.
- Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce an 8-bit product.
- Parallel adder and accumulator: design, implement and test.
- Flip-Flop: assemble, test and investigate operation of S-R, D & J-K flip-flops.
- Counters: Design, assemble and test various Asynchronous and Synchronous binary counter.
- Shift Registers: Design and investigate the operation of all types of shift registers.
- Above experiments are to be implemented in CPLD/FPGA through VHDL.

### **Lab Outcomes**

- Construct basic combinational circuits and verify their functionalities.
- Apply the design procedures to design basic sequential circuits.
- Learn about counters and Shift registers.
- Design any digital circuit using VHDL.

<b>Course Code</b>	ECC303
<b>Course Title</b>	Electromagnetic Field Theory
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	PC

### Course Objectives

- To expose the students to the Electromagnetic theory and wave propagation essential for subsequent courses on microwave engineering, antennas.

### Course Contents

**Unit I - Electrostatic and Magnetic Fields:** Poisson's and Laplace's equation in various coordinate systems, solution of single dimensional Laplace's equation, Conditions at a boundary between dielectrics, Electrostatic uniqueness theorem, Energy and Mechanical forces in electric fields, Method of Electrical images for a point charge in the neighborhood of infinite conducting plane, Application of image method for transmission line capacitance calculations. Magnetic vector Potential, Magnetic scalar Potential, Energy and Mechanical forces in magnetic fields.

**Unit II - Maxwell's Equations:** Equation of continuity for time varying fields. Inconsistency of Amperes law, Maxwell's equations and their physical interpretation, Maxwell's Equations in Phasor Form. Conditions at a boundary surface.

**Unit III - Electromagnetic Waves:** TEM, Derivation of the wave equation and their general solution. Plane waves in unbounded media. Wave propagation in lossless and conducting medium. Penetration depth. Reflection and refraction of plane waves, surface impedance. Poynting Vector and Flow of Power: Poynting's theorem, Interpretation of (Ex H) - vector, Instantaneous, Average and complex Poynting Vector, Power Loss in a plane conductor.

**Unit IV - Transmission Lines:** Distributed parameters, Transmission Line Equations, Input impedance, Lossless propagation, Line distortion and attenuation, line termination, impedance matching, standing wave ratio, Transmission line charts (Smith Chart).

**Unit V - Guided Waves and Wave Guides:** Waves between parallel planes, Characteristics of TE and TM waves, Velocities of wave propagation, wave impedances. Introduction to wave guides. TE and TM waves in rectangular wave guides, Circular waveguides, Impossibility of TEM waves in wave guides, Wave impedances and characteristics impedances, Transmission line analogy for wave guides, Attenuation and Q-factor of wave guides.

### Course Outcomes

- Recognize and classify the basic Electrostatic theorems and laws.
- Discuss the behavior of Electric fields in matter and Polarization concepts.

### Text Books

1. Balanis, C. A., "*Advanced Engineering Electromagnetics*", 2<sup>nd</sup> edition, Wiley, 2012.
2. Hayt, W. and Buck, J. A., and Akhtar, M. J., "*Engineering Electromagnetics*", 8<sup>th</sup> edition, McGraw-Hill Education, 2017.

### Reference Books

1. Guru, B. and Hiziroglu, H., "Electromagnetic field theory Fundamentals", Cambridge University Press, 2005.
2. Jordon, E. C. and Balmain, K. G., "*Electromagnetic waves and Radiating System*", second edition, Prentice Hall New Delhi, 2007.

<b>Course Code</b>	ECC304
<b>Course Title</b>	Communication Systems
<b>Number of Credits</b>	3-1-4-6
<b>Type of Course</b>	PC

### Course Objectives

- To provide detailed description communication system.
- To get student familiarize with concepts of modulation technique along with their transmitter and receiver system.

### Course Contents

**Unit I- Analog Modulation Techniques:** Introduction, Amplitude Modulation; AM Power Calculations, AM Modulation with a Complex wave, Frequency Modulation (FM); Spectra of FM Signals, Narrow Band and Wide Band FM, Phase Modulation, Noise in Frequency Modulation, Pre-emphasis and De-emphasis.

**Unit II – Analog modulation Transmission/ Reception:** Introduction, Generation of Amplitude Modulation, Basic Principles of AM Generation; Square law Diode Modulation, Balanced Modulator. Tuned Radio Frequency (TRF) Receiver, Basic Elements of AM Super-heterodyne receiver; RF Amplifiers Characteristics-Sensitivity, Selectivity, Image Frequency Rejection, AM Detectors; Envelope Detector. Generation of FM by Direct Methods. Indirect Generation of FM; The Armstrong Method, FM Stereo Transmission and reception. FM Receiver. Direct and Indirect Methods of Frequency Demodulation; Slope Detector, Foster-Seely or Phase Discriminator

**Unit III - Pulse Modulation Transmission and Reception:** Introduction, Pulse Amplitude Modulation (PAM), PAM Modulator Circuit, Demodulation of PAM Signals; Pulse Width Modulation (PWM), Pulse Position Modulation (PPM). Various types of PCM waveforms., M-ary Pulse Modulation waveforms, Differential pulse code modulation, Multiplexing PCM signals, Delta modulation, slope overload, Adaptive delta modulation, Adaptive DPCM, Comparison of PCM and DM.

**Unit IV - Digital modulation and demodulation:** Types of digital modulation, Wave forms for Amplitude, Frequency and Phase Shift Keying, Method of generation and detection of coherent & non-coherent binary ASK, FSK & PSK, Differential phase shift keying, Quadrature modulation techniques, M-ary FSK, Minimum Shift Keying (MSK), Probability of error and comparison of various digital modulation techniques. The Optimum filter, Matched Filter.

**Unit V - Multiple Access Techniques:** TDM, FDM, CDM.

### Course Outcomes

- Provided in-depth knowledge of transmitter and receiver design.
- Able to apply the concepts on upcoming trends in communication technology.

### Text Books

1. Haykin, S. and Moher, M., “*Communication Systems*” 5<sup>th</sup> edition, Wiley, 2018.
2. Sklar, B., “*Digital Communication - Fundamentals and Applications*”, 2<sup>nd</sup> edition, Prentice-Hall India, 2017.

### Reference Books

1. Tomasi, W., “*Advanced Electronic Communications systems*” 6<sup>th</sup> edition, Pearson Publishers, 2015.
2. Proakis, J. G., “*Digital Communications*”, 5<sup>th</sup> edition, McGraw Hill, 2008.

## COMMUNICATION SYSTEMS LAB

### Lab Objectives

- To enhance and develop scientific and analytical skills
- To relate concepts learned in lab to the real-world situations.

### List of Experiments

- To study Amplitude Modulation/demodulation using a transistor, depth of modulation, and observe the diagonal peak clipping effect of AM.
- Frequency Modulation using Voltage Controlled Oscillator.
- Generation of DSB-SC, SSB, and VSB.
- Study of Phase Lock Loop (PLL) and detection of FM Signal using PLL.
- Study functioning of Super-heterodyne AM Receiver, and study the limiter circuit and IF filter frequency response, study of the effect of image frequency.
- Measurement of Sensitivity, Selectivity, and Fidelity of radio receivers.
- Study of PAM, PPM, and PPM.
- Study of line coding techniques.
- Study of sampling theorem.
- Study of pulse code modulation and demodulation.
- Study of delta modulation and demodulation, the effect of slope overload.
- Study pulse data coding techniques for NRZ and RZ formats.
- Study of ASK, PSK, FSK, QPSK, MSK and QAM modulator and demodulator..
- Study of TDMA, FDMA and CDMA.

### Lab Outcomes

- Analyzed the modulation and demodulation circuits for analog communication techniques.
- Observed different transmission signals like DSB SC, SSB etc
- Examined various parameters of analog and digital receivers.

## FOURTH SEMESTER

<b>Course Code</b>	ECC401
<b>Course Title</b>	Microwave Engineering
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	PC

### Course Objectives

- To introduce the essential Microwave Circuit Theory and the design aspects of Microwave engineering.

### Course Contents

**Unit I –Introduction to Microwaves:** History of Microwaves, Microwave Frequency bands, General Applications of Microwaves, Advantages of Microwaves.**Mathematical model of Microwave Transmission:** Concept of Mode, Characteristics of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

**Unit II - Analysis of Microwave Transmission Lines and Waveguides:** Transmission line equations & solutions, reflection and transmission coefficient, standing wave and standing wave ratio, line impedance and admittance, impedance matching, using stub line, application of smith chart in solving transmission line problems Introduction to strip lines, Micro strip lines, parallel strip lines, coplanar strip lines, shielded strip lines, Rectangular and circular waveguides-theory and analysis.

**Unit III - Microwave Network Analysis:** Equivalent Voltages and currents for non-TEM lines, Network parameters for microwave Circuits, Scattering Parameters.**Passive and Active microwave Devices:** Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, Wave-guide Corners, Bends, Twists, Attenuator, Circulator, Isolator and Resonator. Microwave Active components: Tunnel diode, Varactor diodes, Step recovery diodes, Schottky Barrier diodes, PIN diodes, Gunn Diodes, IMPATT and TRAPATT diodes, Parametric Amplifiers, Microwave Transistors, Microwave oscillators and Mixers. Microwave tubes: Klystron, TWT, Magnetron.

**Unit IV - Microwave Measurements:** Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure.

**Unit V - Modern Trends in Microwaves Engineering:** Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC), Monolithic Microwave IC fabrication, RF MEMS for microwave components, Microwave Imaging.**Microwave Systems:** Wireless Communications system, Radar Systems, Radiometer Systems, Satellite Communication, Remote sensing, Microwave Propagation, Microwave Antennas.

### Course Outcomes

- Able to apply the basic knowledge of waveguide and microwave resonator circuits.
- Ability to use microwave engineering in modern trends.

### Text Book

1. Pozar, D. M., “Microwave Engineering”, 4<sup>th</sup> edition, Wiley, 2013.
2. Das, A. and Das, S. K., “*Microwave Engineering*”, 3<sup>rd</sup> edition, McGraw Hill Education, 2017.

### Reference Book

1. Collin, R. E., “*Foundations for Microwave Engineering*”, 2<sup>nd</sup> edition, Wiley, 2007.
2. Liao. S. Y., “*Microwave Device And Circuits*”, 3<sup>rd</sup> edition, Pearson Education, 2000.

## **MICROWAVE ENGINEERING LAB**

### **Lab Objectives**

- To enhance and develop scientific and analytical skills
- To relate concepts learned in lab to the real-world situations.

### **List of Experiments**

- Reflex Klystron Characteristics.
- Gunn Diode Characteristics.
- Directional Coupler Characteristics.
- VSWR Measurement.
- Measurement of Waveguide Parameter.
- Measurement of Impedance of a given Load.
- Measurement of Scattering parameter of a Magic Tee.
- Measurement of scattering parameters of a Circulators.
- Attenuation Measurement.
- Microwave Frequency Measurement.

### **Lab Outcomes**

- Able to apply the basic knowledge of waveguide and microwave resonator circuits.
- Assessed the methods used for generation and amplification of the microwave power.
- Analyzed the operating principles and performances of the microwave devices.

<b>Course Code</b>	ECC402
<b>Course Title</b>	Control Systems
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	PC

### Course Objectives

- To learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective.
- To understand stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot.

### Course Contents

**Unit I- Basic Concepts:** Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems.

**Unit II- Mathematical Models of Control System:** Linear and non-linear systems, Transfer function, Mathematical modeling of electrical, Mechanical and thermal systems, Analogies, Block diagrams and signal flow graphs.

**Unit III- Control Components:** DC servomotor, AC servomotor, Potentiometers, Synchronous, Stepper-motor.

**Unit IV- Time and Frequency Domain Analysis:** Transient and frequency response of first and second order systems, Correlation ship between time and frequency domain specifications, Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.

**Unit V- Stability and State Variable Analysis:** Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins, Concept of State, State variables & state models, State space representation of linear continuous time systems, State models for linear continuous time systems, State variables and linear discrete time systems, Solution of state equations, Concept of controllability & observability.

### Course Outcomes

- Apply root locus technique for stability analysis.
- Identify open and closed loop control systems.
- Formulate mathematical model for physical systems.

### Text Books

1. Nagrath, I. J. and Gopal, M., “*Control System Engineering*”, 6<sup>th</sup> edition, New Age International, 2018.
2. K. Ogata, “*Discrete-Time Control Systems*”, 2<sup>nd</sup> edition, Prentice-Hall India, 2015.

### Reference Book

1. Warwick, K., “*An Introduction to Control Systems*”, 2<sup>nd</sup> edition, World Scientific Publishing, 1996.

## CONTROL SYSTEMS LAB

### Lab Objectives

- To impart knowledge on practical control system and PLC applications.
- To demonstrate applications of machines & electronic devices with control systems.

### List of Experiments

- Step, Ramp and Impulse response.
- Identification of damping in second order.
- Time domain analysis.
- Stability analysis using Routh- Hurwitz method.
- Stability analysis of linear system using various graphical methods.
- Frequency response analysis using Bode and Polar plot.
- Design of PID Controller for first order and second order systems, speed control of DC motor system and Twin Rotor Multi Input Multi Output.
- Simulation of first order and second order system with and without dead time using Discretization method and Runge – Kutta method.
- State feedback control of a process by Pole placement.
- State estimation of a process using full order and reduced order Observers.
- Logic gates operations, timing operations, counter operations and math operations using PLC.
- Control of bottle filling system and sequential operation of motors using PLC.
- PC based Data Acquisition Report Generation.
- Simulation of complex control systems using Matlab/Other Equivalent software package.
- Study of distributed control system.
- Control of a given process using real time embedded controller.
- Control of speed using armature current.
- Control of armature current.
- Disturbance observer without feedback of current.
- Encoder-less speed control of PMDC motor using compensation of plant nonlinearity.

### Lab Outcomes

- Ability to identify the hardware and software that are needed in a basic control system.
- Ability to make this hardware and software work together.
- Ability to debug small errors that may appear during practical implementation.

### References

1. Franklin, G. F., Powell, J. D., and Emami-Naeini, A., “*Feedback Control of Dynamic Systems*”, 4<sup>th</sup> edition, Pearson Education, 2002.
2. Control System Laboratory Manual, Department of Electronics and Communication Engineering, Indian Institute of Information Technology, Una (2019).



<b>Course Code</b>	ECC403
<b>Course Title</b>	Microprocessors and Microcontrollers
<b>Number of Credits</b>	3-1-4-6
<b>Type of Course</b>	PC

### Course Objectives

- To study the architecture of 8086 Microprocessor and 8051 Microcontroller.
- To learn the design aspects of I/O and Memory interfacing circuits.

### Course Contents

**Unit I –The 8086 Microprocessor:** Introduction to 8086, Microprocessor architecture, Addressing modes, Instruction set and assembler directives, Assembly language programming, Modular Programming, Linking and Relocation, Stacks, Procedures, Macros, Interrupts and interrupt service routines, Byte and String Manipulation.

**Unit II –8086 System Bus Structure:** 8086 signals, Basic configurations, System bus timing, System design using 8086, I/O programming, Introduction to Multiprogramming, System Bus Structure, Multiprocessor configurations, Coprocessor, Closely coupled and loosely Coupled configurations, Introduction to advanced processors.

**Unit III - I/O Interfacing:** Memory Interfacing and I/O interfacing, Parallel communication interface, Serial communication interface, D/A and A/D Interface, Timer, Keyboard /display controller, Interrupt controller, DMA controller, Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

**Unit IV - Microcontroller:**Architecture of 8051, Special Function Registers(SFRs), I/O Pins Ports and Circuits, Instruction set. Addressing modes, Assembly language programming.

**Unit V - Interfacing Microcontroller:** Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, ADC, DAC &Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation.

### Course Outcomes

- Design and implement programs on 8086 microprocessor and 8051 microcontroller based systems.
- Design Memory interfacing circuits.

### Text Books

1. Liu, Y. C. and Gibson, G. A., “*Microcomputer Systems - The 8086/8088 Family: Architecture, Programming and Design*”, 2<sup>nd</sup> edition, Prentice Hall of India, 2011.
2. Mazidi, M. A., Mazidi, J. G., and McKinlay, R. D., “*The 8051 Microcontroller and Embedded systems*”, 2<sup>nd</sup> edition, Pearson Education, 2011.

### Reference Books

1. Brey, B. B., “*Intel Microprocessors*”, 8<sup>th</sup> edition, Pearson Education, 2013.
2. Davies, J. H., “*MSP430 Microcontroller Basics*”, 1<sup>st</sup> edition, Elsevier, 2010.

## **MICROPROCESSORS AND MICROCONTROLLERS LAB**

### **Lab Objectives**

- To become familiar with the architecture and instruction set of Intel 8085 microprocessor.
- To provide practical hands on experience with assembly language programming.

### **List of Experiments**

- Programs for 64 bit arithmetic operations for 8086 (using various addressing modes)
- Program for sorting an array for 8086
- Programs for searching a number or character in a string for 8086
- Programs for string manipulation for 8086
- Programs for digital clock design using 8086, Interfacing ADC and DAC to 8086
- Parallel communication between two microprocessors kits using 8255
- Serial communications between two microprocessors kits using 8251
- Programming using arithmetic, logical and bit manipulation instructions of 8051
- Interfacing to 8086 and programming to control stepper motor
- Program and verify timer/counter in 8051
- Program and verify interrupt handling in 8051
- UART operation in 8051, Communication between 8051 kit and pc
- Interfacing LCD to 8051
- Interfacing matrix/keyboard to 8051
- Data transfer from peripheral to memory through DMA controller 8237/8257
- Review of the assembly programs with interfacing
- LED blinking, Interfacing ADC to 8051
- Interfacing keyboard and LCD to 8051
- Interfacing & programming for the fastest finger
- LED blinking model-I, LED blinking model-II
- Interfacing to 8051 and programming to control stepper motor
- Programming for the electronic vote machine
- ALP for finding the factorial of a given number

### **Lab Outcomes**

- Able to design circuits for various applications using microcontrollers
- Provided in-depth knowledge of applying the concepts on real- time applications

<b>Course Code</b>	ECC404
<b>Course Title</b>	Electronic Instrumentation and Measurements
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	PC

### Course Objectives

- To explain basic concepts and definitions in measurement.
- To describe the bridge configurations and their applications.

### Course Contents

**Unit I - Measurement errors and Bridges:** Definitions, Accuracy and Precision, Significant Figures, Types of Error, Statistical Analysis, Probability of Errors, Limiting Errors, Time and Frequency Standards, Electrical Standards, Wheatstone Bridge, Kelvin Bridge, Maxwell Bridge, Hay's Bridge, Wein Bridge. Anderson's Bridge, De Sauty's Bridge, Schering Bridge.

**Unit II - Electronics instrument:** True RMS Responding Voltmeter, Digital Frequency Meter, Circuit for Measurement of Frequency, Period Measurement, Ratio and Multiple Ratio Measurements, Time Interval Measurements, Vector Impedance Meter, Oscilloscope Block Diagram, Cathode Ray Tube, Delay Line, Multiple Trace, Oscilloscope, DSO.

**Unit III - Instrument for generation and analysis of waveforms:** Sine Wave Generator, Frequency Synthesized Signal Generator, Frequency Divider Generator, Signal Generator Modulation, Sweep Frequency Generator, Pulse and Square Wave Generator, Function Generator, Wave Analyzers, Harmonic Distortion Analyzer, Spectrum Analyzer.

**Unit IV - Transducers:** Electrical Transducers Selection and Considerations, Resistive, Strain Gauges, Temperature Transducers: Platinum Resistance Type, Thermistor, Thermocouples, Inductive, LVDT, Capacitive, Load Cell, Piezoelectric, Photoelectric Transducers.

**Unit V - Signal converters:** I To P / P To I Converter, Temperature to Voltage Converter, Conversion To Frequency, Period, or Time Duration, Measurement of Phase Difference, Measurement of Active And Reactive Power of Supply Line, Locking Amplifiers, Variable Oscillators.

### Course Outcomes

- Define measurement parameters and methods, standards, characteristics, errors.
- Graduates will be able to study the working of different ac and dc bridges, Transformers

### Text Books

1. Doebelin, E. and Manik, D. N., "*Doebelin's Measurement Systems*", 6<sup>th</sup> edition, McGraw Hill Education, 2017.
2. Helfrick, A. D. and Cooper, W. D., "*Modern Electronic Instrumentation and Measurement Techniques*", 1<sup>st</sup> edition, Pearson Education, 2015.

### Reference Book

1. Bell, D. B., "*Electronic Instrumentation and Measurements*", 3<sup>rd</sup> edition, Oxford University Press, 2013.

## FIFTH SEMESTER

<b>Course Code</b>	ENL501
<b>Course Title</b>	Professional Communication and Soft Skills
<b>Number of Credits</b>	0-0-4-2
<b>Type of Course</b>	PC

### Course Objectives

- To enhance the holistic development of students and improve their employability skills.

### Course Contents

**Unit I - Introduction to Soft Skills & Professional ethics:** Aspects of Soft Skills, Effective Communication Skills, Personality Development, Importance of Professional Ethics.

**Unit II - Team Building:** To know the nature of the team, To understand personal as well as professional goals of the members of the group, To work effectively in a team through building relation and interpersonal communication.

**Unit III - Art of Negotiation:** What is negotiation, Ways of negotiating, To understand the power of language and non-verbal communication.

**Unit IV - Organizing Meetings:** How to call the meeting, How to organize a meeting, How to design the agenda and prepare minutes of the meeting.

**Unit V - Presentation Skills:** Reading, structure of presentation, verbs often required, language focus, importance of body language in presentation, preparing an outline of a presentation, ending the presentation.

**Unit VI - Stress Management & Time Management:** Kinds of stress, Identify the right reason/s of stress, How to handle the pressure, Techniques to cope with the stressful situation at a workplace. Goal setting, Understand the importance of time and How to prepare the time line.

**Unit VII - Group Discussion & Public Speaking:** Nature of discussion, Ways to form and present the arguments. To learn the skills of appearing in an interview and being successful in it.

### Course Outcomes

- Understand and recognize the importance of interpersonal skills.
- Understand the realistic perspective of work and work expectations.

### Text Books

1. Rizvi, A., “*Effective Technical Communication*”, Tata McGraw Hill, 2008.
2. Mohan, K., “*Developing Communication Skills*”, Mac Millan India Limited, 2009.

### Reference Book

1. Dale, C., “*How to win Friends and Influence People*”, New York: Simon & Schuster, 1998.
2. Coleman, D., “*Emotional Intelligence*”. Bantam Book, 2006.

## **SIXTH SEMESTER**

<b>Course Code</b>	ECL601
<b>Course Title</b>	Internship
<b>Number of Credits</b>	0-0-0-0
<b>Type of Course</b>	GIR

## SEVENTH SEMESTER

<b>Course Code</b>	HMC701
<b>Course Title</b>	Professional Ethics
<b>Number of Credits</b>	1-0-0-0
<b>Type of Course</b>	GIR

### Course Objectives

- To enable the students to create an awareness on Engineering Ethics and Human values.
- To instil Moral and Social Values and loyalty and to appreciate the rights of others.

### Course Contents

**Unit I - Human Values:** Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality, Introduction to Yoga and meditation for professional excellence and stress management.

**Unit II - Engineering Ethics:** Senses of 'Engineering Ethics', Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories.

**Unit III - Engineering as Social Experimentation:** Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law.

**Unit IV - Safety, Responsibilities and Rights:** Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination.

**Unit V - Global Issues:** Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility.

### Course Outcomes

- Students will be able to apply ethics in society, discuss the ethical issues related to engineering and realise the responsibilities and rights in the society.

### Text Books

1. Martin, M. W., Schinzinger, R., "*Ethics in engineering*", 4th edition, Tata McGraw Hill, 2017.
2. Govindarajan, M., Natarajan, S., Senthilkumar, V.S., "*Engineering Ethics*", Prentice Hall of India, 2013.

## **EIGHTH SEMESTER**

- **All the subjects are electives.**

## PROGRAM ELECTIVES

### Program Elective-I

Course Code	ECPE11
Course Title	Digital Signal Processing
Number of Credits	3-0-4-5
Type of Course	PE

#### Course Objectives

- To understand digital filters such as FIR and IIR along with adaptive filtering algorithms for multi-rate signal processing.

#### Course Contents

**Unit I - Review of signals and systems:** Overview of the Frequency Analysis of the Signals and Systems, FFT algorithm, Properties of the DFT, Circular Convolution, Linear Convolution using the DFT. Standards IEEE 265-1966, IEEE 1057-2007

**Unit II - Design of digital filters:** Basic principles of Filters and Filtering Different types of the filters, Problems associated with Passive filters, Difference between analog and digital filter design.

**Unit III - Design of FIR filters:** Symmetric and Anti-symmetric FIR filters, Linear phase concept, Design of ideal and practical FIR filter (LPF, HPF, BPF and BRF) without using Window functions and with window functions, Comparison of window functions, Design of FIR filters using frequency sampling methods, Design of digital differentiator, Structure for realizing digital FIR filters.

**Unit IV - Design of IIR filters:** Butterworth and Chebyshev approximation, Design of Butterworth (Type 1 and II) Low-pass filters using approximation of Derivative, Impulse invariance and Bilinear Transformation, Frequency warping effect, Pre-warping, Frequency transformation in both analog and digital domain. Difference between IIR and FIR filters, Structure for realizing digital IIR filters.

**Unit V – Multi-rate signal processing:** Concept of multi-rate signal processing, Decimation and Interpolation, Up-sampling and Down-sampling in the Z-domain, FIR filter poly-phase structure, Filters for decimation and interpolation, Multi-stage decimators and interpolators. Filter banks, Uniform DFT filter bank, Poly-phase realization of the uniform DFT filter bank, Two channel QMF bank, FIR QMF banks with PR, Half-band filters, Different applications of the Multi-rate signal processing.

#### Course Outcomes

- To design both digital FIR and IIR filters using different approaches and their structures.
- To design a filtering algorithm for the real time application.

#### Text Books

1. Proakis, J. G. and Manolakis, D. G., “*Digital Signal Processing: Principles, Algorithms and Applications*”, 4<sup>th</sup> edition, Pearson education, 2014.
2. Oppenheim, A. V. and Schafer, R. W., “*Discrete-Time Signal Processing*”, 3<sup>rd</sup> edition, Pearson Education, 2014.

#### Reference Books

1. Tan, L. and Jiang, J., “*Digital Signal Processing: Fundamentals and Applications*”, 2<sup>nd</sup> edition, Academic Press, 2013.
2. Mitra, S. K., “*Digital Signal Processing: A computer based approach*”, 4<sup>th</sup> edition, McGraw Hill Education, 2013.



## DIGITAL SIGNAL PROCESSING LAB

### Lab Objectives

- To understand digital filters such as FIR and IIR along with adaptive filtering algorithms for multi-rate signal processing.

### List of Experiments

- To generate basic signals like unit impulse, unit step, unit ramp signal and Exponential signals using MATLAB.
- To generate continuous time sinusoidal signal, discrete time cosine signal.
- To write a MATLAB code for verifying sampling theorem.
- To write a MATLAB code to perform linear convolution upon two given discrete time signals.
- To write a MATLAB code to perform circular convolution upon two given discrete time signals.
- To write a MATLAB code to perform autocorrelation on a given signal and to verify its properties.
- To write a MATLAB code to perform cross correlation and to verify its properties.
- To write a MATLAB code to evaluate the Frequency response of the system.
- To write a MATLAB code to evaluate the impulse response of the system.
- To write the MATLAB code to find the DFT / IDFT of given signal.
- To calculate the linear convolution of two sequences using DFT and IDFT.
- To calculate the circular convolution of two sequences using DFT and IDFT.
- To implement Fast Fourier Transform (FFT) of given sequence.
- To verify Power Spectral Density.
- To design and implement FIR Low pass filters using MATLAB commands.
- To design and implement FIR High pass filters using MATLAB commands.
- To verify Frequency response of analog IIR filter using MATLAB (LP/HP).
- To generate the sinusoidal signal using filter.
- To implementation of decimation of given sequence by factor M.
- To implementation of interpolation for given sequence by factor L.
- Plot the window function and normalized frequency response in dB of the Rectangular and Barlett window.
- Plot the window function and normalized frequency response in dB of the Blackman and Hamming window.
- To write a program to calculate Hilbert transform of a function.
- To write a program to generate a Kaiser window. Use different values of M and  $\alpha$  and generate at least three different windows.

### Lab Outcomes

- Ability to generate elementary signals/ waveforms and perform arithmetic operations.
- Ability to Calculate and Plot DFT / IDFT of given DT signal.
- Ability to plot frequency response of a given system and verify the properties of LTI system

<b>Course Code</b>	ECPE12
<b>Course Title</b>	Artificial Neural Networks and Optimization
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	PE

### Course Objectives

- To gain exposure in the field of neural networks
- To provide knowledge of computation and dynamical systems using neural networks.

### Course Contents

**Unit I - Perceptron Architecture:** Single-Neuron Perceptron- Multi-Neuron Perceptron.

**Unit II - Perceptron Learning Rule:** Constructing Learning Rules, Training Multiple-Neuron Perceptrons.

**Unit III - Simple Associative Networks:** Unsupervised Hebb Rule, Hebb Rule with Decay, Instar Rule-Outstar Rule, Kohonen Rule.

**Unit IV - Adaline Network:** Madaline Network -Mean Square Error, LMS Algorithm, Back Propagational Neural networks, Hopfield Networks

**Unit V - Adaptive Filtering:** Adaptive Noise Cancellation, Forecasting, Neural control applications – Character recognition.

### Course Outcomes

- To address the optimization problems through the use of evolutionary algorithms that mimic natural evolutionary principles.
- Number of popular evolutionary algorithms discussed with the help of case studies.
- Some high performance computing platforms supporting evolutionary algorithms to be presented.
- Provides understanding of some case studies for engineering design

### Text Books

1. Hagan, M. T., Demuth, H. B., and Beale, M. H., “*Neural network design*”, 2<sup>nd</sup> edition, Martin Hagan, 2014.
2. Freeman, J.A. and Skapura, D. M., “*Neural networks: Algorithms, Applications and Programming Techniques*”, 1<sup>st</sup> edition, Pearson Education, 2002.

### Reference Books

1. Yegnanarayana, B., “*Artificial Neural Networks*”, Prentice Hall India, 2015.
2. Kumar, S., “*Neural Networks – A classroom approach*”, 2<sup>nd</sup> edition, Tata McGraw-Hill, 2017.

## **ARTIFICIAL NEURAL NETWORKS AND OPTIMIZATION LAB**

### **Lab Objective**

- To provide practical knowledge of computation and dynamical systems using artificial neural networks

### **List of Experiments**

- Parallel and distributed processing - I: Interactive activation and competition model.
- Parallel and distributed processing - II: Constraint satisfaction neural network model
- Perceptron learning.
- Hopfield model for pattern storage task
- Hopfield model with stochastic update
- Competitive learning neural networks for pattern clustering
- Solution to travelling salesman problem using self-organizing maps
- Solution to optimization problems using Hopfield models
- Weighted matching problem: Deterministic, stochastic and mean-field annealing of an Hopfield model

### **Lab Outcomes**

- To address the optimization problems through the use of evolutionary algorithms that mimic natural evolutionary principles.
- Number of popular evolutionary algorithms discussed with the help of case studies.
- Some high performance computing platforms supporting evolutionary algorithms to be presented.
- Provides understanding of some case studies for engineering design

## Program Elective-II

Course Code	ECPE21
Course Title	Statistical Signal Processing
Number of Credits	3-0-4-5
Type of Course	PE

### Course Objective

- To introduce mathematical ideas that forms the basis for modern statistically-based analysis of signals and systems.

### Course Contents

**Unit I - Introduction to Signal Detection:** Formulation of the binary hypothesis testing problem Maximum Likelihood-based Optimal Detection Likelihood Ratio Test and Performance Neyman Pearson Criterion for optimal detection Minimum probability of error detector Bayesian minimum risk detector.

**Unit II - Discrete Random Process:** Random Process- Ensemble Average, Gaussian Process, Stationary Process, The Autocorrelation and Autocovariance Matrix, Ergodicity, White Noise, The Power Spectrum, Filtering Random Process, Special Types of Random Process-ARMV Process, AR Process, MA Process, Harmonic Process. **Signal Modeling:** Introduction, Stochastic Models- ARMA Models, AR Models, MA Models, Application: Power Spectrum Estimation.

**Unit III- Wiener Filtering:** Introduction, The FIR Wiener Filter- Filtering, Linear Prediction, Noise Cancellation, IIR Wiener Filter- Noncausal IIR Wiener Filter, The Causal IIR Wiener Filter, Causal Wiener Filtering, Causal Linear Prediction, Wiener Deconvolution, Discrete Kalman Filter.

**Unit IV - Spectrum Estimation:** Introduction, Nonparametric Method- The Periodogram, Performance of Periodogram. Parametric Methods- AR Spectrum Estimation, MA Spectrum Estimation, ARMA Spectrum Estimation.

**Unit V - Adaptive Filtering:** Introduction, FIR Adaptive Filters- The Steepest Descent Adaptive Filter, The LMS Algorithm, Convergence of LMS Algorithm, NLMS, Noise Cancellation, LMS Based Adaptive Filter, Channel Equalization, Adaptive Recursive Filter, RLS Exponentially Weighted RLS, Sliding Window RLS.

### Course Outcomes

- Ability to understand the notion of a random process and statistical time series.
- Able to apply the least squares, maximum-likelihood, and Bayesian estimators to model based signal processing problems.

### Text Book

1. Hayes, M. H., “*Statistical Digital Signal Processing and Modeling*”, Wiley, 2012.
2. Haykin, S., “*Adaptive Filter Theory*”, 4<sup>th</sup> edition, Pearson Education, 2008.

### Reference Books

1. Kay, S. M., “*Fundamentals of Statistical Signal Processing: Estimation Theory*”, Pearson Education, 2009.
2. Widrow, B. and Stearns, S. D., “*Adaptive Signal Processing*”, 1<sup>st</sup> edition, Pearson Education, 2002.

## STATISTICAL SIGNAL PROCESSING LAB

### Lab Objective

- To introduce mathematical ideas that forms the basis for modern statistically-based analysis of signals and systems.

### List of Experiments

- The Autocorrelation and Autocovariance Matrix
- Power spectrum estimators.
- Linear and nonlinear transformation of stochastic vectors/processes.
- AR Spectrum Estimation, MA Spectrum Estimation.
- Sigma-delta modulators, Markov chains, complex/chaotic discrete-time systems, PWM signal generators,
- Compressive linear encoding and decoding.
- FIR Adaptive Filters.
- Stochastic Models.

### Course Outcomes

- Explain and understand the notion of a random process and statistical time series.
- Discuss the principles of estimation theory, define basic properties of estimators, and be able to analyze and calculate the properties of a given estimator.
- Apply least squares, maximum-likelihood, and Bayesian estimators to model based signal processing problems.

<b>Course Code</b>	ECPE22
<b>Course Title</b>	Linear Integrated Circuits
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	PE

### Course Objectives

- To introduce the basic building blocks of linear integrated circuits.
- To teach the linear and non-linear applications of operational amplifiers.

### Course Contents

**Unit I - Basics of Operational Amplifiers:** Current mirror and current sources, Current sources as active loads, BJT Differential amplifier with active loads, Ideal Operational Amplifier, General operational amplifier stages, internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

**Unit II - Applications of Operational Amplifiers:** Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Butterworth filters.

**Unit III - Analog Multiplier and PLL:** Analog Multiplier using Emitter Coupled Transistor Pair, Gilbert Multiplier cell, Variable trans-conductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

**Unit IV - Analog to Digital and Digital to Analog Converters:** Analog and Digital Data Conversions, D/A converter, weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R-2R Ladder types, switches for D/A converters, high speed sample-and-hold circuits, A/D Converters, Flash type, Successive Approximation type, Single Slope type, Dual Slope type, A/D Converter using Voltage-to-Time Conversion.

**Unit V - Waveform Generators and Special Function ICs:** Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, IC L8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Frequency to Voltage and Voltage to Frequency converters.

### Course Outcomes

- Elucidate and design the linear and non-linear applications of an OP-AMP.
- Explain and compare the working of multi-vibrators using general purpose OP-AMP.
- Classify and comprehend the working principle of data converters.

### Text Books

1. Franco, S., “*Design with Operational Amplifiers and Analog Integrated Circuits*”, 4<sup>th</sup> edition, McGraw-Hill education, 2016.
2. Gayakwad, R. A., “*OP-AMP and Linear Integrated Circuits*”, 4<sup>th</sup> edition, Pearson Education, 2015.

### Reference Book

1. Choudhry, D. R. and Jain, S. B., “*Linear Integrated Circuits*”, 5<sup>th</sup> edition, New Age International, 2018.

## **LINEAR INTEGRATED CIRCUITS LAB**

### **Lab Objectives**

- To understand characteristics of operational amplifier, and apply operational amplifiers in linear and nonlinear applications.
- To use SPICE software for circuit design.

### **List of Experiments**

- Design and testing of inverting and non-inverting operational amplifiers.
- To verify the function of an operational amplifier as an adder and subtractor.
- To demonstrate the integrator and differentiator circuits using Op-amp.
- Design and testing Instrumentation amplifier.
- Design and testing active low-pass, high-pass, band-pass and band-stop filters.
- Design and testing of astable and mono-stable multi-vibrators using Op-amp.
- Design and testing Schmitt Trigger and Comparator using Op-amp.
- Design, Build and Test a Square wave and triangular wave generators using op-amp.
- To study the operation of IC 565 as PLL.
- Study of Multiplier IC.
- To study the output characteristics of half-wave and full-wave rectifier using op-amp.
- Above experiments are to be Simulated using SPICE.

### **Lab Outcomes**

- Design oscillators and amplifiers using operational amplifiers.
- Design filters using op-amp and performs experiment on frequency response.
- Analyze the working of PLL and use PLL as frequency multiplier.
- Analyze the performance of oscillators and multi-vibrators using spice.

### Program Elective-III

<b>Course Code</b>	ECPE31
<b>Course Title</b>	Fiber Optic Communication-I
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	PE

#### Course Objective

- To learn the basics of signal propagation through optical fibers and devices.

#### Course Contents

**Unit I** - Optical evolution, advantages of optical communication, its representations, Optical waveguides, basic optical laws, acceptance angle, numerical aperture Skew rays, Rays and modes, step-index, graded-index fibers, phase and group velocities, Signal degradation in optical fibers, attenuation units, absorption, scattering dispersions.

**Unit II** - Optical amplifiers, Optical sources, modulators, transmitted optical fields, optical field expansion Photo detection processes, count statistics, photo counting with receiver fields, photo counting with random photo multiplication.

**Unit III** - Shot noise processes, PSD of shot noise, Coherent and Non-coherent detection, system model, single mode and multimode detection, SNR performance, AM/IM, FM/IM systems.

**Unit IV** - Optical digital communications, heterodyne ASK, FSK, PSK, Systems, PLL Loop receiver and their noise performances.

**Unit V** - Multiplexed FM/IM systems, heterodyne SNRs, WDM, optical link design, Optical networks (SONET).

#### Course Outcomes

- Recognize and classify the structures of Optical fiber and types.
- Discuss the channel impairments like losses and dispersion.
- Analyze various coupling losses.
- Classify the Optical sources and detectors and to discuss their principle.
- Familiar with Design considerations of fiber optic systems.

#### Text Book

1. Senior, J, M., “*Optical Fiber Communications: Principles and Practice*”, 3<sup>rd</sup> edition, Pearson Education, 2010.
2. Keiser, G., “*Optical Fiber Communications*”, 5<sup>th</sup> edition, McGraw Hill Education, 2017.

#### Reference Books

1. Einarsson, G., “*Principles of light wave communications*”, Wiley, 1996.
2. Ghatak, A. and Thyagarajan, K., “*Introduction to Fiber Optics*”, Cambridge University Press, 1998.



<b>Course Code</b>	ECPE32
<b>Course Title</b>	Low Power VLSI
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	PE

### Course Objectives

- To introduce various strategies and methodologies for designing low power circuit and systems.
- To design chips used for battery-powered systems and high performance circuits not exceeding power limits.

### Course Contents

**Unit 1 - Introduction:** Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits, Physics of power dissipation in CMOS devices.

**Unit 2 - Low Power Design:** Circuit Level: Transistor & gate sizing, supply voltage scaling techniques, DTCMOS, MTCMOS, low voltage low power design, Flip Flops & Latches design.

**Unit 3 - Low Power Architecture & Systems:** Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation.

**Unit 4 - Power Estimation Simulation Power analysis:** SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation.

**Unit 5 - Low Power Clock Distribution:** Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew and various clock distribution networks.

### Course Outcomes

- Able to analyze various VLSI processing techniques and fabrication principles.
- Use mathematical methods and circuit analysis models in the analysis of CMOS digital electronics circuits.
- Apply the concept of design flow in back end and front design including simulation, synthesis and design verification.
- Design and implementation of various structures for low power applications.

### Text Books

1. Yeo, K. S. and Roy, K., “*Low Voltage Low Power VLSI Subsystems*”, Mc-Graw Hill Education, 2017.
2. Rabaey, J., “*Low Power Design Essentials*”, Springer, 2009.

### Reference Books

1. Roy, K. and Prasad, S. C., “*Low Power CMOS VLSI Circuit Design*”, Wiley, 2009.
2. Yeap, G. K., “*Practical Low Power Digital VLSI Design*”, Springer, 2012.

### Program Elective-IV

Course Code	ECPE41
Course Title	Fiber Optic Communication-II
Number of Credits	3-0-4-5
Type of Course	PE

#### Course Objectives

- To provide knowledge about various types of optical sources and detectors.
- To impart knowledge about communication system based on optical fiber.

#### Course Contents

**Unit I - Optical Sources:** Optical source properties, finding the energy from the voltage, finding the frequency from the wavelength of light, operating wavelength of optical sources, semiconductor light-emitting diodes and laser diodes, semiconductor material and device operating principles, light-emitting diodes, surface-emitting LEDs, edge-emitting LEDs, super luminescent diodes, laser diodes, comparison of LED and ILD. Fiber optic transmitters, basic optical transmitters, direct versus external modulation, fiber optic transmitter applications, digital applications, analog applications.

**Unit II - Optical Detectors:** Light detectors, Role of an optical detector, Detector characteristics: Responsivity, Noise Equivalent Power, Detectivity, Quantum efficiency, Detector response time, Linearity, Spectral response, Noise considerations: Johnson noise, Shot noise,  $1/f$  noise, Photon noise, The PN junction photo diode - PIN photodetector - Avalanche photo diode construction characteristics and properties, APD Specifications, Applications of APD - comparison of performance noise sources - simple model of photo receiver - Its equivalent for circulation of noise SNR, Optical Receivers.

**Unit III - Optical Fiber Communication System:** Telecommunication, local distribution series, computer networks local data transmission, Digital optical fiber communication system, first & second-generation system, future system.

**Unit IV - Optical Switching & Networks with Advanced Multiplexing Strategies:** Transport Networks, Applications, Requirements, Architectures, Technologies, and Solutions, Introduction to Optical Access Networks, Optical TDM, subscriber multiplexing (SCM), WDM and Hybrid multiplexing methods.

**Unit V - Fiber Optic System Design Considerations and Components:** Components: Indoor Cables, Outdoor Cables, Cabling Example, Power Budget, Bandwidth and Rise Time Budgets, Electrical and Optical Bandwidth, Connectors, Fiber Optic Couplers.

#### Course Outcomes

- Recognized and classified the structures of Optical fiber and types.
- Provided knowledge about various types of optical sources and detectors.
- Imparted the knowledge about communication system based on optical fiber.

#### Text Books

1. Keiser, G., “*Optical Fiber Communications*”, 5<sup>th</sup> edition, McGraw Hill, 2017.
2. Agrawal, G. P., “*Fiber Optic Communication Systems*”, 3<sup>rd</sup> edition, Wiley, 2007.

#### Reference Books

1. Liu, M. M. K., “*Principles and Applications of Optical Communications*”, 1<sup>st</sup> edition, McGraw Hill, 2010.
2. Senior, J. M., “*Optical Fiber Communications: Principles and Practice*”, 3<sup>rd</sup> edition, Pearson Education, 2010.

## **FIBER OPTIC COMMUNICATION-II LAB**

### **Lab Objectives**

- To provide knowledge about various types of optical sources and detectors.
- To impart knowledge about communication system based on optical fiber.

### **List of Experiments**

- Handling of Fibers.
- Characteristics of Laser Diode and LED.
- Characteristics of Photo Detector, APD.
- Measurement of Numerical Aperture.
- Measurement of Attenuation and Bending Loss.
- Fiber Dispersion Measurement.
- Study of BER and Q-Factor.
- Characteristics of WDM Link.
- Analog and voice communication through optical link.
- Simulation & BER calculation using OPTSIM.
- EDFA Design for D-WDM using OPTSIM.
- Characteristics of AWGN & BSC channel.
- BPSK Modulator.
- Convolutional encoder & decoder.
- Orthogonal Frequency Division Multiplexing.
- Measurement of attenuation and bending loss in glass multimode fiber.
- Analog communication through optical link.

### **Lab Outcomes**

- Recognized and classified the structures of Optical fiber and types.
- Provided knowledge about various types of optical sources and detectors.
- Imparted the knowledge about communication system based on optical fiber.

<b>Course Code</b>	ECPE42
<b>Course Title</b>	Power Electronics
<b>Number of Credits</b>	3-0-4-5
<b>Type of Course</b>	PE

### Course Objectives

- To introduce students to the basic theory of power semiconductor devices.
- To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.

### Course Contents

**Unit I - Power semiconductor devices:** Switching and V-I characteristic of devices: power diode, SCR, TRIAC, GTO, IGBT, and MOSFET, Series and parallel grouping of SCR.

**Unit II - AC to DC converter:** Single phase and three phase, half wave and full wave rectifiers with R-L and R-L-E loads and effect of source inductance.

**Unit III - DC to DC converter:** Classification, operation, control strategies, Step-Up, Step-down and Step-Up/Down chopper, Switching mode regulators.

**Unit IV - DC to AC converter:** Single phase and three-phase Bridge Inverters, Voltage control of three Phase Inverters by Sinusoidal PWM, Current Source Inverter. Applications: UPS, SMPS, Battery Chargers, SVC.

**Unit V - AC to AC converter:** Single phase and three phase cyclo-converters with R and R-L load.

### Course Outcomes

- Able to distinguish performance of various power semiconductor devices, passive components and switching circuits.
- Ability to design and analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.

### Text Books

1. Rashid, M. H., “*Power Electronics: Circuits, Devices and Applications*”, Pearson Education, 4<sup>th</sup> edition, Pearson Education, 2017.
2. Mohan, N., Undeland, T. M., and Robbins, W. P., “*Power Electronics: Converters Applications and Design*”, 3<sup>rd</sup> edition, Wiley, 2007.

### Reference Books

1. Sen, P. C., “*Power Electronics*”, 2<sup>nd</sup> edition, McGraw Hill, 2017.
2. Moorthi, V. R., “*Power Electronics: Devices, Circuits and Industrial Applications*”, 1<sup>st</sup> edition, Oxford University Press, 2007.

## **POWER ELECTRONICS LAB**

### **Lab Objectives**

- To introduce students to the basic theory of power semiconductor devices.
- To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.

### **List of Experiments**

- Study of the V-I characteristics of SCR.
- Study of the V-I characteristics of TRIAC.
- Study of the V-I characteristics of IGBT.
- Study of the cosine controlled triggering circuit.
- To measure the latching and holding current of a SCR.
- Study of the single-phase half wave controlled rectifier and semi converter circuit with R and R-L Load.
- Study of single phase full wave controlled rectifier circuits (mid-point and Bridge type) with R and R-L Load.
- Study of three phase full wave controlled rectifier circuits (Full and Semi converter) with R and R-L Load.
- Study the performance of the Buck converter.
- Study the performance of the Boost converter.
- Study the performance of the Buck-Boost converter.
- Study the performance of the single phase PWM voltage source inverter.
- Study the performance of three phase VSI with PWM control.
- Study the performance of single phase cyclo-converter.
- Study the performance of three phase cyclo-converters.

### **Lab Outcomes**

- Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits.
- Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.

### Program Elective-V

<b>Course Code</b>	ECPE51
<b>Course Title</b>	Antenna and Wave Propagation
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	PE

#### Course Objective

- To give a thorough understanding of the radiation characteristics of different types of antennas.
- To create awareness about the different types of propagation of radio waves at different frequencies.

#### Course Contents

**Unit I - Fundamentals of Radiation:** Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching – Baluns, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, Half wave dipole. Folded dipole, Yagi array.

**Unit II - Aperture and Slot Antennas:** Radiation from rectangular apertures, Uniform and Tapered aperture, Horn antenna, Reflector antenna, Aperture blockage, Feeding structures, Slot antennas, Microstrip antennas – Radiation mechanism – Application, Numerical tool for antenna analysis.

**Unit III - Antenna arrays:** N element linear array, Pattern multiplication, Broadside and End fire array – Concept of Phased arrays, Adaptive array, Basic principle of antenna Synthesis-Binomial array.

**Unit IV –Special antennas:** Principle of frequency independent antennas –Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure and applications, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR.

**Unit V - Wave Propagation:** Propagation in free space. Propagation around the earth, surface wave-propagation, structure of the ionosphere, propagation of plane waves in ionized medium, Determination of critical frequency, MUF.Fading, tropospheric propagation, Super refraction.

#### Course Outcomes

- Able to select the appropriate antenna for the specific applications.
- Ability to analyze the antenna arrays, aperture antenna and special antennas such as frequency independent and broad band.

#### Text Book

1. Balanis, C. A., “*Antenna Theory: Analysis and Design*”, 4<sup>th</sup> edition, Wiley, 2016.
2. Collin, R. E., “*Antennas and Radiowave Propagation*”, 4<sup>th</sup> edition, McGraw-Hill, 1985.

#### Reference Books

1. Krauss, J. D., “*Antennas For All Applications*”, 3<sup>rd</sup> edition, McGraw-Hill, 2005.

<b>Course Code</b>	ECPE52
<b>Course Title</b>	Renewable and Sustainable Energy Systems
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	PE

### Course Objectives

- Design, analysis, manufacture and use of electric devices and systems for renewable and sustainable energy conversion industrial applications.

### Course Contents

**Unit I - Solar Energy:** Availability, solar cell energy conversion, efficiency, characteristics, components of PV systems, F chart method,  $\phi$ -F chart method, modeling & simulation of solar energy systems, life cycle analysis of solar energy system.

**Unit II - Wind Energy:** Wind resource assessment, power conversion technologies, wind power estimation techniques, wind mechanics, power content, class of wind turbines, various aspects of wind-turbine design, wind turbine generators: induction, synchronous machine, constant V & f and variable V & f generations.

**Unit III - Hydel Energy:** Classification of hydel plants, concept of micro hydel, MHP plants: components, design and layout, turbines, efficiency, status in India. Hydrogen Energy, sources of hydrogen, fuel for vehicles.

**Unit IV - Nuclear Energy:** Policies and regulations, nuclear energy technologies—fuel enrichment, different types of nuclear reactors, nuclear waste disposal, nuclear fusion.

**Unit V - Distributed Generation Systems:** classification of various generating systems, electric equivalent circuits of fuel cells, solar cells, effects of renewable energy into the grid, supply guarantee, power quality, stability, intentional and unintentional islanding, power converter topologies for grid interconnection, inverter modelling, control of grid interactive power converters, synchronization and phase locking techniques, current control, and recent trends in DG interconnection.

### Course Outcomes

- Ability to acquire in-depth knowledge on the conversion of non-conventional energy resources into Electrical power.
- Able to become intellectual in new developments of renewable energy studies.

### Text Books

1. Andrews, J. and Jelley, N., “*Energy Science: Principles, Technologies, and Impacts*”, 3<sup>rd</sup> edition, Oxford University Press, 2017.
2. Luo, F. L. and Ye, H., “*Renewable Energy Systems: Advanced Conversion Technologies and Applications*”, 1<sup>st</sup> edition, CRC Press, 2017.

### Reference Books

1. Willis, H. L. and Scott, W. G., “*Distributed Power Generation: Planning and Evaluation*”, CRC Press, 2018.
2. Teodorescu, R., Liserre, M., and Rodriguez, P., “*Grid Converters for Photovoltaic and Wind Power Systems*”, 1<sup>st</sup> edition, Wiley-Blackwell, 2011.
3. Khan, B. H., “*Non-Conventional Energy Resources*”, 3<sup>rd</sup> edition, Tata McGraw-Hill Education, 2017.

## Program Elective-VI

<b>Course Code</b>	ECPE61
<b>Course Title</b>	Data Communication and Networks
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	PE

### Course Objectives

- To provide insight about fundamental concepts and reference models (OSI and TCP/IP) and its functionalists
- To gain comprehensive knowledge about the principles, protocols, and significance of Layers in OSI and TCP/IP.
- To know the implementation of various protocols.

### Course Contents

**Unit I - Introduction to computer networks:** Network, Component and Categories, Topologies, Transmission Media, Reference Models: ISO/OSI Model and TCP/IP Model.

**Unit II - Physical Layer:** Digital and analog Signals, Periodic Analog Signals, Transmission Impairments, Digital data transmission techniques, Analog data transmission techniques, Multiplexing and Spread Spectrum.

**Unit III - Data Link Layer:** Error Detection and Correction, Parity, LRC-CRC, Hamming Code, Flow Control and Error Control, Stop and wait, ARQ, Sliding window, HDLC, Multiple Access Protocols, IEEE 802.3 Ethernet.

**Unit IV - Network Layer:** Packet Switching and Datagram approach, IP addressing methods, Subnetting, Routing, Distance Vector Routing, Link State Routing, Broadcast and Multicast Routing.

**Unit V - Transport Layer:** Transport Services, UDP, TCP, Congestion Control, Quality of Services (QOS), Application Layer: Domain Name Space (DNS), Electronic Mail.

### Course Outcomes

- Ability to gain insight about basic network theory and layered communication architectures.
- Ability to provide solutions to various problems in network theory.
- Ability to conceptualize and design a network stack.

### Text Books

1. Foruzan, B. A., “*Data Communication and Networking*”, 5<sup>th</sup> edition, McGraw Hill Education, 2017.
2. Tanenbaum, A. S. and Wetherall, D. J., “*Computer Networks*”, 5<sup>th</sup> edition, Pearson Education, 2013.

### Reference Book

1. Stallings, W., “*Data and Computer Communication*”, 10<sup>th</sup> edition, Pearson Education, 2017.



<b>Course Code</b>	ECPE62
<b>Course Title</b>	Radar Communication
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	PE

### Course Objectives

- To understand various technologies involved in the design of radar transmitters and receivers.
- To learn various radars like MTI, Doppler and tracking radars and their comparison.

### Course Contents

**Unit I - Basics of Radar:** Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems. **Radar Equation:** SNR, Envelope Detector — False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets – sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.

**Unit II - CW and Frequency Modulated Radar:** Doppler Effect, CW Radar — Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. **FM-CW Radar:** Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter, Multiple Frequency CW Radar

**Unit III - MTI and Pulse Doppler Radar:** Introduction, Principle, MTI Radar with – Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancelers — Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

**Unit IV - Tracking Radar:** Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar — Amplitude Comparison Monopulse (one- and two-coordinates), Phase Comparison Monopulse, Tracking in Range. Acquisition and Scanning Patterns. Comparison of Trackers.

**Unit V - Detection of Radar Signals in Noise:** Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Nonwhite Noise. **Radar Receivers:** Noise Figure and Noise Temperature. Displays — types. Duplexers — Branch type and Balanced type. Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Applications. Advantages and Limitations.

### Course Outcomes

- Understand radar fundamentals and analysis of the radar signals.
- Understand various radar transmitters and receivers.

### Text Books

1. Skolnik, M. I., “*Introduction to Radar Systems*”, 3<sup>rd</sup> edition, McGraw Hill, 2017.

### Reference Books

1. Edde, B., “*Radar – principles, technology, applications*”, 1<sup>st</sup> edition, Pearson, 2003.
2. Richards, M. A., Scheer, J. A., and Holm, W. A., “*Principles of Modern Radar: Basic Principles*”, 1<sup>st</sup> edition, Scitech Publishing, 2013.

**STREAM – I**  
**APPLICATIONS**  
**(Offered by Department of IT)**

<b>Course Code</b>	ITSE11
<b>Course Title</b>	Mobile Applications Development
<b>Number of Credits</b>	3-0-0-3
<b>Course Type</b>	SE

### Course Objectives

- To learn the basics of mobile application development
- To get accustomed to Android platform
- To develop skills in developing basic Android applications

### Course Contents

**Unit I - Introduction to Android:** Native Android Application; SDK Features; Introduction to Open Handset Alliance; Development Framework; Application Fundamentals; Device Compatibility; System permissions.

**Unit II - User Interface and Application Components:** Basic UI Design; Fragments; Widget Toolbox; Creating New View; Introduction to Intents; Intent Filters and broadcast Receivers; Activities; Services; Content Providers; Application Widgets; Processes and Threads.

**Unit III - Files and Database Handling:** Saving Application Data; Shared Preferences; Preference Framework and Activity; Static File as Resource; File System; Introduction to SQLite Database; Querying SQLite; Storage options; Data backup.

**Unit IV - User Experience Enhancement:** Action Bar; Menus and Action Bar Items; Settings; Dialogs; Customizing Toast; Notifications; Search; Drag and Drop.

**Unit V - Multimedia, Wireless Connectivity and Telephony:** Audio and Video Handling; Manipulating Raw Audio; Sound Effects; Camera Programming; Video Recording; Managing Wireless Connectivity: Wi-Fi, Bluetooth, Near Field Communication; Hardware Support for Telephony; Telephony Management; SMS and MMS

### Course Outcomes

- Ability to comprehend Android platform and its usefulness in application development
- Ability to acquire skill set to execute applications in Android based devices
- Ability to design and develop deployable Android applications

### Text Books

1. Meier, R. and Lake, I., “*Professional Android*”, 4<sup>th</sup> edition, Wrox, 2018.
2. Matt, G., “*PhoneGap Mobile Application Development Cookbook*”, Packt Publishing, 2012.

### References

1. Kosmaczewski, A., “*Mobile JavaScript Application Development*”, 1<sup>st</sup> edition, O'Reilly Media, 2012.

<b>Course Code</b>	ITSE12
<b>Course Title</b>	Cloud Computing
<b>Number of Credits</b>	3-0-0-3
<b>Course Type</b>	SE

### Course Objectives

- To understand the basics of Cloud Computing.
- To understand the movement from a traditional network infrastructure to a Cloud solution.

### Course Contents

**Unit I - Cloud Computing Basics:** Cloud Computing overview, Applications, Internets and the Cloud, First moves in the Cloud, Benefits, Limitations and Security Concerns in the Cloud.

**Unit II - Cloud Computing Technology:** Hardware and Infrastructure: Clients, Security, Network, Services. Accessing the Cloud: Platforms, Web Applications, Web APIs, Web Browsers.

**Unit III - Cloud Storage and Standards:** Cloud Storage Overview, Cloud Storage Providers. Standards: Application, Client, Infrastructure, Service.

**Unit IV - Cloud Computing at Work:** Software as a Service: Overview, Driving Forces, Company Offerings, Industries. Developing Applications: Google, Microsoft, Intuit Quick-Base, Cast Iron Cloud, Bungee Connect, Development.

**Unit V - Organizations and Cloud Computing:** Cloud Computing with the Titans: Google, EMC, NetApp, Microsoft, Amazon, IBM, Partnerships. The Business case for going to the Cloud.

### Course Outcomes

- Ability to gain insight about basic technology behind the Cloud.
- Ability to comprehend the Cloud computing applications.
- Completing a Business case for going to the Cloud.

### Text Books

1. Sosinsky, B., "*Cloud Computing: Bible*", 1<sup>st</sup> edition, Wiley Publication, 2011.
2. Velte, T., Velte, A., and Elsenpeter, R. C., "*Cloud Computing: A Practical Approach*", 1<sup>st</sup> edition, McGraw Hill, 2009.

### Reference Books

1. Buyya, R., Broberg, J., and Goscinski, A., "*Cloud Computing: Principles and Paradigms*", 1<sup>st</sup> edition, Wiley Publication, 2013.

<b>Course Code</b>	ITSE13
<b>Course Title</b>	Internet of Things
<b>Number of Credits</b>	3-0-0-3
<b>Course Type</b>	SE

### Course Objectives

- To learn the basic issues, policy and challenges in the Internet.
- To get an idea of some of the application areas of Internet of Things.
- To understand the cloud and internet environment and various modes of communications with Internet.

### Course Contents

**Unit I - Introduction:** Definition – Foundations – Challenges and Issues - Identification - Security. Components in internet of things: Control Units – Sensors – Communication modules –Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks –Mobile Internet – Wired Communication-IoT Platform Overview Raspberry pi-Arduino boards.

**Unit II - IoT Protocols:** Protocol Standardization for IoT-M2M and WSN Protocols-SCADA and RFID Protocols-Issues with IoT Standardization-Protocols-IEEE 802.15.4-BACNet Protocol Zig-bee Architecture - Network layer – APS Layer – Security.

**Unit III - Resource Management in the Internet of Things:** Clustering - Software Agents – Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object – Data Synchronization-Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behavior of Objects.

**Unit IV - Case Study and IoT Application Development:**IoT applications in home-infrastructures security-Industries- IoT electronic equipments. Use of Big Data and Visualization in IoT Industry 4.0 concepts - Sensors and sensor Node –Interfacing using Raspberry Pi/ Arduino- Web Enabled Constrained Devices.

**Unit V - Web of Things:** Web of Things versus Internet of Things-Architecture Standardization for WoT-Platform Middleware for WoT- WoT Portals and Business Intelligence-Cloud of Things: Grid/SOA and Cloud Computing-Cloud Standards –Cloud of Things Architecture-Open Source e-Health sensor platform.

### Course Outcomes

- Identify and analyze the components and protocols of IoT.
- Ability to design portable IoT using appropriate boards.
- Ability to develop schemes for the applications of IoT in real time scenarios.

### Text Books

1. Zhou, H., “*The Internet of Things in the Cloud: A Middleware Perspective*”, 1<sup>st</sup> edition, CRC Press, 2013.

### Reference Book

2. Uckelmann, D., Harrison, M., and Michahelles, F., “*Architecting the Internet of Things*”, Springer, 2011.

<b>Course Code</b>	ITSE14
<b>Course Title</b>	Big Data Analytics
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To know the fundamental concepts of big data and analytics.
- To explore tools and practices for working with big data.
- To learn about stream computing.
- To know about the techniques that requires the integration of large amounts of data.

### Course Contents

**Unit I - Introduction to Big Data:** Evolution of big data, Best practices for big data analytics, Big data characteristics; Validating, Promotion of the value of big data, Big data use cases -- Characteristics of big data applications, Perception and quantification of value; Big Data Tools and Techniques: Understanding big data storage, General overview of high-performance architecture, HDFS, Map Reduce and YARN; Map Reduce programming model; Review of basic data analytic methods using R..

**Unit II - Regression and Classification:** Advanced analytical theory and methods, Regression: Linear regression, Logistic regression; Classification: Decision trees, Overview of a decision tree, Decision tree algorithms, Evaluating a decision tree, Decision trees in R, Naïve Bayes, Bayes ‘theorem, Naïve Bayes classifier in R.

**Unit III - Data Stream Analysis:** Introduction to streams concepts: Stream data model and architecture, Stream computing, Sampling data in a stream, Filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, Decaying window; Real Time Analytics Platform (RTAP) applications, Case studies: Real time sentiment analysis, Stock market predictions.

**Unit IV - Frequent Itemsets and Clustering:** Mining frequent itemsets: Market based model, Apriori algorithm, Handling large data sets in main memory, Limited Pass algorithm, Counting frequent itemsets in a stream, Clustering techniques: Hierarchical, k-Means, Clustering high dimensional data.

**Unit V - NoSQL Data Management for Big Data:** NoSQL databases: Schema-less models, Increasing flexibility for data manipulation, Key value stores, Document stores, Tabular stores, Object data stores, Graph databases; Hive; Sharding; HBase; Case Study: Analyzing big data with twitter, Big data for E-Commerce Bigdata for blogs.

### Course Outcomes

- Work with big data tools and its analysis techniques.
- Analyze data by utilizing regression and classification algorithms.
- Perform analytics on data streams.
- Work with NoSQL databases and management.

### Text Books

1. Loshin, D., “*Big Data Analytics: From Strategic Planning to Enterprise Integration With Tools, Techniques, NoSQL, and Graph*”, Morgan Kaufmann / Elsevier Publishers, 2013.
2. Anand, R. and David, U. J., “*Mining of Massive Datasets*”, Cambridge University Press, 2012.

### Reference Books

1. EMC Education Services, “*Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*”, Wiley Publishers, 2015.
2. Bart, B., “*Analytics in a Big Data World: The Essential Guide to Data Science and its Applications*”, Wiley Publishers, 2015.

<b>Course Code</b>	ITSE15
<b>Course Title</b>	Computer Vision
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To develop understanding of basic principles and techniques of image processing and image understanding.
- To develop skills in the design and implementation of computer vision software.

### Course Contents

**Unit I - Camera Geometry:** Transformations in 2D, Transformations in 3D, Composition of transformations in 2D and 3D, homogeneous coordinates in 2D and 3D. Pinhole camera, need for pinhole, geometry of perspective projection through pinhole camera. Camera calibration.

**Unit II - Image Alignment:** Motion models and degrees of freedom; non-parametric image alignment, Control point based image alignment using least squares, SIFT algorithm, Forward and reverse image warping - bilinear and nearest-neighbor interpolation, Image alignment using image similarity measures: mean squared error, normalized cross-correlation, Monomodal and multimodal image alignment.

**Unit III - Robust Methods in Computer Vision:** Least squares problems, Outliers in computer vision, Laplacian Distribution, The importance of heavy-tailed distributions in robust statistics, Mean versus median: L2 fit versus L1 fit, Least median of squares algorithm (LMedS), RanSaC (Random Sample Consensus) algorithm.

**Unit IV - Structure from Motion:** Motion as a cue to inference of 3D structure from images, Motion factorization algorithm by Tomasi and Kanade, SVD: concept of SVD as a weighted summation of rank-one matrices.

**Unit V - Optical Flow:** Dealing with the aperture problem: regularization. Horn and Shunck method: algorithm using discrete formulation, steps of Jacobi's method for matrix inversion, and comments about limitations, Lucas-Kanade algorithm for optical flow, Applications of optical flow.

### Course Outcomes

- To demonstrate knowledge and understanding of human and computer vision systems.
- To understand current approaches to image formation, image modelling, image processing and computer vision.

### Text Books

1. Forsyth, D. A. and Ponce, J., “*Computer Vision: A Modern Approach*”, 2<sup>nd</sup> edition, Pearson Education, 2011.
2. Szeliski, R., “*Computer Vision: Algorithms and Applications*”, Springer, 2010.

### Reference Books

1. Emanuele, T. and Alessandro, V., “*Introductory Techniques for 3D Computer Vision*”, Prentice Hall, 1998.

**STREAM – II**  
**ARTIFICIAL INTELLIGENCE AND MACHINE**  
**LEARNING**  
**(Offered by Department of CSE)**



<b>Course Code</b>	CSSE11
<b>Course Title</b>	Natural Language Processing
<b>Number of Credits</b>	3-0-0-3
<b>Course Type</b>	SE

### Course Objectives

- To understand the application of computational methods in linguists.
- To apply statistical and probabilistic methods for parameter estimation and inference.
- To know how the computational methods give insight into observed human language phenomena.

### Course Contents

**Unit I - Sound:** Biology of Speech Processing; Place and Manner of Articulation; Word Boundary Detection; Argmax based computations; HMM and Speech Recognition.

**Unit II - Words and Word Forms:** Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.

**Unit III - Structures:** Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents; Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and Attachment Ambiguity resolution.

**Unit IV - Meaning:** Lexical Knowledge Networks, Wordnet Theory; Indian Language Wordnets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors; Coreferences.

**Unit V - Web 2.0 Applications:** Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).

### Course Outcomes

- Ability to compare and contrast approaches to natural language processing.
- Ability to comprehend and analyze the various elements of speech processing.
- Ability to design and develop machine learning techniques in the area of NLP.

### Text Books

1. Jurafsky, D. and Martin, J. H., “*Speech and Language Processing*”, 2<sup>nd</sup> edition, Prentice Hall, 2008.
2. Manning, C. D. and Schutze, H., “*Foundations of Statistical Natural Language Processing*”, MIT Press, 1999.

### Reference Books

1. Allen, J., “*Natural Language Understanding*”, 2<sup>nd</sup> edition, Pearson Education, 2002.
2. Charniack, E., “*Statistical Language Learning*”, MIT Press, 1996.

<b>Course Code</b>	CSSE12
<b>Course Title</b>	Artificial Intelligence
<b>Number of Credits</b>	3-0-0-3
<b>Course Type</b>	SE

### Course Objectives

- To learn the concepts of Artificial Intelligence.
- To learn the methods of solving problems using Artificial Intelligence.
- To introduce the concepts of Expert Systems and machine learning.

### Course Contents

**Unit I - Introduction to AI:** Control strategies, Search strategies, Production system characteristics - Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms.

**Unit II - Knowledge representation:** Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

**Unit III - Reasoning:** Production based system, Frame based system. Inference – Backward chaining, forward chaining, Rule value approach, Fuzzy reasoning, Certainty factors, Bayesian Theory, Bayesian Network, Dempster-Shafer theory.

**Unit IV – Game Playing and Planning:** Overview, MinMax search procedure, Alpha-beta cutoffs, Iterative Deepening, Components of planning system, goal stack planning, non-linear planning, hierarchal planning and other planning techniques, reactive systems.

**Unit V - Understanding and NLP:** Introduction to Understanding, Understanding as constraint satisfaction, Introduction to NLP, Syntactic and Sematic analysis, Statistical NLP and Spell Checking.

### Course Outcomes

- Ability to comprehend AI & ES to analyze and map real world activities to digital world.
- Ability to identify problems that are amenably solved by AI methods.
- Ability to design and carry out an empirical evaluation of different AI algorithms.

### Text Books

1. Night, K., Rich, E., and Nair, B., “*Artificial Intelligence (SIE)*,” 3rd Edition, McGraw Hill, 2017.

### Reference Book

1. Kheemani, D.,”A First Course in Artificial Intelligence”, McGraw Hill Education, 1<sup>st</sup>Edition, 2017.

<b>Course Code</b>	CSSE13
<b>Course Title</b>	Soft Computing
<b>Number of Credits</b>	3-0-0-3
<b>Course Type</b>	SE

### Course Objectives

- To understand the concepts of feed forward & feedback neural networks
- To provide adequate knowledge about of FLC and NN toolbox

### Course Contents

**Unit I - Introduction of soft computing** - soft computing vs. hard computing- applications of soft computing-Neuron- Nerve structure and synapse-Neural network architecture-single layer and multilayer feed forward networks- McCulloch Pitts neuron model-perceptron model- MLP-back propagation learning methods- effect of learning rule coefficient.

**Unit II - Evolutionary Computation:** Historical Development of EC- genetic Algorithms-Genetic programming- Evolutionary Strategies- Evolutionary programming, features of Evolutionary computation, Advantages and Applications of Evolutionary Computation. Basic concept of Genetic algorithm, Conventional Optimization and Search Techniques, Comparison of Genetic Algorithm with Other Optimization Techniques, Advantages, Applications and Limitations of Genetic Algorithm.

**Unit III - Terminologies and Operators of GA:** Introduction to basic Terms- Encoding, Breeding, Search Termination, Diploidy, Dominance and Abeyance. Classification of Genetic Algorithm- Simple Genetic Algorithm (SGA), Parallel and Distributed Genetic Algorithm (PGA and DGA), Parallel and Distributed Genetic Algorithm (PGA and DGA), Adaptive Genetic Algorithm (AGA), Fast Messy Genetic Algorithm (FmGA), Independent Sampling Genetic Algorithm (ISGA). **Unit IV** - Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

**Unit IV - Introduction to Fuzzy Logic:** Utility, Limitations, Different faces of imprecision - inexactness, Ambiguity, Undecidability, Fuzziness and certainty, Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of Membership Functions, Fuzzification, and Defuzzification.

**Unit V: Automated Methods for Fuzzy Systems:** Batch Least square and recursive Least Square Algorithms, Clustering methods, Fuzzy system Simulation- fuzzy relational equations, Fuzzy associative memories. Fuzzy Classification and pattern Recognition- Cluster analysis and validity, c-Means clustering, Single sample Identification, Multifeature pattern recognition and Image processing.

### Course Outcomes

- Ability to design and develop ML techniques with assistance of MATLAB.
- Ability to visualize and analyze behavioral pattern to develop evolutionary algorithm.

### Text Books

1. Sivanandam, S. N. and Deepa, S. N., "*Principles of Soft Computing*", 2<sup>nd</sup> edition, Wiley, 2011.
2. Ross, T. J., "*Fuzzy Logic with Engineering Applications*", Wiley India, 3<sup>rd</sup> edition, 2011.

### Reference Books

1. Zimmermann, H. J., "*Fuzzy set theory - and its Applications*", 1<sup>st</sup> edition, Springer, 2013.

<b>Course Code</b>	CSSE14
<b>Course Title</b>	Machine Learning
<b>Number of Credits</b>	3-0-0-3
<b>Course Type</b>	SE

### Course Objectives

- To understand the basic building blocks and general principles those allow one to design machine learning algorithms

### Course Contents

**Unit I - Introduction:** Basic Concepts, Introduction to Machine Learning, Applications of ML, Design Perspective and Issues in ML, Supervised, Unsupervised, Semi-supervised learning

**Unit II - Modeling:** Model (or hypothesis) representation, decision boundary, cost function, gradient descent, regularization, Diagnostics, learning curves, Accuracy and Error measures

**Unit III - Decision Tree and learning rules:** Decision Tree: representation, hypothesis, issues in Decision Tree Learning, Pruning, Rule extraction from Tree, Learning rules from Data, Probabilistic classifiers

**Unit IV - Unsupervised learning techniques:** Clustering Algorithms- Introduction, Similarity and Distance Measures, k-means and k-medoids algorithm, optimization objective, random initialization, choosing value of k, EM algorithm Bayesian networks, Markov and Hidden Markov models, Graphical Models, Combining Multiple Learners.

**Unit V - Reinforcement Learning:** Elements of Reinforcement Learning, Model-Based Learning, Temporal Difference Learning, Generalization, Design and Analysis of Machine Learning Experiments.

### Course Outcomes

- Ability to implement and apply machine learning algorithms to real-world applications.
- Ability to identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.
- Ability to understand how to perform evaluation of learning algorithms and model selection.

### Text Books

1. Shwartz, S. S. and David, S. B., “*Understanding Machine Learning: From Theory to Algorithms*”, Cambridge University Press, 2015.
2. Mitchell, T. M., “*Machine Learning*”, 1<sup>st</sup> edition, McGraw-Hill, 2017.

### Reference Books

1. Alpaydin, E., “*Introduction to Machine Learning*”, 3<sup>rd</sup> edition, PHI, 2015.
2. Witten, I. H., Frank, E., Hall, M. A., and Pal, C. J., “*Data Mining: Practical Machine Learning Tools and Techniques*”, 4<sup>th</sup> edition, Morgan Kaufmann, 2016.
3. Bishop, Christopher, “*Pattern Recognition and Machine Learning*”, Springer, 2006.
4. Duda, R.O., Hart, P.E. and Stork, D.G., “*Pattern Classification*”, Wiley-Interscience, 2<sup>nd</sup> Edition November, 2000.

<b>Course Code</b>	CSSE15
<b>Course Title</b>	Deep Learning
<b>Number of Credits</b>	3-0-0-3
<b>Course Type</b>	SE

### Course Objectives

- To learn the fundamentals of neural network.
- To learn the advanced topics of neural networks.

### Course Contents

**Unit I - Basics:** Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

**Unit II - Feed-forward Networks:** Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders.

**Deep Neural Networks:** Difficulty of training deep neural networks, Greedy layer wise training.

**Unit III - Better Training of Neural Networks:** Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

**Recurrent Neural Networks:** Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs

**Unit IV - Convolutional Neural Networks:** LeNet, AlexNet.

**Generative models:** Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

**Unit V - Recent trends:** Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning.

**Applications:** Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

### Course Outcome

- Ability to implement the concepts of neural network in programming.

### Text Book

1. Goodfellow, I., Bengio, Y., Courville, A., and Bach, F., “*Deep Learning*”, MIT Press, 2017.

### Reference Books

1. Bishop, C. M., “*Pattern Recognition and Machine Learning*”, 2<sup>nd</sup> edition, Springer, 2010.

**STREAM – III**  
**DATABASE AND NETWORKING**  
**(Offered by Department of CSE)**

<b>Course Code</b>	CSSE21
<b>Course Title</b>	Relational Database Management Systems
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To lay a strong foundation into the basic principles using relational databases.
- To lay the foundation for the study and use of relational databases.

### Course Contents

**Unit I - Query Processing and Optimization:** Basic Algorithms for executing Query Operations, Using Heuristics in Optimization. **Transaction Processing Concepts:** Introduction to Transaction Processing, Transaction and System concepts Desirable Properties of transaction, Schedules and recoverability, Serializability of schedules.

**Unit II - Concurrency Control Techniques:** Locking Techniques for concurrency control Techniques Based on Time Stamp Ordering, Multiversion concurrency control Techniques, Validation Concurrency Control Techniques. **Recovery techniques:** Recovery Concepts, Recovery Techniques Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, and Recovery in Multi database Transaction.

**Unit III - Database Security and Authorization:** Introduction to Database Security Issues, Discretionary Access Control Based on Privileges, Mandatory Access Control for Multilevel Security, Statistical Database Security. **Advanced Data Modeling Concepts:** Enhanced – ER (ERR)-to-Relational Mapping, Data Abstraction and Knowledge Representation Concepts, Integrity Constraints in data modeling, EER Update Operations and Transaction Specification.

**Unit IV - Object-Oriented Databases:** Overview of Object-Oriented concepts, Object Identity, Object Structure and Type Constructor. Encapsulations of Operations, Methods and Persistence, Type and Class Hierarchies and Inheritance, Complex Objects, Other O – O concepts.

**Unit V - Deductive Databases:** Introduction to Deductive Databases, Prolog/Data log Notation, Interpretation of Rules, Basic inference Mechanism for Logic Programs and their evaluation. The LDL System, Other Deductive Database Systems. **Emerging Database Technologies and applications:** Progression of Database Technology, Emerging Database Applications, Next Generation of Databases and Database Management Systems, Interfaces with other Technologies.

### Course Outcomes

- Ability to develop relational tables.
- Ability to normalize the tables as per specific normalization forms.

### Text Books

1. Elmasri, R. and Navathe, S. B., "*Fundamentals of Database Systems*", 7<sup>th</sup> edition, Pearson Education, 2017.
2. Dabir, H. and Meher, D., "*Advanced RDBMS Using Oracle*", 2<sup>nd</sup> edition, Vision Publications, 2014.

### Reference Book

1. Ceri, S. and Palagatti. G, "*Distributed Database: Principles & System*", 1<sup>st</sup> edition, McGraw Hill Education, 2017.

<b>Course Code</b>	CSSE22
<b>Course Title</b>	Advanced Database Management Systems
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objective

- To understand the different database models and language queries to access databases.
- To understand the normalization forms in building an effective database tables.
- To protect the data and the database from unauthorized access and manipulation.

### Course Contents

**Unit I - Relational Model Issues:** ER Model - Normalization–Query Processing–Query Optimization–Transaction Processing - Concurrency Control – Recovery - Database Tuning.

**Unit II - Distributed Databases:** Parallel Databases–Inter and Intra Query Parallelism–DistributedDatabase Features – Distributed Database Architecture – Fragmentation – Distributed Query Processing – Distributed Transactions Processing – Concurrency Control – Recovery –Commit Protocols.

**Unit III - Object Oriented Databases:** Introduction to Object Oriented Data Bases – ApproachesModelling and Design - Persistence – Query Languages - Transaction - Concurrency – Multi Version Locks –Recovery – POSTGRES – JASMINE – GEMSTONE - ODMG Model.

**Unit IV - Emerging Systems:** Enhanced Data Models - Client/Server Model - Data Warehousing and DataMining – Web Databases – Mobile Databases- XML and Web Databases.

**Unit V - Current Issues:** Rules - Knowledge Bases - Active and Deductive Databases – MultimediaDatabases Multimedia Data Structures – Multimedia Query languages - Spatial Databases

### Course Outcome

- Ability to comprehend the complex query processing techniques.
- Ability to design and implement multimedia databases and writing query structure.
- Ability to develop skill set in file organization, Query Optimization, Transaction management, and database administration techniques.

### Text Books

1. Connolly, Thomas and Begg, Carlolyn, “*Database Systems: A Practical Approach to Design, Implementation, and Management*”, 5<sup>th</sup> Edition, Addison-Wesley, 2014.

### Reference Books

1. Elmasri, R. and Navathe,S. B. “*Fundamentals of Database Systems*”, 5<sup>th</sup> Edition, Pearson/Addison Wesley, 2017.
2. Silberschatz, Abraham, Korth, Henry F., and Sudharshan, S., “*Database System Concepts*”, 6<sup>th</sup> Edition, Tata McGraw Hill, 2017.



<b>Course Code</b>	CSSE23
<b>Course Title</b>	Database Security
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objective

- Provides an up-to-date overview of data security models, techniques, and architectures in a variety of data management applications and settings.

### Course Contents

**Unit I - Access Control in XML:** Basic structure of XML, characteristics of access control models, models for XML documents, security policies and policy framework for XML, policy modeling and generation, secure data outsourcing.

**Unit II - Encrypted Data:** Management of encrypted data, Database as a Service (DAS), techniques for querying encrypted data, SQL queries over encrypted relational data.

**Unit III Security:** Security techniques for data in data warehouses, security of data in OLAP systems, Security for workflow systems.

**Unit -IV Database Watermarking:** Database watermarking for copyright protection, Information Hiding, Classification of database watermarking approaches, open issues.

**Unit -V Privacy:** Privacy preserving data mining, privacy in database publishing, Privacy-enhanced Location-based Access Control.

### Course Outcomes

- Identify the introductory distributed database concepts and its structures.
- Describe terms related to distributed object database design and management.
- Produce the transaction management and query processing techniques in DDBMS.
- Relate the importance and application of emerging database technology.

### Text Books

1. M. Gertz, S. Jajodia, “*Handbook of Database Security*”, Springer, 2008

<b>Course Code</b>	CSSE24
<b>Course Title</b>	Mobile Computing and Communication
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To understand the fundamentals of mobile communication.
- To understand the architecture of various Wireless Communication Networks.
- To understand the significance of different layers in mobile system.

### Course Contents

**Unit I - Wireless Transmission:** Introduction to Wireless Networks, Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems, Frequency Management and Channel Assignment- types of hand-off and their characteristics.

**Unit II - Medium Access Control:** MAC, Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM Architecture, Location tracking and call setup, Mobility management Handover, Security, GSM SMS, International roaming for GSM, call recording functions, subscriber and service data management, DECT, TETRA, UMTS, IMT-2000.

**Unit III -Wireless LAN:** Infrared Vs Radio transmission, Infrastructure, Adhoc Network, IEEE802.11WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture & protocols.

**Unit IV - Mobile Network Layer:** Mobile IP, Dynamic Host Configuration Protocol, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit / Fast recovery, Transmission / Time-out freezing, Selective retransmission, Transaction Oriented TCP.

**Unit -V Mobility:** WAP Model- Mobile Location based services, WAP Gateway, WAP protocols, WAP user agent profile, caching model, wireless bearers for WAP, WML, WML Scripts, WTA, iMode, SyncML.

### Course Outcomes

- Ability to develop a strong grounding in the fundamentals of mobile Networks.
- Ability to apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network.
- Ability to comprehend, design, and develop a lightweight network stack.

### Text Book

1. Jochen, Schiller, “*Mobile Communication*”, 2nd Edition, Pearson Education, 2008.

### Reference Book

1. Theodore and S. Rappaport, “*Wireless Communications, Principles, Practice*”, 2nd Ed, PHI, 2002.

<b>Course Code</b>	CSSE25
<b>Course Title</b>	Wireless Sensor Networks
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
- To study the various protocols at various layers and its differences with traditional protocols.

### Course Contents

**Unit I - Introduction:** Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

**Unit II - Introduction to adhoc/sensor networks:** Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

**Unit III - MAC Protocols:** Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

**Unit IV -Routing Protocols:** Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

**Unit V -QoS and Energy Management:** Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

### Course Outcomes

- Technical knowhow in building a WSN network.
- Analysis of various critical parameters in deploying a WSN.

### Text Book

1. Ram Murthy, C. Siva, and Manoj, B. S., "*AdHoc Wireless networks*", Pearson Education, 2008.

### Reference Book

1. Feng, Zhao and Leonides,Guibas, "*Wireless sensor networks*", Elsevier publication - 2004.
2. William, Stallings, "*Wireless Communications and Networks*", Pearson Education, 2004.
3. Jochen, Schiller, "*Mobile Communications*", Pearson Education, 2nd Edition, 2003.

**STREAM– IV**  
**SECURITY**  
**(Offered by Department of IT)**

<b>Course Code</b>	ITSE21
<b>Course Title</b>	Information Security
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objective

- To provide understanding of principal concepts, issues and approaches of security.

### Course Contents

**Unit I - Overview:** Computer Security Concepts, Security Functional Requirements, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, Computer Security Strategy.

**Unit II - Access Control:** Access Control Principles, Subjects-Objects and Access Rights, Discretionary Access Control, UNIX File Access Control, Role- Based Access Control, Attribute-Based Access Control, Trust Frameworks. Case Study: RBAC System for a Bank.

**Unit -III Database Security:** The need for Database Security, RDBMS and SQL Injection attacks, Database Access Control, Inference, Database Encryption.

**Unit -IV Authentication and Authorization:** Introduction, Authentication Methods, Passwords, Biometrics, Two-Factor Authentication, Single Sign-On and Web Cookies. Steganography, Authorization: A Brief History, Access control Matrix, Multilevel Security Models, Covert Channels, Inference Control, CAPTCHA.

**Unit -V Firewalls and Intrusion Detection and Prevention Systems:** Firewall Characteristics and Access Policy, Types of Firewall, Firewall Biasing, Firewall Location and Configuration, Intrusion Detection Systems, Intrusion Prevention Systems, Unified Threat Management Products.

### Course Outcome

- Acquire a practical overview of the issues involved in the field of information security and assurance.

### Text Books

1. William, S. and Lowrie, B., “*Computer Security: Principles and Practice*”, Pearson, Fourth Edition, 2018.
2. Mark, S., “*Information Security: Principles and Practices*”, Wiley Publication, Second Edition, 2011.

### Reference Book

1. William, S., “*Cryptography and Network Security: Principles and Practice*”, Pearson, Seventh Edition, 2017.

<b>Course Code</b>	ITSE22
<b>Course Title</b>	Principles of Cryptography
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To gain knowledge about the mathematics of the cryptographic algorithms.
- To get an insight into the working of different existing cryptographic algorithms.
- To learn how to use cryptographic algorithms in security.

### Course Contents

**Unit I - Classical Cryptography:** Introduction: Some Simple Cryptosystems, The Shift Cipher, The Substitution Cipher, The Affine Cipher, The Vigenere Cipher, The Hill Cipher, The Permutation Cipher, Stream Ciphers, Crypt analysis.

**Unit II - Advanced Encryption Standard:** Introduction to DES, Finite field arithmetic, AES Structure, AES Transformation functions, AES Key expansion, An AES Example, AES Implementation.

**Unit III - The RSA System and Factoring:** Introduction to Public-key Cryptography, Number Theory, The Euclidean Algorithm, The Chinese Remainder Theorem, The RSA Cryptosystem, Implementing RSA, Probabilistic Primality Testing, Attacks on RSA.

**Unit IV - Elliptic Curve Cryptosystems:** The basic setup, Diffie-Hellman Key exchange, Massy-Omura Encryption, ElGama Public key encryption.

**Unit V –Digital Signature Schemes:** Introduction, The ElGamal Signature Scheme, The Digital Signature Standard, One-time Signatures, Undeniable Signatures, Fail-stop Signatures. Hash Functions, Signatures and Hash Functions, Collision-free Hash Functions, The Birthday Attack, A Discrete Log Hash Function, Extending Hash Functions, Hash Functions from Cryptosystems, The MD4 Hash Function.

### Course Outcomes

- Ability to understand the basic concepts of classical cryptosystem, public key cryptosystem and digital signature scheme.
- Ability to break the cryptosystems that are not secure.

### Text Books

1. Stinson, D. R. and Paterson, M. B., “*Cryptography: Theory and Practice*”, CRC Press, 2018.
2. Rosen Kenneth H., “*Elliptic Curves: Number Theory and Cryptography*”, second Edition, Chapman and Hall/CRC, 2008
3. William, S., “*Cryptography and Network Security: Principles and Practice*”, 7<sup>th</sup> edition, Pearson Education, 2017.

### Reference Book

1. Forouzan, B. A. and Mukhopadhyay, D., “*Cryptography and Network Security*”, 3<sup>rd</sup> edition, McGraw Hill, 2015.

<b>Course Code</b>	ITSE23
<b>Course Title</b>	Network Security
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objective

- To understand the network security, services, attacks, mechanisms, types of attacks.
- To comprehend and apply authentication services, authentication algorithms.
- To comprehend and apply network layer security protocols, Transport layer security protocols, Web security protocols.

### Course Contents

**Unit I - Overview of Network Security:** Security services, attacks, Security Issues in TCP/IP suite, Sniffing, spoofing, buffer overflow, ARP poisoning, ICMP Exploits, IP address spoofing, IP fragment attack, routing exploits, UDP exploits, TCP exploits.

**Unit II - Digital Signatures and Authentication:** Requirements, Authentication functions, Message Authentication Codes, Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, RIPEMD, HMAC Digital Signatures.

**Unit III - Internet Protocol Security and Standards:** IP Security Overview and Architecture, Authentication Header, Encapsulating Security Payload, Secure E-mail and S/MIME, DomainKeys Identified Mail, Secure Socket Layers (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security.

**Unit IV - Internet Authentication Applications:** Kerberos, X.509, Public Key Infrastructure.

**Unit V- Wireless Network Security:** Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Firewall security.

### Course Outcomes

- Ability to determine appropriate mechanisms for protecting the network.
- Ability to design and develop security solutions for a given application or system.
- Ability to develop a secure network stack.

### Text Book

1. Stallings, W. and Brown, L., “*Computer Security: Principles and Practice*”, 4<sup>th</sup> edition, Pearson Education, 2018.
2. Stallings, W., “*Cryptography and Network Security: Principles and Practice*”, 7<sup>th</sup> edition, Pearson Education, 2017.

### Reference Books

1. Kahate, A., “*Cryptography and Network Security*”, 3<sup>rd</sup> edition, McGraw-Hill Education, 2013.

<b>Course Code</b>	ITSE24
<b>Course Title</b>	Applied Cryptography
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To understand the application of cryptographic techniques in real world applications.
- To comprehend the notion of provable security and its implication with improved security guarantees.

### Course Contents

**Unit I - Foundations:** Terminology, Steganography, Substitution Cipher and Transposition Cipher, Simple XOR, One-Time Pads, Computer Algorithms, Large Numbers. Intermediate Protocols: Timestamping Services, Subliminal Channel, Undeniable Digital Signatures, Proxy Signatures, Group Signatures, Fail-Stop Digital Signatures, Computing with Encrypted Data, Bit Commitment, Fair Coin Flips, Mental Poker, One-Way Accumulators, All-or-None Disclosure of Secrets.

**Unit II - Cryptographic Protocols:** Esoteric Protocols: Secure Elections, Secure Multiparty Computation, Anonymous Message Broadcast, Digital Cash. Key Length: Symmetric and Public-Key Key Length, Comparison, Birthday attacks against One-Way Hash Functions, Caveat Emptor.

**Unit III - Cryptographic Techniques:** Key Management: Generating Keys, Non-linear Keyspaces, Transferring Keys, Verifying Keys, Using Keys, Updating Keys, Storing Keys, Backup Keys, Compromised Keys, Lifetime of Keys, Destroying Keys, Public-key key Management. Using Algorithms: Choosing an Algorithm, Public-Key vs Symmetric Cryptography, Encrypted Communications Channels, Encrypting Data for Storage, Hardware vs Software Encryption, Detecting Encryption, Hiding Ciphertext in Ciphertext, Destroying Information.

**Unit IV -Cryptographic Algorithms:** Block Ciphers: Lucifer, Madryga, NewDES, FEAL, REDOC, LOKI, Khufu and Khafre, RC2, IDEA, MMB, CA-1.1, Skipjack. Combining Block Ciphers: Double and Triple Encryption, Doubling the Block Length, Other Multiple Encryption Schemes, CDMF Key Shortening, Whitening, Cascading Multiple Block Algorithms, Combining Multiple Block Algorithms.

**Unit V - The Real World:** Example Implementation: IBM Secret-Key Management Protocol, Kerberos, Privacy-Enhanced Mail, Pretty Good Privacy, Smart Cards, Universal Electronic Payment System.

### Course Outcomes

- Ability to derive simple provable security proofs for cryptographic schemes.
- Ability to design and implement cryptographic protocols.

### Text Books

1. Bruce, S., “*Applied Cryptography: Protocols, Algorithms and Source Code in C*”, Wiley Publication, Second Edition, 2012.

### Reference Books

1. Stallings W., “*Cryptography and Network Security: Principles and Practice*”, Seventh Edition, Pearson, 2017.



<b>Course Code</b>	ITSE25
<b>Course Title</b>	Cyber-Physical Systems
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To gain knowledge about the mathematics of the Cyber-Physical Systems.
- To get an insight into the working of different existing Cyber-Physical Systems.
- To learn the basics of Distributed Cyber-Physical Systems and their security challenges.

### Course Contents

**Unit I - Symbolic Synthesis for Cyber-Physical Systems:** Introduction and Motivation, Basic Techniques, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques, Software Tools.

**Unit II - Software and Platform Issues in Feedback Control Systems:** Introduction, Basic Techniques, Controller Timing, Controller Design for resource efficiency, Advanced Techniques. Logical Correctness of Hybrid Systems, Introduction, Basic Techniques, Discrete Verification, Advanced Techniques.

**Unit III - Security of Cyber-Physical Systems:** Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques, System Theoretic Approaches.

**Unit IV - Synchronization in Distributed Cyber –Physical Systems:** Challenges in Cyber-Physical Systems, A Complexity Reduction Technique for Synchronization, Basic Techniques.

**Unit V - Cyber Physical Systems Application Domain:** Medical Cyber-Physical Systems, Energy Cyber-Physical Systems, Cyber-Physical Systems Built on Wireless Sensor Networks.

### Course Outcome

- Ability to understand the Cyber Physical Systems in real world problems and their applications.

### Text Book

1. Rajkumar, R., Niz, D. D, and Klein, M., “*Cyber-Physical Systems*”, 1<sup>st</sup> edition, Pearson Education, Nov 2017.

**STREAM – V**  
**SIGNAL PROCESSING AND**  
**COMMUNICATION**  
**(Offered by Department of ECE)**

<b>Course Code</b>	ECSE11
<b>Course Title</b>	Information Theory and Coding
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To introduce the principles and applications of information theory
- To calculate the capacity of a communication channel with and without noise.

### Course Contents

**Unit I- Information Theory:** Definition of Information, Entropy, Mutual Information, Properties of Mutual Information, Fundamental Inequality, I.T. Inequality, Divergence, Properties of Divergence, Divergence Inequality, Relationship between entropy and mutual information, Chain Rules for entropy, relative entropy and mutual information.

**Unit II- Channel Capacity:** Uniform Dispersive Channel, Uniform Focusing Channel, Strongly Symmetric Channel, Binary Symmetric Channel, Binary Erasure Channel. Channel Capacity of the all these channels, Channel Coding Theorem, Shannon-Hartley Theorem.

**Unit III- Data Compression:** Kraft inequality, Huffman codes, Shannon-Fano coding, Arithmetic Coding.

**Unit IV- Linear Block Codes:** Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Hamming codes; Weight enumerators and the Mac-Williams identities; Perfect codes. Cyclic Codes, BCH codes; Reed-Solomon codes, Justen codes, MDS codes, Alterant, Goppa and generalized BCH codes; Spectral properties of cyclic codes

**Unit V- Convolution codes:** Wozencraft's sequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm, Turbo Codes, Concatenated Codes.

### Course Outcomes

- Able to measure information in terms of probability and entropy.
- Analyzed the capacity of a communication channel with and without noise.
- Studied various data compression techniques.

### Text Books

1. Saha, A., Manna, N., and Mandal, S., “*Information Theory, Coding and Cryptography*”, 1<sup>st</sup> edition, Pearson Education, 2013.
2. Bose, R., “*Information Theory, Coding and Cryptography*”, 3<sup>rd</sup> edition, Mc-Graw Hill Education, 2017.

### Reference Books

1. Cover, T. M. and Thomas, J. A., “*Elements of Information Theory*”, 2<sup>nd</sup> edition, Wiley, 2013.
2. Jones, G. A., “*Information and Coding Theory*”, Springer, 2004.

<b>Course Code</b>	ECSE12
<b>Course Title</b>	Digital Speech Processing
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To learn speech production, related parameters of speech and different speech modeling procedures and their implementation issues.

### Course Contents

**Unit I - Basic concepts:** Speech fundamentals: articulatory phonetics – production and classification of speech sounds; acoustic phonetics – acoustics of speech production; review of digital signal processing concepts; short-time Fourier transform, filter-bank and LPC methods.

**Unit II - Speech analysis:** Features, feature extraction and pattern comparison techniques: speech distortion measures– mathematical and perceptual – log–spectral distance, cepstral distances, weighted cepstral distances and filtering, likelihood distortions, spectral distortion using a warped frequency scale, LPC, PLP and MFCC coefficients, time alignment and normalization – dynamic time warping, multiple time – alignment paths.

**Unit III - Speech modeling:** Hidden Markov models: markov processes, HMMS–2 evaluation, optimal state sequence – viterbi search, Baum-Welch parameter re-estimation, implementation issues.

**Unit IV - Speech recognition:** Large vocabulary continuous speech recognition: architecture of a large vocabulary continuous speech recognition system – acoustics and language models – N-grams, context dependent sub-word units; applications and present status.

**Unit V -Speech synthesis:** Text-to-speech synthesis: concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, applications and present status.

### Course Outcomes

- To model speech production system.
- To extract and compare different speech parameters.

### Text Books

1. Rabiner, L. and Schafer, R., “*Theory and Applications of Digital Speech Processing*”, 1<sup>st</sup> edition, Pearson Education, 2010.
2. Rabiner, L. R., Juang, B. H., and Yegnararayana, B., “*Fundamentals of Speech Recognition*”, 1<sup>st</sup> edition, Pearson Education, 2008.

### Reference Book

1. Jurafsky, D. and Martin, J. H., “*Speech and Language Processing*”, 2<sup>nd</sup> edition, Pearson Education, 2013.

<b>Course Code</b>	ECSE13
<b>Course Title</b>	Wireless Communication
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To get an understanding of mobile radio communication principles,
- To study the recent trends adopted in cellular and wireless systems and standards.

### Course Contents

**Unit I - Introduction to Wireless Communication System:** Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL), Wireless Local Area network (WLAN), Bluetooth and Personal Area Networks.

**Unit II - The Cellular Concept- System Design Fundamentals:** Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies Distance to frequency reuse ratio, Channel & co-channel interference reduction factor, S/I ratio consideration and calculation for Minimum Cochannel and adjacent interference, Handoff Strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular System-cell splitting, Cell sectorization, Repeaters, Micro cell zone concept, Channel antenna system design considerations.

**Unit III - Mobile Radio Propagation Model, Small Scale Fading and diversity:** Large scale path loss:-Free Space Propagation loss equation, Pathloss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread, Feher's delay spread, upper bound Small scale, Multipath Measurement parameters of multipath channels, Types of small scale Fading, Rayleigh and rician distribution, Statistical for models multipath fading channels and diversity techniques in brief.

**Unit IV - Multiple Access Techniques:** Introduction, Comparisons of multiple Access Strategies TDMA, CDMA, FDMA, OFDM.

**Unit V - Wireless Systems:** GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture.

### Course Outcomes

- Able to apply the knowledge of basic wireless communication systems
- Able to analyze and examine the multiple access techniques and its application.

### Text Books

1. Rappaport, T. S., "*Wireless Communication: Principles and Practice*", 2<sup>nd</sup> edition, Pearson, 2010.

### Reference Books

1. Lee, W. C. Y., "*Mobile Communication Engineering: Theory and Applications*", 2<sup>nd</sup> edition, McGraw Hill Education, 2017.
2. Feher, K., "*Wireless Digital Communications: Modulation and Spread Spectrum Applications*", 1<sup>st</sup> edition, Prentice Hall India, 1995.

<b>Course Code</b>	ECSE14
<b>Course Title</b>	Biomedical Signal Processing
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To understand for performing signal processing of common signals derived from the human body.

### Course Contents

**Unit I- Basic neurology:** Nervous System, neuron, Resting potential, Nernst equation, electrical equivalents.

**Unit II- Electrical activity of heart:** Introduction to ECG Lead system and recording, ECG wave component detection and analysis, Vector cardio-graphy, Inversecardiography, Signal conditioning & processing.

**Unit III- Electrical activity of neuromuscular system:** Muscular system, Electrical signals of motor unit and gross muscle, Human motor coordination system, Electrodes, Correlation of force and work; EMG integrators, Signals conditioning & processing.

**Unit IV- Electrical activity of brain:** Sources of brain potentials, Generation of signals, component waves, EEG recording electrodes, 10-20 electrode system, EEG under normal, Grand mal and Petit mal seizures, Signal conditioning & processing.

**Unit V- Electrical signals from visual system:** Sources of electrical signals in eye, Generation of signals, Electro-retinogram, Electro-oculogram, Analysis of signals. Electrical signals from Auditory System: Generation of cochlear potentials and nature; Evoked responses, Auditory nerves, Signal conditioning & processing.

### Course Outcome

- Ability to understand and apply filtering and spectral analysis to evaluate the electroencephalographic bio-signals and heart rate variability.

### Text Books

1. Rangayyan, R. M., “*Biomedical Signal Analysis*”, 2<sup>nd</sup> edition, Wiley, 2016.
2. Tompkins, W. J., “*Biomedical Digital Signal Processing: C Language Examples and Laboratory Experiments for the IBM PC*”, Prentice-Hall India, 1998.

### Reference Books

1. Bruce, E. N., “*Biomedical Signal Processing and Signal Modeling*”, Wiley, 2007.
2. Semmlow, J. L. and Griffel, B., “*Biosignal and Medical Image Processing*”, 3<sup>rd</sup> edition, CRC press, 2014.

<b>Course Code</b>	ECSE15
<b>Course Title</b>	Satellite Communication
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To introduce the fundamentals of satellite communication.
- To understand the analog and digital technologies used for satellite communication.

### Course Contents

**Unit I –Satellite Orbits:** Kepler’s Laws, Newton’s law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility –eclipse-Sub satellite point –Sun transit outage-Launching Procedures – launch vehicles and propulsion.

**Unit II - Space Segment and Satellite Link Design:** Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget, E/N calculation-performance impairments-system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime.

**Unit III - Earth Segment:** Introduction, Receive, Only home TV systems, Outdoor unit, Indoor unit for analog (FM). TV: Master antenna TV system, Community antenna TV system, Transmit, Receive earth stations, Problems, Equivalent isotropic radiated power. Transmission losses, Free-space transmission, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses, Link power budget equation, System noise, Antenna noise, Amplifier noise temperature, Amplifiers in cascade, Noise factor, Noise temperature of absorptive networks, Overall system noise temperature, Carrier-to- Noise ratio, Uplink, Saturation flux density, Input back off. The earth station, HPA, Downlink, Output back off, Satellite TWTA output, Effects of rain, Uplink rain, Fade margin, Downlink rain, Fade margin, Combined uplink and downlink C/N ratio.

**Unit IV - Satellite Access:** Modulation and Multiplexing: Voice, Data, Video, Analog, digital transmission system, video Broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression, encryption.

**Unit V - Satellite Applications:** INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast (DAB)- Worldspace services, Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video conferencing, Internet.

### Course Outcomes

- Able to analyze the satellite orbits.
- Able to apply various modulation techniques, coding, multiple access techniques.
- Ability to design the various satellite applications.

### Text Books

1. Roddy, D., “*Satellite Communications*”, 4<sup>th</sup> edition, McGraw Hill Education, 2017.
2. Pratt, T., Bostian, C., and Allnutt, J., “*Satellite Communication*”, 2<sup>nd</sup> edition, Wiley, 2006.

### Reference Books

1. Maral, G. and Bousquet, M., “*Satellite Communication Systems: Systems, Techniques and Technology*”, 5<sup>th</sup> edition, Wiley, 2014.
2. Martin, D. H., “*Communication satellites*”, 4<sup>th</sup> edition, Aerospace Press, 2000.

**STREAM – VI**  
**VLSI AND ELECTRONIC SYSTEMS**  
**(Offered by Department of ECE)**



<b>Course Code</b>	ECSE21
<b>Course Title</b>	Digital VLSI Design
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To understand theory and to learn design of digital systems at transistor level.
- The course will involve design, layout and simulation of digital VLSI circuits.

### Course Contents

**Unit 1 - Introduction to VLSI:** Design Flow, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology. Fabrication of MOSFETs, Basic Concepts the CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full Customs Mask Layout Design.

**Unit 2 - MOS Transistor:** Structure, Structure and Operation of MOS Transistor (MOSFET), Current-Voltage Characteristics, MOSFET Scaling, MOSFET Capacitance. MOS Inverters, Resistive-Load Inverters, CMOS Inverter.

**Unit 3 - MOS Inverters:** Switching Characteristics and Interconnect Effects, Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitic, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters. Combinational MOS Logic Circuits, CMOS Transmission Gates (Pass Gates).

**Unit 4 - Sequential MOS Logic Circuits:** Behaviour of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge Triggered Flip Flop. Dynamic Logic Circuits, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, High Performance Dynamic CMOS Circuits.

**Unit 5 - Design for Testability:** Introduction, Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test Techniques, Current Monitoring IDDQ Test. Semiconductor Memories: Dynamic Random Access Memory, Static Random Access Memory, Non-volatile Memory, Flash Memory.

### Course Outcomes

- Silicon technology and transistors are introduced and described from a digital point of view, and the performance of various circuits is derived and estimated.
- CMOS digital circuits will be designed and analyzed.

### Text Books

1. Kang, S. M., Leblebici, Y., and Kim, C., “*CMOS Digital Integrated Circuits: Analysis and Design*”, 4<sup>th</sup> edition, McGraw Hill Education, 2016.
2. Rabaey, J. M., Chandrakasan, A., and Nikolic, B., “*Digital Integrated Circuits: A Design Perspective*”, 2<sup>nd</sup> edition, Pearson Education, 2016.

### Reference Books

1. Uyemura, J. P., “*Circuit Design for CMOS VLSI*”, 1<sup>st</sup> edition, Springer, 2011.
2. West, N. H. E. and Eshraghian, K., “*Principles of CMOS VLSI Design: A Systems Perspective*”, 2<sup>nd</sup> edition, Pearson Education, 1993.

<b>Course Code</b>	ECSE22
<b>Course Title</b>	Embedded Systems
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To introduce students to the modern embedded system concepts.
- To make the students to understand and program modern embedded systems using modern embedded processors.

### Course Contents

**Unit I - Introduction to Embedded Computing:** Characteristics of Embedding Applications, Concept of Real time Systems, Challenges in Embedded System Design, Design Process.

**Unit II - Embedded System Architecture:** Instruction Set Architecture, CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller.

**Unit III - Designing Embedded Computing Platform:** Bus Protocols, Memory Devices and their Characteristics, Memory mapped I/O, I/O Devices, I/O mapped I/O, Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, Mixed Signals Processing.

**Unit IV - Programming Embedded Systems:** Basic Features of an Operating System, Kernel Features, Real-time Kernels, Processes and Threads, Dynamic Allocation, Device Drivers, Real-time Transactions and Files, Real-time OS.

**Unit V - Network Based Embedded Applications:** Embedded Networking Fundamentals, IoT overview and architecture. Various wireless protocols and its applications: NFC, Zig-Bee, Bluetooth, Bluetooth Low Energy, Wi-Fi. CAN. Overview of wireless sensor networks and design examples.

### Course Outcomes

- Upon completion of this course, students will be able to get an insight into the overall landscape and characteristics of embedded systems.
- Become familiar with the architecture and programming aspects of the embedded processor (ATOM).
- Develop application software for embedded systems using the RTOS functions.

### Text Books

1. Wolf, M., “*Computers as Components: Principles of Embedded Computing System Design*”, 3<sup>rd</sup> edition, Elsevier, 2013.
2. Krishna, C. M. and Shin, K. G., “*Real-Time Systems*”, 1<sup>st</sup> edition, McGraw Hill Education, 2017.

### Reference Books

1. Hermann, K., “*Real Time Systems: Design Principles for Distributed Embedded Applications*”, 2<sup>nd</sup> edition, Springer, 2013.
2. Hohl, W., and Hinds, C., “*ARM Assembly Language: Fundamentals and Techniques*”, 2<sup>nd</sup> edition, CRC Press, 2014.

<b>Course Code</b>	ECSE23
<b>Course Title</b>	MEMS and Sensor Design
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To learn Introduction to MEMS and micro fabrication.
- To study the essential material properties.
- To study various sensing and transduction technique.

### Course Contents

**Unit I - Introduction to MEMS:** Introduction to MEMS and Microsystems, Materials and Substrates for MEMS, Sensors/Transducers, Sensors characterization and classifications, Micro-actuators, Application of MEMS.

**Unit II - Material Properties:** MEMS materials, Structural and sacrificial materials, Properties of silicon: mechanical, electrical and thermal, Basic modeling of elements in electrical and mechanical systems.

**Unit III - MEMS Fabrication:** MEMS Fabrication Technologies, Single crystal growth, Micro-machining, Photolithography, Micro-stereo lithography, Thin film deposition, Impurity doping, Diffusion, Etching, Bulk and surface micro-machining, Etch stop technique and microstructure, LIGA.

**Unit IV - Mechanical Sensors & Actuators:** Stress and Strain, Hooke's Law. Stress and Strain of Beam Structures, Cantilever, Pressure sensors, Piezo-resistance Effect, Piezoelectricity, Piezo-resistive Sensor, capacitive sensors, Inductive sensors, MEMS inertial sensors, micro-machine micro-accelerometer for MEMS, Parallel-plate Actuator, Piezo-actuators.

**Unit V - Magnetic and Thermal Sensors:** Magnetic material for MEMS, Magnetic sensing and detection, Magneto-resistive sensors, Hall effect, Magneto-diode, Magneto-transistors, MEMS magnetic sensors, RF MEMS. Temperature coefficient of resistance, Thermo-electricity, Thermocouples, Thermal and temperature sensors, Heat pump, micro-machined thermocouple probe, Thermal flow sensors, Shape memory alloy.

### Course Outcomes

- Demonstrate a clear understanding of concepts of MEMS, and their fabrication.
- To be fluent with the design, analysis and testing of MEMS. To use knowledge of MEMS for different applications.

### Text Books

1. Liu, C., “*Foundations of MEMS*”, Pearson Education, 2011.
2. Senturia, S. D., “*Microsystem Design*”, 1<sup>st</sup> edition, Springer, 2013.

### Reference Book

1. Rebiz, G. M., “*RF MEMS Theory, Design, and Technology*”, Wiley, 2010.

<b>Course Code</b>	ECSE24
<b>Course Title</b>	Introduction to Robotics
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To understand the functions of the basic components of a robot effectors and sensors.
- To impart knowledge in robot kinematics and programming.

### Course Contents

**Unit I - Fundamentals of Robots:** Robot definition, Robot anatomy, Co-ordinate systems, Work envelope types and classification, Yaw, Roll, Joint notations, Speed of motion, Pay load- Robot parts and their functions, Need for Robots, with applications.

**Unit II - Robot Drive Systems and End Effectors:** Pneumatic drives, Hydraulic drives, Mechanical drives, Electrical drives, D.C. servo motors, Stepper motors, A.C. servo motors, Salient features, Applications and comparison of all these drives, Grippers such as End effectors, Mechanical, Pneumatic and hydraulic, Magnetic, Vacuum; Two fingered; Internal and external Grippers; Selection and design considerations.

**Unit III - Sensors and Machine Vision:** Requirements of a sensor, Principles and applications of the following types of sensors, LVDT, Resolvers, Optical encoders, Pneumatic position sensors, Range sensors triangulations principles, Structured, Lighting approach, Time of flight, Range finders, Laser range meters, Frame grabber, Sensing and digitizing image data-signal conversion, Image storage, visual serving and navigation.

**Unit IV - Robot Kinematics and Robot Programming:** Forward kinematics, Inverse kinematics and difference, Forward kinematics and reverse kinematics of manipulators with two, Three degrees of freedom, Four degrees of freedom Jacobians, Velocity and forces manipulator dynamics, Trajectory generator, Manipulator mechanism design, Lead through programming, Robot programming languages, and simple programs.

### Unit V - Implementation and Robot Economics:

RGV, AGV, Implementation of robots in industries, Various steps, Safety considerations for Robot operations, Economic analysis of Robots.

### Course Outcome

- Able to apply the basic engineering knowledge for the design of robot.

### Text Books

1. Craig, J. J., *“Introduction to Robotics: Mechanics and Control”*, 3<sup>rd</sup> edition, Pearson Education, 2008.
2. Lynch, K. M. and Park, F. C., *“Modern Robotics: Mechanics, Planning, and Control”*, 1<sup>st</sup> edition, Cambridge University Press, 2017.

### Reference Book

1. Klafter, R. D., Chmielewski, T. A., and Negin, M. *“Robotic Engineering: An Integrated Approach”*, Prentice Hall India, 1993.

<b>Course Code</b>	ECSE25
<b>Course Title</b>	Introduction to Nano-electronics
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	SE

### Course Objectives

- To learn and understand basic concepts of Nano-electronics.
- To know the techniques of fabrication and measurement.

### Course Contents

**Unit I - Introduction To Nanoelectronics:** Microelectronics towards bio-molecule electronics, Particles and waves, Wave-particle duality, Wave mechanics, Schrödinger wave equation, Wave mechanics of particles: Atoms and atomic orbitals, Materials for nanoelectronics, Semiconductors, Crystal lattices: Bonding in crystals, Electron energy bands, Semiconductor hetero-structures, Lattice-matched and pseudo-morphic hetero structures, Inorganic-organic hetero-structures, Carbon nanomaterials: nanotubes and fullerenes.

**Unit II–Material Properties:** Dielectrics, ferroelectrics and electronic properties, Quantum Effects, Magneto-electronics, Electronic structures, Molecular basis of their electrical excitability, Circuit and system design, Analysis by diffraction and fluorescence methods.

**Unit III - Fabrication and Measurement Techniques:** Growth, fabrication and measurement techniques for nanostructures, Bulk crystal and heterostructure growth, Nanolithography, Methods of nano-tube growth, Chemical and biological methods for nano-scale fabrication, Fabrication of nano-electromechanical systems, Scanning probe techniques.

**Unit IV –Nano-Structure Devices:** Electron transport in semiconductors and nanostructures, Electrons in quantum wells and wires, Electrons in quantum dots, Nanostructure devices, Resonant-tunneling diodes, Field-effect transistors, Single electron transfer devices, Potential effect transistors.

**Unit V –NanoelectronicsApplications:** Nano-electromechanical system, Quantum-dot cellular automata, Superconductor digital electronics, Quantum computing, Carbon nanotubes, Molecular electronics.

### Course Outcomes

- Ability to demonstrate distinct phenomena that are important in nano-electronic devices.
- Ability to understand principles, merits, demerits and challenges of some of the futuristic nano-electronic devices.

### Text Books

1. Datta, S., “*Lessons from Nanoelectronics: A New Perspective on Transport*”, 2<sup>nd</sup> edition, World Scientific, 2018.
2. Ranier, W., “*Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices*”, 3<sup>rd</sup> edition, Wiley, 2012.

### Reference Book

1. Hanson, G. W., “*Fundamentals of Nanoelectronics*”, 1<sup>st</sup> edition, Pearson Education, 2009.

## MANAGEMENT ELECTIVES

<b>Course Code</b>	HME861
<b>Course Title</b>	Organizational Behaviour
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	GIR

### Course Objectives

- Understand organizational behavior which can foster job satisfaction leading towards higher productivity.
- Develop skills like command and control mentality, leadership and conflict resolution.

### Course Contents

**Unit I - Focus and purpose:** Definition, need and importance of organizational behavior, Nature and scope, Frame work, Organizational behavior models.

**Unit II - Individual behaviour:** Personality types, Factors influencing personality, Theories, Learning, Types of learners, The learning process, Learning theories, Organizational behavior modification. Misbehavior Types, Management Intervention. Emotions - Emotional Labor, Emotional Intelligence, Theories. Attitudes, Characteristics, Components, Formation, Measurement, Values. Perceptions, Importance, Factors influencing perception, Interpersonal perception, Impression Management. Motivation, importance, Types, Effects on work behavior.

**Unit III - Group behaviour:** Organization structure, Formation, Groups in organizations, Influence, Group dynamics, Emergence of informal leaders and working norms, Group decision making techniques. **Team building:** Interpersonal relations, Communication, Control.

**Unit IV - Leadership and Power** Meaning, Importance, Leadership styles, Theories, Leaders versus Managers, Sources of power, Power centers, Power and Politics.

**Unit V - Dynamics of organizational behaviour** Organizational culture and climate, Factors affecting organizational climate, Importance. Job satisfaction, Determinants, Measurements, Influence on behavior. Organizational change, Importance, Stability versus Change, Proactive versus Reaction change, the change process, Resistance to change, Managing change. Stress, Work Stressors, Prevention and Management of stress, Balancing work and Life. Organizational development. Organizational effectiveness.

### Course Outcomes

- Application of organizational behavior concepts, models and theories to real life management situations through case analysis.
- Effective communication in oral and written forms about organizational behavior theories and their application.

### Text Books

1. Luthans, F., “*Organizational Behavior: An Evidence-Based Approach*”, 12<sup>th</sup> edition, McGraw Hill, 2017.
2. Robins, S. P., Judge, T. A., and Vohra, N., “*Organizational Behavior*”, 16<sup>th</sup> edition, Pearson Education, 2016.

### Reference Book

1. Pareek, U. and Khanna, S., “*Understanding Organizational Behavior*”, 4<sup>th</sup> edition, Oxford, 2016.

<b>Course Code</b>	HME862
<b>Course Title</b>	Entrepreneurship Development
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	GIR

### Course Objectives

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

### Course Contents

**Unit I - Entrepreneurship:** Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

**Unit II –Motivation:** Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

**Unit III - Business:**Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

**Unit IV - Financing and Accounting:**Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

**Unit V - Support To Entrepreneurs:**Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

### Course Outcomes

- Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

### Text Books

1. Khanka, S.S., “*Entrepreneurial Development*” S. Chand & Co. Ltd., 2013.
2. Donald, F. K., “*Entrepreneurship – Theory, Process and Practice*”, 9<sup>th</sup> Edition, Cengage Learning, 2014.

<b>Course Code</b>	HME863
<b>Course Title</b>	E-Commerce and Digital Marketing
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	GIR

### Course Objectives

- To identify several factors and web store requirements needed to succeed in e-commerce.
- To understand the main technologies behind e-commerce systems and how these technologies interact.
- To define various electronic payment types and associated security risks and the ways to protect against them.

### Course Contents

**Unit I - Electronic Commerce:** Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications. Consumer Oriented Electronic commerce – Mercantile Process models.

**Unit II - Electronic payment systems:** Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems. Inter Organizational Commerce – EDI, EDI Implementation, Value added networks.

**Unit III - Intra Organizational Commerce:** work Flow, Automation Customization and internal Commerce, Supply chain Management.

**Unit IV - Digital Marketing:** Introduction, email marketing, social media marketing- Facebook, Twitter, LinkedIn, mobile marketing, web analytics.

**Unit V - Search Engine Optimization:** Introduction, SEO- white hat, black hat, tools for SEO, Pay per click.

### Course Outcomes

- Identification of the business relationships between the organizations and their customers.
- Performance of various transactions like payment, data transfer etc.

### Text Books

1. Schneider, G. P., “*Electronic Commerce*”, Cengage learning publishers, 10<sup>th</sup> edition, 2012.
2. Chan, H., Lee, R., Dillon, T., and Chang, E., “*E-Commerce Fundamentals and Applications*”, Wiley, 1<sup>st</sup> edition, 2007.
3. Dodson, Ian, “*The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns*”, Wiley, 1st edition, 2016.

### Reference Book

1. Kalakata, “*Frontiers of electronic commerce*”, Pearson, 1<sup>st</sup> edition, 2002.



<b>Course Code</b>	HME864
<b>Course Title</b>	Usability Analysis
<b>Number of Credits</b>	3-0-0-3
<b>Type of Course</b>	GIR

### Course Objectives:

- To understand the concept of usability analysis.
- To analyze the usability requirements to succeed in e-commerce.
- To introduce students to the techniques being used for web usability.

### Course Contents:

**Unit 1: Usability Analysis:** Concept of usability analysis, Advantages of usability analysis, Framework of usability analysis, Models of usability evaluation, System quality, Information quality, Service quality, Application of usability analysis in e-commerce, and web-design.

**Unit 2: Usability and Customer Retention in E-commerce:** Usability measures in e-commerce, User-interface architecture, Customer conversion, Customer satisfaction and retention in business to business e-commerce and business to consumer e-commerce.

**Unit 3: Web Usability:** Introduction, Dimensions of web usability, Web usability criteria, Principles and evaluation methods, Serviceability, Learnability, Simplicity, Efficiency, Control, Customer relationship management.

**Unit 4: Web Design Optimization:** Web analytics, Web design errors, Web design conventions, Design features to promote usability, Search engine optimization.

**Unit 5: Usability Testing:** Process of usability testing, Elements and techniques of usability testing, Comparative and explorative usability testing, Qualitative and quantitative usability testing, System usability scale (SUS), Heuristic evaluations.

### Course Outcome:

- Ability to apply the usability analysis for customer retention in the field of e-commerce and web designing.
- Ability to apply the usability techniques to succeed in e-commerce and web designing.

### Text Books:

- 1) Travis, David, “*E-Commerce Usability: Tools and Techniques to Perfect the On-Line Experience*”, Taylor and Francis, 2<sup>nd</sup> edition, 2017.
- 2) Steve, Krug, “*Don't Make Me Think, Revisited: A Common-Sense Approach to Web Usability*”, Pearson Education, 3<sup>rd</sup> edition, 2014.

## Course Outcomes Survey Form

Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Course Code : \_\_\_\_\_

Course Name : \_\_\_\_\_

Year/Semester : \_\_\_\_\_

Faculty : \_\_\_\_\_

S. No.	Your satisfaction on the following statements	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
1	Faculty has made the subject interesting				
2	Faculty is enthusiastic about what is taught				
3	Faculty is good at explain things				
4	The course is well organized				
5	The course is intellectually stimulating				
6	Any changes in the course or teaching have been communicated effectively				
7	The criteria used in assessment have been clearly stated in advance				
8	Assessment and marking have been fair				
9	I have been able to contact faculty when I needed to				
10	I have received detailed comments on my work				
11	I have received sufficient advice and support from the faculty for my studies				
12	I have been able to access general IT resources when I needed to				
13	My communication skills have improved				
14	Feedback on my work has been prompt				
15	Feedback on my work has helped me clarify things I did not understand				
16	As a result of the course, I feel confident in tackling problems related to this course				
17	Overall, I am satisfied with the quality of the course				

Signature of Student

# B.Tech. (ECE) Program Survey Form

(By Final Year B. Tech. Students)

Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

## 1. Course Outcomes

Overall, Your satisfaction on the following statements:	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
How current the content is in most subjects in your courses?				
How interesting the teaching is in most subjects in your courses?				
The variety of courses offered in your programme.				
How helpful and accurate the academic advising is in your course?				
How helpful and accurate the career counselling is in your programme?				
How challenging the work is intellectually in most courses in your programme?				
The overall educational experience in your programme.				

## 2. About Faculty

To what extent do you agree or disagree with the following statements:	Strongly Agree	Agree	Disagree	Strongly Disagree
Faculties are good at explaining things				
Faculties are good at motivating me to do my best work				
Faculties normally give me helpful feedback on how I am doing				
Faculties give feedback promptly				
Faculties work hard to make the subjects interesting				
Faculties grading method are fair				
Faculties treat students with respect				
Faculties are available when I need them				
Course objectives are clear in most courses				
Course objectives are met in most courses				

## 3. Teaching and Learning Environment

What extents are you satisfied with the following aspects of the teaching and learning environment?	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
Intellectual stimulation of most courses				
Amount of work required in most courses				
Relevance of lab/practical classes				
Group work for assignments				
Level of class interactions in most courses				
Course content in most courses				
Assistance from most faculty outside of class				
Library access to reading materials				
Opportunities to be involved with other students outside of class				
Being informed about things in the department				

#### 4. Skill Development

What extent does your coursework in your major improve the following skills?	Strongly Agree	Agree	Disagree	Strongly Disagree
Communication skills				
Writing skills				
Interpersonal relationship skills				
Self-reliance skills				
Decision-making skills				
Ability to execute plans				
Ability to work in groups on projects				
Leadership skills				
Analytical skills				
Research skills				
Making logical judgements				
Producing independent work				
Understanding my strengths and weaknesses				
Achieving personal goals				
Achieving career goals				
My education from IITU is important to me				

#### 5. Professional Ethics

What extent do you agree or disagree with the following statements	Strongly Agree	Agree	Disagree	Strongly Disagree
I show respectful behaviour toward faculty and other students in most of my classes				
I actively participate in most class discussions				
I usually attend my classes				
I usually read the text or other readings prior to class				
I study extensively for exams and quizzes				
I study a few days before the cycle tests/ end semester exam				
I complete all course assignments as explained in syllabus				
I ask for help from most of my faculty when I need it				
I am motivated to learn course materials				
I care about what grade I will receive in most courses				

Signature of Student

# Alumni Survey Form

## (Assessment of Outcomes - B. Tech. (ECE))

Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Name: \_\_\_\_\_ Year of Graduation: \_\_\_\_\_

Organization: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_ E-mail: \_\_\_\_\_

Overall, are you satisfied with:	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
Demonstrate basic knowledge in mathematics, science, engineering, and humanities.				
Define the problems and provide solutions by designing and conducting experiments, interpreting and analyzing data, and reporting the results.				
Demonstrate the ability to design Computer Science and Engineering systems				
Ability to participate as members of multidisciplinary design teams along with mechanical, electrical, and other engineers				
Understand quantitative modelling and analysis of a broad array of systems-level techniques to identify, formulate and solve ECE problems				
Broadly educated and will understand ethical responsibilities				
Proficient in English language in both communicative and technical forms				
Awareness to apply engineering solutions in global, national, and societal contexts.				
Capable of self-education and clearly understand the value of updating their professional knowledge to engage in life-long learning				
Demonstrate the ability to apply advanced technologies to solve contemporary and new problems				
Demonstrate the ability to choose and apply appropriate resource management techniques.				

Signature of Alumnus

# Employer/Scholar Survey Form

## B. Tech. (ECE) IITU Alumni

Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Name of the Company/ Institution: \_\_\_\_\_

Name of the B. Tech. (ECE) IITU Alumni: \_\_\_\_\_ Batch: 20\_\_\_\_ to 20\_\_\_\_

Designation of Alumni: \_\_\_\_\_

Job Spec of Alumni: \_\_\_\_\_

Name of the Assessor: \_\_\_\_\_

Designation: \_\_\_\_\_

How do you rate the current potential of IITU ECE alumni working in your organization on the following criteria	Very Satisfied	Generally Satisfied	Generally dissatisfied	Very dissatisfied
Application of mathematical foundations				
Application of computer science theory and algorithmic principles				
Application of modeling and design of computer-based systems				
Application of engineering knowledge in their domain Domain: Health care/ Banking/ Finance/ Medical/ Law/ Others Others, specify:				
Design and conduct of experiments and to analyze and interpret data				
Analyze the problem, subdivide into smaller tasks with well-defined interface for interaction among components				
Complete the project (given task) within the specified time frame and financial constraints				
Proposal of original ideas and solutions				
Design, implement, and evaluation of hardware/software systems with security features				
Design, implement, and evaluation of hardware/software systems with assured quality and efficiency				
Effective communication of engineering solution to peers and leads				
Effective communication of engineering solution to customers and users				
Understanding of contemporary issues				
Engagement in lifelong learning				

Signature of Assessor

# Time Table

Day	Period-I 8:30 AM- 9:20 AM	Period-II 9:20 AM- 10:10 AM		Period-III 10:30 AM- 11:20 AM	Period-IV 11:20 AM- 12:10 PM		Period-V 13:30 PM- 14:20 PM	Period-VI 14:20 PM- 15:10 PM		Period-VII 15:20 PM- 16:10 PM	Period-VIII 16:10 PM- 17:00 PM
Mon			B  R  E  A  K			B  R  E  A  K			B  R  E  A  K		
Tue											
Wed											
Thu											
Fri											

	<p align="center"><b>Indian Institute of Information Technology, Una [HP]</b>          An Institute of National Importance under MoE</p> <p><b>Contact No.:</b> 01972-254077      <b>Website:</b> www.iiitu.ac.in</p>	
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## COURSE ENROLMENT FORM

This form has to be submitted, on the day of Registration of Courses, First working day of the odd/even semester, attaching the proof for fee payment.

**Date:** \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Student Name: \_\_\_\_\_

Roll No.: \_\_\_\_\_ Program: \_\_\_\_\_ Branch: ECE

Academic Year: \_\_\_\_\_ Semester: \_\_\_\_\_

S. No.	Course Code	Course Name	Credits
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

### Fees Payment Details:

Date of Payment	Bank Name	Transaction/ DD Number	Amount	Is proof of payment attached

Encl.: Proof of Payment details

**Signature of Student**

**Faculty In-charge**





