DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABUS

IIITUGECE18

2019-2020

SCHOOL OF ELECTRONICS

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA, HIMACHAL PRADESH

B.TECH.CURRICULUM

Academic Year: 2019-20

SCHOOL OF ELECTRONICS

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IIITUGECE18

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA

TRANSIT CAMPUS - I, NIT CAMPUS, HAMIRPUR– 177 005

Personal Details

Name of the Student :

Parent/ Guardian :

Roll Number :

Batch :

Residential Address :

Contact Number :

E-mail :

Blood Group :

Aadhar Card No. :

Table of Contents

History of School of Electronics

Program	Description
UG in B.Tech. (Electronics and Communication Engineering)	• Started with 30 seats in 2014 • Intake increased to 60 in 2017

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 formentioned theory and 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 four theory courses are mandatory. Project Work will be carried out in theV, 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, 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 PCconsists of 9 theory courses out of which 7 courses comprise labs. The PC comprises a total number of 42credits(29 Theories + 13Labs). 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 subjectswill be offered in V, VII, and VIII semesters. The subjects are grouped into six streams and further, each elective comprises fivenumber 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 semesterfor 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 IIIand IV semester, having3 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 approximately15 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). Thenumbers corresponding to L, T and P denote the contact hours per week forLecture, Tutorial and Practical/Practicum respectively, and that of C denotesthe 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	Professional Communication*
5	Basic Environmental Science and Engineering
6	Humanities
7	Basics of Programming in C *
8	Basic Electrical and Electronics Engineering *
9	Electronics/ Computer/ IT Workshop
10	Internship
11	Project Work
12	Technical Clubs/ Sports/ Cultural/ Yoga/ NCC/ NSS
13	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	34	22
2	PC Theory	29	18
3	PE Theory	18	12
4	GIR Lab	17	11
5	PC Lab	13	08
6	PE Lab	06	04
7	SE	15	10
8	IN	00	00
9	PW	18	11
10	PM	06	04
11	OC (Honors/Optional)	12	07

The curriculum supports approximately 62% Theory and 38% Lab including PW and PM. Online courses are optional.

B.Tech. (ECE) – Curriculum (IIITUGECE18)

Semester-wise Curriculum

ISemester

S. No.	Course Code	Course Name	L	T	P	C
1	EC-1101	Engineering Mathematics - I	3	1	0	3
2	EC-1102	Engineering Physics	3	1	0	3
3	EC-1103	Basic Environmental Science and Engineering	3	1	0	3
4	EC-1104	Basic Electronics Engineering	3	1	0	3
5	EC-1105	Computer Programming	3	1	0	3
6	EC-1106	Workshop and Product Design	1	0	3	2
7	EC-1107	Basic Electronics Lab	0	0	3	1
8	EC-1108	Physics Lab	0	0	3	1
9	EC-1109	Computer Programming Lab	0	0	3	1
		Total	**16**	**5**	**12**	**20**

II Semester

S. No.	Course Code	Course Name	L	T	P	C
1	EC-1201	Engineering Mathematics - II	3	1	0	3
2	EC-1202	Engineering Chemistry	3	1	0	3
3	EC-1203	Professional Communication	3	1	0	3
4	EC-1204	Basic Electrical Engineering	3	1	0	3
5	EC-1205	Digital Electronics and Logic Design	3	1	0	3
6	EC-1207	Digital Electronics Lab	0	0	3	1
7	EC-1208	Basic Electrical Lab	0	0	3	1
8	EC-1209	Chemistry Lab	0	0	3	1
9	EC-1210	Introduction to Computational Tools and Practices	1	0	3	3
		Total	**16**	**5**	**12**	**21**

III Semester

S. No.	Course Code	Course Name	L	T	P	C
1	ECC301	Electronic Devices and Circuits	3	0	4	5
2	ECC302	Signals and Systems	3	1	4	6
3	ECC303	Electromagnetic Field Theory	3	0	0	3
4	ECC304	Communication Systems	3	1	4	6
5	ECC305	Electrical Circuits and Networks	3	0	4	5
6	ECL306	Practicum-I	0	0	6	3
		Total	**15**	**2**	**22**	**28**

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-II	0	0	6	3
		Total	**12**	**1**	**18**	**22**

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**

***NPTEL/ SWAYAM/ MOOCs, etc.**

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**

VII Semester

S. No.	Course Code	Course Name	L	T	P	C
1	XXXXXX	Program Elective - IV	3	0	4	5
2	XXXXXX	Program Elective - V	3	0	0	3
3	XXXXXX	Program Elective - VI	3	0	0	3
4	XXXXXX	Stream Elective - II	3	0	0	3
5	HMC701	Professional Ethics	1	0	0	0
6	ECC702	Verilog based Design	1	0	4	3
7	ECL703	Project Phase - II	0	0	12	6
8	ECO704	Honors Online Course - III*	5	1	0	3
		Optional Online Course - III*	5	1	0	0-3
Total			**14**	**0**	**20**	**23**

VIII Semester

S. No.	Course Code	Course Name	L	T	P	C
1	XXXXXX	Stream Elective - III	3	0	0	3
2	XXXXXX	Stream Elective - IV	3	0	0	3
3	XXXXXX	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	20	21	28	22	21	00	23	21	**156**

***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, 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

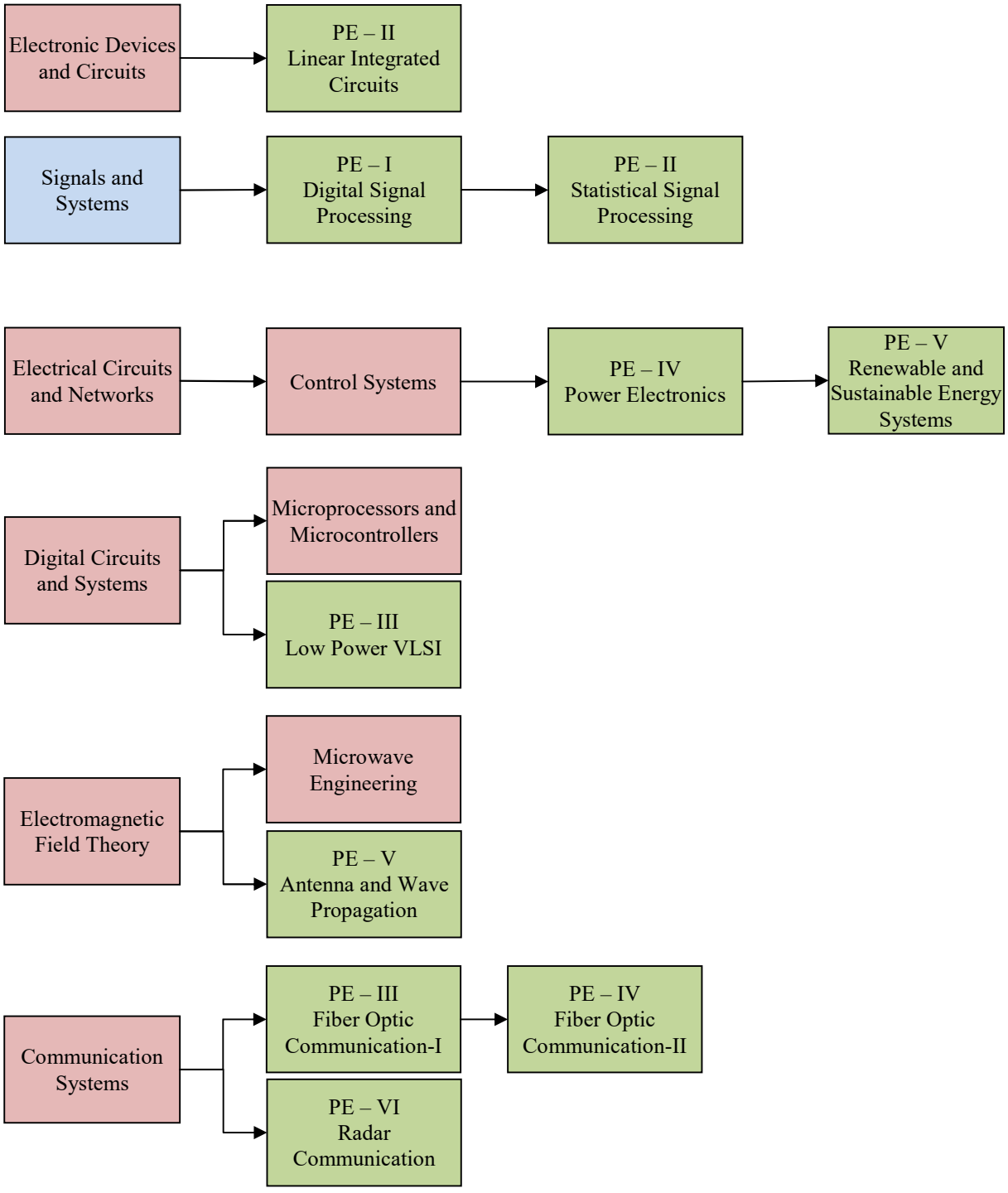
STUDY CHART

Semester-I	Semester-II	Semester-III	Semester-IV	Semester-V	Semester-VI	Semester-VII	Semester-VIII
Engineering Mathematics-I	Engineering Mathematics-II	Electronic Devices and Circuits*	Microwave Engineering*	Professional Communication and Soft Skills	Internship	PE – IV Fiber Optic Communication-II* Power Electronics*	SE -III
Engineering Physics*	Engineering Chemistry*	Signals 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	Professional Communication	Electromagnetic Field Theory	Microprocessors and Microcontrollers*	PE – II Statistical Signal Processing* Linear Integrated Circuits*		PE – VI Data Communication and Networks Radar Communication	SE - V
Basic Electronics Engineering*	Basic Electrical Engineering*	Communication Systems*	Electronic Instrumentation and Measurements	PE – III Fiber Optic Communication-I Low Power VLSI		SE -II	Management Elective
Computer Programming*	Digital Electronics and Logic Design*	Electrical Circuits and Networks*		SE -I		Professional Ethics	
Workshop and Product Design*	Introduction to Computational Tools and Practices*					Verilog based Design	
		Practicum-I	Practicum-II	Project Phase-I		Project Phase-II	Project Phase-III

GIR | PC | PE | SE | Internship | Practicum | Project

*Includes Lab

DEPENDENCY CHART



FIRST SEMESTER

Course Code	EC-1101
Course Title	Engineering Mathematics -I
Number of Credits	3-1-0-3
Type of Course	GIR

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, Rouche'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 - Differential calculus: Indeterminate forms, Partial Differentiation and its geometrical interpretation, Homogeneous functions, Euler‟s theorem and its extension, Total differentials, Composite function, Jacobian, Taylor‟s and Maclaurin‟s infinite series, Errors and increments, Introduction to limits and Indeterminate forms, Maxima and minima of functions of two variables, Method of undetermined multipliers. Curve tracing

Unit IV –Integral calculus: Quadrature, Rectification, Surface and Volume of revolution for simple curves, Double integrals and their applications, Change of order of integration, Change of variables, Triple integrals and their applications, Change of variables.

Unit V –Vector Calculus: Differentiation of vectors, Curves in space, Velocity and acceleration, Relative velocity and acceleration, Scalar and vector point functions, Vector operator del, gradient, divergence and curl with their physical interpretations, Formulae involving gradient, divergence and curl. Line, surface and volume integrals, Theorems of Green, Stokes and Gauss (without proofs) and their verifications and applications, Irrotational and Solenoidal fields.

Text Books

1. Keyszig, E., "*Advanced Engineering Mathematics"*, 2nd edition, CBS Publications, John Wiley and Sons, NC, New York.
2. Jain, R. K. and Iyengar, S. R. K., "*Advanced Engineering Mathematics"*, 5th edition, Narosa Publications, 2016.

Reference Book

1. Wylie, C. R. and Barrett, L. C., "*Advanced Engineering Mathematics*", 6th edition McGraw-Hill, 2003.
2. Differential & Integral Calculus: by N. Piskunov, MIR Publications.

Course Code	EC-1102
Course Title	Engineering Physics
Number of Credits	3-1-0-3
Type of Course	GIR

Course Contents

Unit I - Semiconductor Device Physics: Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level and quasi Fermi levels, Fermi-Dirac Statistic, Effective mass, Conductivity as a function of temperature p-n junctions, Schottky junction and Ohmic contacts, Semiconductor optoelectronic materials, Bandgap modification, Heterostructures and Quantum Wells.

Unit II - Magnetic And Dielectric Properties Of Materials: Origin of magnetism, dia, Para, Ferro, antiferro and ferrimagnetisms, soft and hard magnetic materials, dielectric properties, Piezo, pyro and Ferro electricity.

Unit III - Structure of Materials: Space lattice and unit cells, crystal system, Symmetry operation, Structures of common metallic, Semiconductor ceramic and, Miller Indices, Packing fractions, Structure determination using X-ray diffraction, Braggs law, and lattice parameter determination. Bonding in solids, coordination number, ceramics, silicates and clay structures, glass transition temperature, non-crystalline materials.

Unit IV - Interaction of Photons with Materials: Rates of emission and absorption, spontaneous and stimulated emission, Condition for amplification by stimulated emission, the laser amplifier, characteristics of laser light, three and four level laser system, coherence,Ruby, He-Ne, CO2 and semiconductor lasers. Optical Fiber, physical structure and basic theory, modes in optical fibers, step index and graded index fibers, losses in optical fibers, applications of optical fibers.

Unit V - Superconductivity: Introduction and discovery of superconductivity, superconducting materials, Meissner effect, critical magnetic field and critical current, type -I and type-II superconductors, Isotope effect, BCS theory of superconductivity, flux quantization, SQUIDS, applications of superconductivity.

Text/Reference Books

1. J.Singh, Semiconductor Optoelectronics:Physics and Technology, McGraw-Hill Inc. (1995)
2. Introduction to Solid State Physics, C. Kittel.
3. Solid State Physics, N.W. Ashcroft and N.D. Mermin.
4. A text Book of Engineering Physics; M.N. Avadhanulu and P.G. Kashirsagar, S. Chand & Co. Ltd.
5. Modern Engineering Physics; A.s. Vasudeva, S. Chand & Co. Ltd.
6. Optical Electronics; AK Ghatak and Thyagarajan, Foundation Books, New Delhi.
7. Concepts of modern Physics; Arthur and Beiser, McGraw Hill Publication.
8. Optical Fiber Communication and Technology, D.K. Mynbaev and L.L.Scheiner, Pearson Education

Course Code	EC-1103
Course Title	Basic Environmental Science and Engineering
Number of Credits	3-1-0-3
Type of Course	GIR

Course Contents

Unit I - Environmental Management, Resources And Legislation: Environmental disturbances, quantification of environmental issues, soil resources and their classification, equitable use of resources, natural resource management, food chain and trophic levels, environmental impacts of energy development, legislation.

Unit II - Global Atmospheric Change: The atmosphere of earth, global temperature, greenhouse effect, radiative forcing of climate change, global warming potential, carbon cycle, carbon emissions from fossil fuels, regional impacts of temperature change, global initiatives

Unit III - Physical, Chemical And Biological Processes: Particle dispersion, methods of expressing particle concentrations, stoichiometry, chemical equilibria, solubility of gases in water, carbonate system, organic chemistry, nuclear chemistry, nuclear fission and fusion, basic atmospheric properties, fundamentals of microbiology.

Unit IV - Population and Economic Growth: The nature of human population growth, population parameters, industrialisation, urbanisation, sustainable development, sustainable consumption, resettlement and rehabilitation issues, health and the environmental impacts.

Unit V -Solid and Hazardous Waste Management: Integrated solid waste management, hazardous waste management, biomedical waste treatment technologies and disposal options, e-waste management, waste minimisation for sustainability, waste management – Indian scenario.

Unit VI -Pollution and Monitoring: Water resources, characteristics of water, water pollutants, oxygen demanding wastes, surface water quality, groundwater quality, water and wastewater treatment systems. Air quality standards, emission standards, criteria pollutants, air pollution and meteorology, atmospheric dispersion, emission controls.Effect of noise on people, rating systems, community noise sources and criteria, traffic noise prediction, noise control.

Text/Reference Books

1. Mackenzie L. Davis and David A. Cornwell.2010. Introduction to Environmental Engineering, 4e. Tata McGraw-Hill Education Private Limited New Delhi.
2. Gilbert M. Masters.2007. Introduction to Environmental Engineering and Science, 2e. Pearson Education. Dorling Kindersley (India) Pvt. Ltd. Delhi.
3. J. Glynn Henry and Gary W. Heinke.2004. Environmental Science and Engineering, 2e. Pearson Education (Singapore) Pte. Ltd.

Course Code	EC-1104
Course Title	Basic Electronics Engineering
Number of Credits	3-1-0-3
Type of Course	GIR

Course Contents

Unit I - Semi-Conductors and Diodes: Introduction, Insulators, semiconductors and metals, Mobility and conductivity, Intrinsic and extrinsic semiconductors, Charge density, current components in semiconductors, Continuity equation, PN junction diode- Characteristics and analysis, Types of diodes- Zener, Photodiodes, LED, Varactor diode, tunnel diodes.

Unit II - Diode Applications: Rectifiers and filter circuit: Half wave rectifier, Full wave rectifier, bridge rectifier and their analysis, L,C and Pi filters, Series and shunt diode clippers, Clipping at two independent levels, Clamping operation , Clamping circuit, Practical clamping circuits, Basic regulator supply using zener diode.

Unit III - Transistors: Construction and characteristics of BJT, Transistor configuration: CB, CE, CC configuration, Transistor at low frequency, Small signal low frequency transistor model(h-parameters), Analysis of transistor amplifier using h-parameters, Transistor biasing and bias stabilization: Operating point, Stability factor, Analysis of fixed bias, collector to base bias, Emitter resistance bias circuit and self bias circuit, Bias compensation techniques.

Unit IV - Field Effect Transistor: Construction and characteristics of JFET, JFET biasing circuit, JFET amplifier, MOSFET construction and characteristics.

Unit V- Amplifiers and Oscillators: Classification of amplifiers, concept of feedback, Characteristics of feedback amplifiers, Single stage RC coupled amplifier, Oscillators, Criterion for oscillation, Types of oscillators: Hartley oscillator, Colpitt oscillator, RC-phase shift oscillator, Wein bridge oscillator.

Unit VI- Operational Amplifiers: Introduction, inverting and non-inverting configuration, Applications of op-amp: Adder, subtractor, Integrator, Differentiator, Comparator and practical op-amps.

Text Books

1. Integrated devices & Circuits by Millman&Halkias.
2. Electronics Devices and Circuit Theory by R. Boylestad.

Reference Books

1. Electronics Devices and Circuits-II by A.P.Godre& U.A. Bakshi.
2. Electronics Devices and Circuit by G.K. Mithal.

Course Code	EC-1105
Course Title	Computer Programming
Number of Credits	3-1-0-3
Type of Course	GIR

Course Contents

Unit I - Introduction: Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

Unit II - C Programming Basics: Problem formulation – Problem Solving - Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

Unit III - Arrays and Strings: Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. StringString operations – String Arrays. Simple programs- sorting- searching – matrix operations.

Unit IV - Functions and Pointers: Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays, Example Problems.

Unit V - Structures and Unions: Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

Text books

1. "Computer Fundamentals and Programming in C", by Anita Goel and Ajay Mittal, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. "Fundamentals of Computing and Programming in C", First Edition, by PradipDey, ManasGhosh, Oxford University Press, 2009
3. "Let Us C", by Yashavant P. Kanetkar, BPB Publications, 2011.

Reference Books

1. "Programming with C", by Byron S Gottfried, Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. "How to Solve it by Computer", by Dromey R.G., Pearson Education, Fourth Reprint, 2007.
3. "The C Programming language", by Kernighan,B.W and Ritchie,D.M, Pearson Education, Second Edition, 2006.

Course Code	EC-1106
Course Title	Workshop and product design
Number of Credits	1-0-3-2
Type of Course	GIR

Course Contents

Unit I - Electronics Components: Resistors: classification of resistors, Materials used for resistors, Maxi mum power rating, tolerance, temperature co-efficient, Carbon film resistors, standard Wire wound resistors, Color Coding, LDR. Capacitors: Materials used for capacitors, working voltage, capacitive reactance. Coding of capacitors Fixed Capacitor types: Disc, Ceramic capacitor, Aluminum electrolytic capacitor, Variable capacitor types: Air Gang, PVC gang capacitor, Trimmer mica capacitor. Inductors: Air core, iron core, ferrite core inductor, frequency range Inductors: A.F., R.F., I.F., Transformers used in electronic circuits. Diodes: Use of p-n junction diodes and Special Diodes, Zener diode, Varactor diode, LED, photo diode, etc. Transistors: Use of transistors in electronic circuits, testing of BJT and FET, understand and interpret the data sheet of transistors. ICs: IC packages, Pin identification of ICs, understand and interpret the data sheet of transistors.

Unit II - Measuring Instruments: Use Analog & digital multimeters, CRO, power supply and Function generator, Testing various electrical and electronic components using multimeters and CRO.

Unit III - Cables, Connectors and Switches:CABLES: General specifications of cables- characteristic impedance, current carrying capacity, flexibility. Types of cables: SWG Single core, Multi core, Single strand, Multi strand and their types, Shielded wires, Coaxial cables, Twisted pair, UTP cables, Flat ribbon cable, Teflon coated wires, optical Fiber Cable. CONNECTORS: General specifications of connectors- contact resistance, breakdown voltage, insulation resistance, applications of BNC, D series, Audio, Video, printer, edge, FRC, RJ 45 connectors. SWITCHES: Toggle switch- SPDT, DPDT, TPDT, Centre off, Without center-off, Rotary switch types depending on their poles and positions Rocker switch, Push button latch and non-latch, Tactile switch, Micro switch, Limit switch, DIP switch, Thumb wheel switchBCD, Decimal, Membrane switch..

Unit IV - Functions and Pointers: Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays, Example Problems.

Unit V - Workshop Practice: Use of various workshop tools: nose pliers, wire stripper, wire cutter. Study and understanding electronic circuit diagrams. Transfer and testing of circuit diagram to Bread. General purpose PCB, Custom made PCB- types of PCB and their use, Transfer and testing of circuit diagram to PCB, Soldering and De-soldering - technique-requirements and methods.

Text books

1. Raina K. B., Bhattacharya S. K., Juneja T., “Electrical engineering materials and electronic components,” TTTI Chandigarh.
2. Dhir S.M., “Electronic Components and Materials,” Tata McGraw Hills publishing company Ltd., N.Delhi

Reference Books

1. Thomas H. Jones, “Electronic Components Handbook,” Reston Publishing.
2. Data sheets of transistors and ICs.

SECOND SEMESTER

Course Code	EC-1201
Course Title	Engineering Mathematics - II
Number of Credits	3-1-0-3
Type of Course	GIR

Course Contents

Unit I - 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 II - 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 III - Complex Numbers: Applications of De Moivre‟s theorem, Exponential, Circular, Hyperbolic and Logarithmic functions of a complex variable, Inverse Hyperbolic functions, Real and imaginary parts of Circular and Hyperbolic functions, Summation of the series-„C+iS‟ method.

Unit IV - Functions of Complex Variable: Limit and derivative of complex functions, Cauchy-Riemann equations, Analytic functions and its applications, Geometrical representation of complex function, Conformal mapping and standard transformations, Complex integration, Cauchy‟s theorem, Cauchy‟s integral formula, Series of complex terms, Taylor‟s and Laurent‟s series, Cauchy‟s residue theorem and its application for the evaluation of real definite integrals.

Unit V - 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.

Text Books

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

Reference Books

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill.
2. Vector Calculus: by C. E. Weatherburn. John Wiley and Sons, NC, New York.
3. Complex variables and Applications: by R. V. Churchill, T. J. Brown & R. F. Verhey, McGraw Hill.

Course Code	EC-1202
Course Title	Engineering Chemistry
Number of Credits	3-1-0-3
Type of Course	GIR

Course Contents

Unit I - Polymers: Introduction, classification, tacticity, types of polymerization, coordination polymerization, mechanisms of polymerization, synthesis and applications of some important polymers Effect of polymer structure on properties, Moulding of plastics into articles, Conducting polymers: preparation, types, properties and applications.

Unit II - Science of CompositeMaterials: Introduction, Classification, constituents of composites, Fiber reinforced composites, unidirectional fibre reinforced composites, short fibre reinforced composites, particle reinforced composites, important types and failures of fiber reinforced composites, Advantages and applications of composites.

Unit III - Characterization Techniques: Introduction to spectroscopy; UV-Visible spectroscopy- Absorption laws, Instrumentation, formation of absorption bands, Theory of electronic spectroscopy, Chromophore and auxochrome concept, fluorescence & phosphorescence, application of UV-Visible spectroscopy ; IR spectroscopy- Principle, theory of molecular vibrations, selection rules, spectral features of some classes of compounds, important features of IR spectroscopy and applications; NMR- Principle, relaxation processes, Instrumentation, shielding-desheilding effects, spinspin coupling, coupling constant, applications of NMR; MS spectroscopy- Basic principle, Instrumentation, determination of molecular formulae, important features of mass spectroscopy; Chromatography- Introduction, types, gas chromatography ; thermal methodinstrumentation, fundamental principles and applications of TGA, DTA and DSC.

Unit IV - Nanochemistry: Introduction to nanochemsitry, synthesis, characteristics and applications of carbon nanostructures fullerenes, carbon nanotubes and graphene.

Unit V - Fuels and Non-Conventional Energy Sources: Introduction, classification, solid, liquid and gas fuel; Nuclear energy- Breeder reactor and light water nuclear reactor for power generation (Block diagram only), solar energy conservation and solar cells; Fuel Cells-Introduction, types and their characteristics, alternate fuels.

Unit VI - Corrosion and Its Control: Introduction, Types of corrosion – chemical and electrochemical, Mechanisms of corrosion, factors affecting corrosion and different protection techniques for corrosion control.

Unit VII - Lubricants: Introduction, Mechanisms of lubrication, Types and selection of lubricants, synthetic lubricants, properties and different methods for testing of lubricating oils and greases.

Text Books

1. Applied Chemistry- A textbook for engineers and technologist by H.D. Gesser.
2. Engineering Chemistry: by P C Jain & Monika Jain
3. A Text Book of Engineering Chemistry: by ShashiChawla.

References Book

1. Fundamental of organic spectroscopy by Y. R. Sharma
2. Introduction to spectroscopy by Pavia, Lampman, Kriz.
3. Science and Engineering of Materials by Askeland and Phule
4. Introduction to nanotechnology by C. P. Poole Jr. and F.J. Owens
5. Principles of polymerization by George Odian
6. Textbook of polymer science by F.W. Billmeyer Jr.

Course Code	EC-1203
Course Title	Professional Communication
Number of Credits	3-1-0-3
Type of Course	GIR

Course Contents

Unit I - The Process of Communication: Introduction. What is communication? Barriers to communication. Different types of communication. Written vs. oral communication. Different types of face-to-face interactions, characteristics and conventions of conversation, conversational problems of second foreign language users, difference between conversation and other speech events.

Unit II - Telephone Techniques: Speaking and listening, commonly used phrases in telephone conversations, reading: conference calls, vocabulary, writing and listening, leaving a message, grammar and usage: the perfect tense, pronunciation: contracted forms.

Unit III - Job Applications and Interviews: Reading, vocabulary, apply for a job, curriculum vitae, language focus: some useful words, study skills: preparing for an interview, listening, speaking, writing.

Unit IV - Group Discussions: Reading, writing skills, listening: how to be successful in a group discussion, study skills, language facts, vocabulary, speaking, grammar: connectives, pronunciation.

Unit V - 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.

Unit VI - Meetings: Reading: a successful meeting, 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 according to part of speech.

Unit VII - Taking Notes and Preparing Minutes: Speaking and listening, commonly used phrases in telephone conversations, reading: conference calls, vocabulary, writing and listening, leaving a message, grammar and usage: the perfect tense, pronunciation: contracted forms.

Unit VIII - Presentation Skills-I: Reading, presentation skills, grammar: verbs often required in presentations, language focus, listening: importance of body language in presentations, speaking: preparing an outline of a presentation, pronunciation.

Unit IX - Presentation Skills-II: Reading: structure of presentation, study skills: visual aids, ending the presentation, language focus: taking about increase and decrease grammar: prepositions. Listening: podium panic, speaking, pronunciation: emphasizing the important words in context.

Unit X - Negotiation Skills: Language focus, idiomatic expressions, study skills: process of negotiations, grammar: phrasal verbs, listening: effective negotiations, speaking, writing.

Reference Books

1. Effective technical communication by M. Ashraf rizviPub:tataMcGrow Hill (2009). 2. Developing communiction skills by krishnamohan Pub: Mac Millan India Limited (2009).
3. An approach to communiction skills by IndrajitBhatacharya Pub: DhanpatRai Co. Pvt. Ltd. New Delhi (2007).
4. Handbook of practiclcommu. Skills by Wright, Chrissie, Pub: jaico publishing house, mumbai (2007).
5. The skills of communicating by bill Scott. Pub: jaico publishing house, Mumbai (2009).

Course Code	EC-1204
Course Title	Basic Electrical Engineering
Number of Credits	3-1-0-3
Type of Course	GIR

Course Contents

Unit I - Electric Circuits: Introduction to linear and non-linear circuits, circuit elements, various sources and source transformation, star delta transformation, solution of D.C. circuits using Kirchoff's laws, signal wave forms and passive elements specifications, basic theorems, generation of A.C. sinusoidal voltage and currents, average and R.M.S. values, Form factor and peak factor, phasor representation, phasor in polar, rectangular and exponential forms, terminal relationship for pure passive elements and their combination in series and parallel. Analysis of single phase series, parallel and series-parallel circuits.Active and reactive power, p.f. and volt-amperes', frequency response and Q-factor.Analysis of balanced three phase a.c. circuits - Introductory concept, voltage, current and power in three phase balanced circuits.Introduction to Domestic Electric Wiring and Storage Batteries.

Unit II- Electromagnetic and Transformer: Magnetic circuit concept, B-H curves characteristics of magnetic materials, practical magnetic circuits, magnetic circuits with D.C. and A.C. excitation, hysteresis and eddy current losses. Magnetic force, self and mutual inductances, Faraday`s laws, Lenz`s Law, statically and dynamically induced EMFs, energy stored in magnetic fields. Principle of Transformer operation, construction & equivalent circuit of transformer.

Unit III - Measuring Instruments: Introduction to galvanometer (Moving coil and moving iron), ammeter, voltmeter, wattmeter, energy meter, use of shunt and multiplier.

Unit IV - Electrical Machines: Fundamentals of D.C. and A.C. machines. Single phase transformers, three phase transformers - connections, parallel operation, auto-transformer, energy conversion principles, DC machines - types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors, Induction motors - principles, types, performance characteristics, starting and speed control, Synchronous machines - performance, regulation, parallel operation of generators, motor starting, characteristics and applications, servo and stepper motors.

Text/Reference Books

1. Fundamentals of Electric Circuits by Charles K Alexander and Matthew N. O. Sadiku, TMH Publication, 2nd Edition, 2009.
2. Electrical Engineering Fundamentals by Vincent Del Toro, PHI Publication, Second Edition
3. Electrical Technology by H Cotton, CBS Publishers and Distributors,7th Edition, 2005
4. Basic Electrical Technology by A.E. Fitzgerald, McGraw Hill Publication.

Course Code	EC-1205
Course Title	Digital Electronics and Logic Design
Number of Credits	3-1-0-3
Type of Course	GIR

Course Contents

Unit I - Number System & Codes: Number systems and their inter-conversion, Binary Arithmetic (Addition, Subtraction, Multiplication and Division), Diminished radix and radix compliments, BCD codes, Excess-3 code, Gray code, Hamming code, error detection and correction.

Unit II- Logic Gates & Logic Families: Digital Logic Gates, Various Logic Families like RTL, DTL, TTL and ECL, I2L, working and their characteristics, MOS and CMOS devices, TTL CMOS Interfacing, IEEE/ANSI representation of Logic Families.

Unit III - Combinational Logic Design: Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Boolean Functions, Canonical and Standard forms-map method, Two, Three, Four and Five variable maps, Sum of products and Product of Sums Simplification, NAND and NOR implementation, incompletely specified functions, Ex-OR functions, The tabulation method, Determination of Prime implicants, Selection of Essential Prime implicants.

Unit IV - MSI and PLD Components: Binary adder and subtractor, Multiplexers, Decoders/Demultiplexers, Read Only Memory, Programmable Logic Arrays, Programmable Array Logic, Implementation of Combinatorial Logic using these devices.

Unit V - Sequential Logic Design: Introduction, S-R Flip-flops, JK flip-flop, D flip-flop, T flip-flop, master slave flip-flop. Flipflop excitation table, Interconversion of flip-flop, Classification of sequential circuits, Register and Counter circuits. A to D and D to A converter circuits, Sequence Generator using direct and indirect method.

Text Books

1. Digital Design: M. Morris Mano, Prentice Hall of India.
2. Modern Digital Electronic: R.P.Jain (TMH).

Reference Books

1. Digital Principle and Applications Malvino and Leach- (TMH).
2. Modern Digital Systems Design: Cheung (WPC).
3. Fundamentals of Digital Electronics: Anand Kumar (PHI).

Course Code	EC-1210
Course Title	Introduction to Computational Tools and Practices
Number of Credits	1-0-3-3
Type of Course	GIR

Course Contents

Unit I –Interface, Variables, and Data Types: Introduction to MATLAB, creating variables, some useful functions, data types, script files, exercises.

Unit II - Plotting: Introduction to Arrays, graphing, plotting, sub-plotting, legends, labels, titles, color description, exercises.

Unit III – Statements: Input and Output statements, conditional statements: logical operators, if, else, and elseif, conditional structure: switch, exercises.

Unit IV - Loops: Introduction to loops, for loops, while loops, nested loops and the break statement, exercises.

Unit V - Arrays: arrays, array function. Introduction to Simulink, exercises.

Text Books

1. MATLAB: A Practical Introduction to Programming and Problem Solving, 3rd edition, Stormy Attaway, Elsevier, 2013.

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 *re* 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*", 7th edition, Oxford University Press, 2017.
2. Boylestad, R. L. and Nashelsky, L., "*Electronic Devices and Circuits theory*", 11th edition, Pearson Education, 2015.

Reference Book

1. Milliman, J., Halkias, C., and Jit, S., "*Electronics Devices and Circuits*", 2nd 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 gm, rd and μ 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.

Course Code	ECC302
Course Title	Signals and Systems
Number of Credits	3-1-4-6
Type of Course	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,"* 2nd edition, Pearson Education, 2015.
2. Lathi, B. P., *"Principles of Linear Systems and Signals,"* 2nd edition, Oxford, 2009.

Reference Books

1. Haykin, S., *"Signals and Systems,"* 2nd 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.

Course Code	ECC303
Course Title	Electromagnetic Field Theory
Number of Credits	3-0-0-3
Type of Course	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 scaler 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*", 2nd edition, Wiley, 2012.
2. Hayt, W. and Buck, J. A., and Akhtar, M. J., "*Engineering Electromagnetics*", 8th 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.

Course Code	ECC304
Course Title	Communication Systems
Number of Credits	3-1-4-6
Type of Course	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*" 5th edition, Wiley, 2018.
2. Sklar, B., "*Digital Communication - Fundamentals and Applications*", 2nd edition, Prentice-Hall India, 2017.

Reference Books

1. Tomasi, W., "*Advanced Electronic Communications systems*" 6th edition, Pearson Publishers, 2015.
2. Proakis, J. G., "*Digital Communications*", 5th 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.

Course Code	ECC305
Course Title	Electrical Circuits and Networks
Number of Credits	3-0-4-5
Type of Course	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, Indefinites 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*", 3rd edition, Pearson Education, 2015.
2. Hayt, W. H. and Kemmerly, J, "*Engineering Circuit Analysis*", 8th edition, McGraw-Hill Educatuion, 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 Tellegin'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 circuital 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.

FOURTH SEMESTER

Course Code	ECC401
Course Title	Microwave Engineering
Number of Credits	3-0-4-5
Type of Course	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", 4th edition, Wiley, 2013.
2. Das, A. and Das, S. K., "*Microwave Engineering*", 3rd edition, McGraw Hill Education, 2017.

Reference Book

1. Collin, R. E., "*Foundations for Microwave Engineering*", 2nd edition, Wiley, 2007.
2. Liao. S. Y., "*Microwave Device And Circuits*", 3rd 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.

Course Code	ECC402
Course Title	Control Systems
Number of Credits	3-0-4-5
Type of Course	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*", 6th edition, New Age International, 2018.
2. K. Ogata, "*Discrete-Time Control Systems*", 2nd edition, Prentice-Hall India, 2015.

Reference Book

1. Warwick, K., "*An Introduction to Control Systems*", 2nd 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"*, 4th edition, Pearson Education, 2002.
2. Control System Laboratory Manual, Department of Electronics and Communication Engineering, Indian Institute of Information Technology, Una (2019).

Course Code	ECC403
Course Title	Microprocessors and Microcontrollers
Number of Credits	3-1-4-6
Type of Course	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*", 2nd edition, Prentice Hall of India, 2011.
2. Mazidi, M. A., Mazidi, J. G., and McKinlay, R. D., *"The 8051 Microcontroller and Embedded systems*", 2nd edition, Pearson Education, 2011.

Reference Books

1. Brey, B. B., "*Intel Microprocessors*", 8th edition, Pearson Education, 2013.
2. Davies, J. H., "*MSP430 Microcontroller Basics*", 1st 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

Course Code	ECC404
Course Title	Electronic Instrumentation and Measurements
Number of Credits	3-0-0-3
Type of Course	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*", 6th edition, McGraw Hill Education, 2017.
2. Helfrick, A. D. and Cooper, W. D., "*Modern Electronic Instrumentation and Measurement Techniques*", 1st edition, Pearson Education, 2015.

Reference Book

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

FIFTH SEMESTER

Course Code	ENL501
Course Title	Professional Communication and Soft Skills
Number of Credits	0-0-4-2
Type of Course	GIR

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

Course Code	ECL601
Course Title	Internship
Number of Credits	0-0-0-0
Type of Course	GIR

SEVENTH SEMESTER

Course Code	HMC701
Course Title	Professional Ethics
Number of Credits	1-0-0-0
Type of Course	GIR

Course Objectives

- To enable the students to create on 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.

Course Code	ECC702
Course Title	Verilog based Design
Number of Credits	1-0-4-3
Type of Course	GIR

Course Objectives

- To introduce basic Concepts of Verilog HDL like Data Types, System Tasks and Compiler Directives.
- To explain the importance of Logic Synthesis in IC design and its design flow.

Course Contents

Unit I - Introduction to Verilog HDL: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Function Verification, Systems tasks, programming language interface, Module, Simulation and Synthesis tools. Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic values, Strengths, Data types, Scalars and Vectors, Parameters, Operators.

Unit II - Gate Level Modeling: Introduction, AND Gate Primitive, Module, Structure, Other Gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances of Primitives, Design of Flip – Flops with Gate Primitives, Delays, Strengths and Construction Resolution, Net Types, Design of Basic Circuit. Modeling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments Assignment to Vectors, Operators.

Unit III - Behavioral Modeling: Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Assignments with Delays, Wait Construct, Multiple Always Block, Designs at Behavioral Level, Blocking and Non-Blocking Assignments, The Case Statement, Simulation Flow if an if-Else Constructs, Assign- De-Assign Construct, Repeat Construct, for Loop, the Disable Construct, While Loop, For Ever Loop, Parallel Blocks, Force Release, Construct, Event.

Unit IV - Switch Level Modeling: Basic Transistor Switches, CMOS Switches, Bi Directional Gates, Time Delays with Switch Primitives, Instantiation with Strengths and Delays, Strength Contention with Trireg Nets. System Tasks, Functions and Compiler Directives: Parameters, Path Delays, Module Parameters, System Tasks, Functions, File Based Tasks, Computer Directives, Hierarchical Access, User Defined Primitives.

Unit V - Sequential Circuit Description: Sequential Models – Feedback Model, Capacitive Model, Implicit Model, Basic Memory Components, Functional Register, Static Machine Coding, Sequential Synthesis. Component Test and Verification: Test Bench-Combinational Circuit Testing, Sequential Circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification.

Course Outcomes

- Able to apply the simulation and implementation of digital circuits.
- Able to apply design of digital circuits using different modeling styles.

Text Books

1. Padmanabhan, T. R. and Sundari, B. T., "*Design Through Verilog HDL*", 1st edition, Wiley-Blackwell, 2003.
2. Bhasker, J., "*A VHDL Primer*", 3rd edition, Prentice Hall India, 2015.

References Books

1. Brown, S. and Vranesic, Z., "*Fundamentals of Digital Logic with Verilog Design*", 2nd edition, McGraw Hill Education, 2017.
2. Mano, M. M. and Ciletti, M. D., "Digital Design: With an Introduction to the Verilog HDL, VHDL and System Verilog", Pearson Education, 6th edition, 2018.

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*", 4th edition, Pearson education, 2014.
2. Oppenheim, A. V. and Schafer, R. W., "*Discrete-Time Signal Processing*", 3rd edition, Pearson Education, 2014.

Reference Books

1. Tan, L. and Jiang, J., "*Digital Signal Processing: Fundamentals and Applications*", 2nd edition, Academic Press, 2013.
2. Mitra, S. K., "*Digital Signal Processing: A computer based approach*", 4th 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 α 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

Course Code	ECPE12
Course Title	Artificial Neural Networks and Optimization
Number of Credits	3-0-4-5
Type of Course	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*", 2nd edition, Martin Hagan, 2014.
2. Freeman, J.A. and Skapura, D. M., "*Neural networks: Algorithms, Applications and Programming Techniques*", 1st edition, Pearson Education, 2002.

Reference Books

1. Yegnanarayana, B., "*Artificial Neural Networks*", Prentice Hall India, 2015.
2. Kumar, S., "*Neural Networks – A classroom approach*", 2nd 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"*, 4th 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"*, 1st 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.

Course Code	ECPE22
Course Title	Linear Integrated Circuits
Number of Credits	3-0-4-5
Type of Course	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*", 4th edition, McGraw-Hill education, 2016.
2. Gayakwad, R. A., "*OP-AMP and Linear Integrated Circuits*", 4th edition, Pearson Education, 2015.

Reference Book

1. Choudhry, D. R. and Jain, S. B., "*Linear Integrated Circuits*", 5th 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

Course Code	ECPE31
Course Title	Fiber Optic Communication-I
Number of Credits	3-0-0-3
Type of Course	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*", 3rd edition, Pearson Education, 2010.
2. Keiser, G., "*Optical Fiber Communications*", 5th 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.

Course Code	ECPE32
Course Title	Low Power VLSI
Number of Credits	3-0-0-3
Type of Course	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",* 5th edition, McGraw Hill, 2017.
2. Agrawal, G. P., "*Fiber Optic Communication Systems*", 3rd edition, Wiley, 2007.

Reference Books

1. Liu, M. M. K., "*Principles and Applications of Optical Communications*", 1st edition, McGraw Hill, 2010.
2. Senior, J. M., "*Optical Fiber Communications: Principles and Practice*", 3rd 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.

Course Code	ECPE42
Course Title	Power Electronics
Number of Credits	3-0-4-5
Type of Course	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, 4th edition, Pearson Education, 2017.
2. Mohan, N., Undeland, T. M., and Robbins, W. P., "*Power Electronics: Converters Applications and Design"*, 3rd edition, Wiley, 2007.

Reference Books

1. Sen, P. C., "*Power Electronics"*, 2nd edition, McGraw Hill, 2017.
2. Moorthi**,** V. R., "*Power Electronics: Devices, Circuits and Industrial Applications"*, 1st 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 ofsinglephase cyclo-converter.
- Study the performance ofthree 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

Course Code	ECPE51
Course Title	Antenna and Wave Propagation
Number of Credits	3-0-0-3
Type of Course	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*", 4th edition, Wiley, 2016.
2. Collin, R. E., "*Antennas and Radiowave Propagation*", 4th edition, McGraw-Hill, 1985.

Reference Books

1. Krauss, J. D., "*Antennas For All Applications*", 3rd edition, McGraw-Hill, 2005.

Course Code	ECPE52
Course Title	Renewable and Sustainable Energy Systems
Number of Credits	3-0-0-3
Type of Course	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, φ–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*", 3rd edition, Oxford University Press, 2017.
2. Luo, F. L. and Ye, H., "*Renewable Energy Systems: Advanced Conversion Technologies and Applications"*, 1st 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"*, 1st edition, Wiley-Blackwell, 2011.
3. Khan, B. H., "*Non-Conventional Energy Resources*", 3rd edition, Tata McGraw-Hill Education, 2017.

Program Elective-VI

Course Code	ECPE61
Course Title	Data Communication and Networks
Number of Credits	3-0-0-3
Type of Course	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: ErrorDetection 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*", 5th edition, McGraw Hill Education, 2017.
2. Tanenbaum, A. S. and Wetherall, D. J., "*Computer Networks*", 5th edition, Pearson Education, 2013.

Reference Book

1. Stallings, W., "*Data and Computer Communication*", 10th edition, Pearson Education, 2017.

Course Code	ECPE62
Course Title	Radar Communication
Number of Credits	3-0-0-3
Type of Course	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 Fitter with Nonwhite Noise.**Radar Receivers:** Noise Figure and Noise Temperature. Displays — types.Duplexers — Branch type and Balanced type.Circulators as Duptexers. 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*", 3rd edition, Mcgraw Hill, 2017.

Reference Books

1. Edde, B., "*Radar – principles, technology, applications*", 1st edition, Pearson, 2003.
2. Richards, M. A., Scheer, J. A., and Holm, W. A., "*Principles of Modem Radar: Basic Principles*", 1st edition, Scitech Publishing, 2013.

STREAM – I

APPLICATIONS

(Offered by Department of IT)

Course Code	ITSE11
Course Title	Mobile Applications Development
Number of Credits	3-0-0-3
Course Type	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*", 4th edition, Wrox, 2018.
2. Matt, G., "*PhoneGap Mobile Application Development Cookbook*", Packt Publishing, 2012.

References

1. Kosmaczewski, A., "*Mobile JavaScript Application Development*", 1st edition, O'Reilly Media, 2012.

Course Code	ITSE12
Course Title	Cloud Computing
Number of Credits	3-0-0-3
Course Type	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*", 1st edition, Wiley Publication, 2011.
2. Velte, T., Velte, A., and Elsenpeter, R. C., "*Cloud Computing: A Practical Approach*", 1st edition, McGraw Hill, 2009.

Reference Books

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

Course Code	ITSE13
Course Title	Internet of Things
Number of Credits	3-0-0-3
Course Type	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*", 1st edition, CRC Press, 2013.

Reference Book

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

Course Code	ITSE14
Course Title	Big Data Analytics
Number of Credits	3-0-0-3
Type of Course	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, NaïveBayes 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 withNoSQL databases and management.

Text Books

1. Loshin, D.,*"Big Data Analytics: From Strategic Planning to Enterprise IntegrationWith Tools, Techniques, NoSQL, and Graph",* Morgan Kaufmann / Elsevier Publishers,2013.
2. Anand, R. and David, U. J., *"Mining of MassiveDatasets"*, 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.

Course Code	ITSE15
Course Title	Computer Vision
Number of Credits	3-0-0-3
Type of Course	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"*, 2nd 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)

Course Code	CSSE11
Course Title	Natural Language Processing
Number of Credits	3-0-0-3
Course Type	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*", 2nd 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*", 2nd edition, Pearson Education, 2002.
2. Charniack, E., "*Statistical Language Learning*", MIT Press, 1996.

Course Code	CSSE12
Course Title	Artificial Intelligence
Number of Credits	3-0-0-3
Course Type	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, 1st Edition, 2017.

Course Code	CSSE13
Course Title	Soft Computing
Number of Credits	3-0-0-3
Course Type	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*", 2nd edition, Wiley, 2011.
2. Ross, T. J., "*Fuzzy Logic with Engineering Applications*", Wiley India, 3rd edition, 2011.

Reference Books

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

Course Code	CSSE14
Course Title	Machine Learning
Number of Credits	3-0-0-3
Course Type	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"*, 1st edition, McGraw-Hill, 2017.

Reference Books

1. Alpaydin, E., *"Introduction to Machine Learning",* 3rd edition, PHI, 2015.
2. Witten, I. H., Frank, E., Hall, M. A., and Pal, C. J., *"Data Mining: Practical Machine Learning Tools and Techniques"*, 4th 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, 2nd Edition November, 2000.

Course Code	CSSE15
Course Title	Deep Learning
Number of Credits	3-0-0-3
Course Type	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: VariationalAutoencoders, 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",* 2nd edition, Springer, 2010.

STREAM – III

DATABASE AND NETWORKING

(Offered by Department of CSE)

Course Code	CSSE21
Course Title	Relational Database Management Systems
Number of Credits	3-0-0-3
Type of Course	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 interference 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*", 7th edition, Pearson Education, 2017.
2. Dabir, H. and Meher, D., "*Advanced RDBMS Using Oracle*", 2nd edition, Vision Publications, 2014.

Reference Book

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

Course Code	CSSE22
Course Title	Advanced Database Management Systems
Number of Credits	3-0-0-3
Type of Course	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",* 5th Edition, Addison-Wesley, 2014.

Reference Books

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

Course Code	CSSE23
Course Title	Database Security
Number of Credits	3-0-0-3
Type of Course	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

Course Code	CSSE24
Course Title	Mobile Computing and Communication
Number of Credits	3-0-0-3
Type of Course	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.

Course Code	CSSE25
Course Title	Wireless Sensor Networks
Number of Credits	3-0-0-3
Type of Course	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)

Course Code	ITSE21
Course Title	Information Security
Number of Credits	3-0-0-3
Type of Course	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.

Course Code	ITSE22
Course Title	Principles of Cryptography
Number of Credits	3-0-0-3
Type of Course	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*", 7th edition, Pearson Education, 2017.

Reference Book

1. Forouzan, B. A. and Mukhopadhyay, D., "*Cryptography and Network Security*", 3rd edition, McGraw Hill, 2015.

Course Code	ITSE23
Course Title	Network Security
Number of Credits	3-0-0-3
Type of Course	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",* 4th edition, Pearson Education, 2018.
2. Stallings, W., *"Cryptography and Network Security: Principles and Practice"*, 7th edition, Pearson Education, 2017.

Reference Books

1. Kahate, A., *"Cryptography and Network Security"*, 3rd edition, McGraw-Hill Education, 2013.

Course Code	ITSE24
Course Title	Applied Cryptography
Number of Credits	3-0-0-3
Type of Course	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 Communicatrions 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.

Course Code	ITSE25
Course Title	Cyber-Physical Systems
Number of Credits	3-0-0-3
Type of Course	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",* 1st edition, Pearson Education, Nov 2017.

STREAM – V

SIGNAL PROCESSING AND COMMUNICATION

(Offered by Department of ECE)

Course Code	ECSE11
Course Title	Information Theory and Coding
Number of Credits	3-0-0-3
Type of Course	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, Justeen 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*", 1st edition, Pearson Education, 2013.
2. Bose, R., "*Information Theory, Coding and Cryptography*", 3rd edition, Mc-Graw Hill Education, 2017.

Reference Books

1. Cover, T. M. and Thomas, J. A., "*Elements of Information Theory*", 2nd edition, Wiley, 2013.
2. Jones, G. A., "*Information and Coding Theory*", Springer, 2004.

Course Code	ECSE12
Course Title	Digital Speech Processing
Number of Credits	3-0-0-3
Type of Course	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*", 1st edition, Pearson Education, 2010.
2. Rabiner, L. R.,Juang, B. H., and Yegnararayana, B.,"*Fundamentals of Speech Recognition*", 1st edition, Pearson Education, 2008.

Reference Book

1. Jurafsky, D. and Martin, J. H., "*Speech and Language Processing*", 2nd edition, Pearson Education, 2013.

Course Code	ECSE13
Course Title	Wireless Communication
Number of Credits	3-0-0-3
Type of Course	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*", 2nd edition, Pearson, 2010.

Reference Books

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

Course Code	ECSE14
Course Title	Biomedical Signal Processing
Number of Credits	3-0-0-3
Type of Course	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-occulogram, 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*", 2nd 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*", 3rd edition, CRC press, 2014.

Course Code	ECSE15
Course Title	Satellite Communication
Number of Credits	3-0-0-3
Type of Course	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, Carrierto-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*", 4th edition, McGraw Hill Education, 2017.
2. Pratt, T., Bostian, C., and Allnutt, J., "*Satellite Communication*", 2nd edition, Wiley, 2006.

Reference Books

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

STREAM – VI

VLSI AND ELECTRONIC SYSTEMS

(Offered by Department of ECE)

Course Code	ECSE21
Course Title	Digital VLSI Design
Number of Credits	3-0-0-3
Type of Course	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"*, 4th edition, McGraw Hill Education, 2016.
2. Rabaey, J. M., Chandrakasan, A., and Nikolic, B., "*Digital Integrated Circuits: A Design Perspective"*, 2nd edition, Pearson Education, 2016.

Reference Books

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

Course Code	ECSE22
Course Title	Embedded Systems
Number of Credits	3-0-0-3
Type of Course	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*", 3rd edition, Elsevier, 2013.
2. Krishna, C. M. and Shin, K. G., "*Real-Time Systems*", 1st edition, McGraw Hill Education, 2017.

Reference Books

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

Course Code	ECSE23
Course Title	MEMS and Sensor Design
Number of Credits	3-0-0-3
Type of Course	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-maching, Photolithography, Micro-stero lithography, Thin film deposition, Impurity doping, Diffusion, Etching, Bulk and surface micro-maching, 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, Megneto-transitors, 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*", 1st edition, Springer, 2013.

Reference Book

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

Course Code	ECSE24
Course Title	Introduction to Robotics
Number of Credits	3-0-0-3
Type of Course	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*", 3rd edition, Pearson Education, 2008.
2. Lynch, K. M. and Park, F. C., "*Modern Robotics: Mechanics, Planning, and Control"*, 1st 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.

Course Code	ECSE25
Course Title	Introduction to Nano-electronics
Number of Credits	3-0-0-3
Type of Course	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*", 2nd edition, World Scientific, 2018.
2. Ranier, W., "*Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices*", 3rd edition, Wiley, 2012.

Reference Book

1. Hanson, G. W., "*Fundamentals of Nanoelectronics*", 1st edition, Pearson Education, 2009.

MANAGEMENT ELECTIVES

Course Code	HME861
Course Title	Organizational Behaviour
Number of Credits	3-0-0-3
Type of Course	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"*, 12th edition, McGraw Hill, 2017.
2. Robins, S. P., Judge, T. A., and Vohra, N., "*Organizational Behavior"*, 16th edition, Pearson Education, 2016.

Reference Book

1. Pareek, U. and Khanna, S., "*Understanding Organizational Behavior"*, 4th edition, Oxford, 2016.

Course Code	HME862
Course Title	Entrepreneurship Development
Number of Credits	3-0-0-3
Type of Course	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., "*Entreprenuership – Theory, Process and Practice*", 9th Edition, Cengage Learning, 2014.

Course Code	HME863
Course Title	E-Commerce and Digital Marketing
Number of Credits	3-0-0-3
Type of Course	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",* Cencage learning publishers*,* 10th edition*,* 2012.
2. Chan, H., Lee, R., Dillon, T., and Chang, E., "*E-Commerce Fundamentals and Applications",* Wiley, 1st 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, 1st edition, 2002.

Course Code	HME864
Course Title	Usability Analysis
Number of Credits	3-0-0-3
Type of Course	GIR

Syllabus to be designed

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 IIITU 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) IIITU Alumni

Date: ____/____/____

Name of the Company/ Institution:_____

Name of the B. Tech. (ECE) IIITU 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 IIITU 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	BREAK	Period-III 10:30 AM- 11:20 AM	Period-IV 11:20 AM- 12:10 PM	BREAK	Period-V 13:30 PM- 14:20 PM	Period-VI 14:20 PM- 15:10 PM	BREAK	Period-VII 15:20 PM- 16:10 PM	Period-VIII 16:10 PM- 17:00 PM
Mon											
Tue											
Wed											
Thu											
Fri											

Indian Institute of Information Technology, Una [HP]

An Institute of National Importance under MHRD

Contact No.: 01972-254077 **Website:**www.iiitu.ac.in

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: ____/____/____

StudentName: _____

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**