DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING:

TIRUPATI-517502

R-20 – Scheme of Instructions effective from the academic year 2020 – 2021

Programme Scheme

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)

SRI VENKATESWARA UNIVERSITY

TIRUPATI-517502 (A.P), INDIA.

Vision of the Department:

To be a lead department imparting quality and value embedded higher education and research emphasizing freedom of learning and practice.

Mission of the Department:

1. Transforming students into full-fledged professionals and to become leaders in dynamic global environment.
2. Augmenting knowledge and technologies in rapidly advancing fields of Electronics and Communication Engineering.
3. Promoting in depth research and create centre of excellence in thrust areas.

PROGRAM OUTCOMES

1. PO1- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems related to Electronics & Communication and Engineering.
2. PO2- **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems related to Electronics & Communication Engineering and reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. PO3- **Design/development of solutions:** Design solutions for complex engineering problems related to Electronics & Communication Engineering and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. PO4- **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. PO5- **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. PO6- **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Electronics & Communication Engineering professional engineering practice.
7. PO7- **Environment and sustainability:** Understand the impact of the Electronics & Communication Engineering professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. PO8- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. PO9- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. PO10- **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design

documentation, make effective presentations, and give and receive clear instructions.

11. PO11- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to manage projects and in multidisciplinary environments.
12. PO12- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program specific outcomes (PSOs)

1. PSO1- Competence in analysis and design of analog and digital system using hardware and software tools.
2. PSO2- Understand, analyse the present and future generations of wireless communication technologies.

Programme Educational Objectives (PEOs)

ECE graduates will

1. PEO 1- have adequate analytical capabilities and practical knowledge to attend to the current challenging tasks and to absorb futuristic trends.
2. PEO 2- have adequate analytical capabilities and practical knowledge to attend to the current challenging tasks and to absorb futuristic trends.
3. PEO 3- able to abreast with the latest hardware and software design techniques and cutting-edge technologies.
4. PEO 4- able to enhance the knowledge and skills continually throughout their career and to make them capable to adapt in diverse environments.
5. PEO 5- imbibe leadership qualities among the students to take up challenging roles in their career by ensuring professional ethics with high sense of social responsibility.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
R-20 – Scheme of Instruction effective from the academic year 2020-2021
B. Tech (Electronics and Communications Engineering)

Semester III (Second Year)

S. No.	Course Code	Category	Course Title	Hours/Week			Credits	Scheme of Evaluation Marks		Total Marks
				L	T	P		Internal	End Sem	
1	MA301B	BSC	Mathematics-III	3	0	0	3	40	60	100
2	EC302C	PCC	Network Theory	3	0	0	3	40	60	100
3	EC303C	PCC	Signals and Systems	3	0	0	3	40	60	100
4	EC304C	PCC	Electromagnetic Waves and Transmission Lines	3	0	0	3	40	60	100
5	EC305C	PCC	Digital Logic Design	3	0	0	3	40	60	100
6	EC306C	PCC	Analog Circuits	3	0	0	3	40	60	100
7	EC307L	PCC-Lab	Basic Electrical Engineering lab	0	0	3	1.5	40	60	100
8	EC308L	PCC-Lab	Electronic Devices lab	0	0	3	1.5	40	60	100
9	EC309S	SC	Entrepreneurship and Design Thinking	2	0	0	2	100	--	100
10	MC310A	MC	Constitution of India	2	0	0	0	100	--	100
11	EC311L	PCC-Lab	Simulation Lab	0	0	2	1	100	---	100
Total Credits				**22**	**0**	**8**	**24**	**620**	**480**	**1100**

Category	**CREDITS**
Basic Science Course	03
Professional Core Course -PCC	19
Skill Oriented Course-SC	02
TOTAL CREDITS	**24**

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
R-20 – Scheme of Instruction effective from the academic year 2020-2021
B. Tech (Electronics and Communication Engineering)
Semester IV (Second Year)

S. No.	Course Code	Category	Course Title	Hours/Week			Credits	Scheme of Evaluation Marks		Total Marks
				L	T	P		Internal	End Sem	
1	EC401C	ESC	Linear Control Systems	3	0	0	3	40	60	100
2	EC402C	PCC	Probability theory and Stochastic Process	3	0	0	3	40	60	100
3	HS403C	HSS	Managerial Economics and Accountancy	3	0	0	3	40	60	100
4	EC404C	PCC	IC Applications	3	0	0	3	40	60	100
5	EC405C	PCC	Analog Communications	3	0	0	3	40	60	100
6	EC406L	PCC-Lab	Digital Logic Design lab	0	0	3	1.5	40	60	100
7	EC407L	PCC-Lab	Analog Circuits Lab	0	0	3	1.5	40	60	100
8	EC408L	PCC-Lab	IC Applications Lab	0	0	3	1.5	40	60	100
9	EC409S	SC	Python Programming	1	0	2	2	100	---	100
10		MC	NSS/ NCC/ NSO Activities	0	0	0	-	-	-	-
			Total Credits	**16**	**0**	**11**	**21.5**	**420**	**480**	**900**

Category	CREDITS
Professional Core Course -PCC	13.5
Engineering Science course—ESC	03
Humanities and Social sciences-HSS	03
Skill Oriented Course-SC	02
TOTAL CREDITS	**21.5**

All undergraduate students shall register for NCC/NSS/NSO activities in First semester of B.Tech. A student will be required to participate in an activity for two hours in a week during second and third semesters i.e., 60 hours. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet on the basis of participation, attendance, performance and behaviour. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements**.**

B.Tech. (R20) Program Electives				
I	**II**	**III**	**IV**	**V**
(VI-Semester)	**(VI-Semester)**	**(VII-Semester)**	**(VII-Semester)**	**(VII-Semester)**
CMOS VLSI Design	Cyber Security	Neural Networks and Fuzzy Logic	Satellite Communication	Embedded System Design
Information Theory and Coding	Nano Electronics	Radar Engineering	Fiber Optic Communication	Real Time Operating Systems
Optimization Techniques	Sensors and Transducers	Testing and Testability	Wireless Communication	FPGA Based System Design
Hardware-Software Co-design	Electronic Instrumentation	Bio-Medical Instrumentation	MEMS	Digital Signal Processors & Architectures

Courses offered for Honors degree

S.No.	Course Code	Course Title	Prerequisite if any	Contact Hours per week		Credits
				L	T	
Any 4(Four)From the Following 6(Six) Courses						
1	ECHN01	Advanced Digital Signal Processing	Digital Signal Processing	3	1	4
2	ECHN02	Antennas and Radiating Systems	Antenna and Wave Propagation	3	1	4
3	ECHN03	Wireless and Mobile Communications	Digital Communications	3	1	4
4	ECHN04	Voice and Data Networks	NIL	3	1	4
5	ECHN05	Advanced Communication Networks	Computer Networks	3	1	4
6	ECHN06	Pattern recognition and Machine Learning	Digital Image & Video Processing	3	1	4
Two courses to be pursued through MOOCS with duration of 8 weeks each.						
7	ECHN07	Remote Sensing				2
8	ECHN08	Optical Networks				2
9	ECHNO9	Cloud Computing				2
	Total Credits					**20**

Courses offered for Minors in Electronics

S. No	Course Code	Course Title	Prerequisite if any	Contact Hours per week			Credits
				L	T	P	
Any 4(Four)From the Following 6(Six) Courses							
1.	ECMN01 (EC 104)	Electronic Devices	NIL	3	1	0	4
2.	ECMN02 (EC305C)	Digital Logic Design	NIL	3	1	0	4
3.	ECMN03 (EC306C)	Analog Circuits	Electronic Devices	3	1	0	4
4	ECMN04(EC404C)	IC Applications	Analog Circuits	3	1	0	4
5	ECMN05 (EC604C-Program Elective-II)	Electronic Instrumentation	Electronic Devices	3	1	0	4
6	ECMN06 (EC603C --Program Elective-I)	CMOS VLSI Design	1.Electronic Devices 2.Analog Circuits	3	1	0	4
Two courses to be pursued through MOOCS with a duration of 8 weeks							
7	ECMN07	Internet of Things and Applications					2
8	ECMN08	Sensors and Transducers					2
9	ECMN09	Micro-electromechanical Systems (MEMS)					2
10	ECMN10	Microprocessors and Micro Controllers					2
	Total Credits						20

Courses offered for Minors in Communications

S.No	Course Code	Course Title Offered in Semester	Prerequisite if any	Contact Hours per week			Credits
				L	T	P	
Any 4(Four)From the Following 7(Seven) Courses							
1.	ECMN11 (EC303C)	Signals & Systems	1.Mathematics-I 2.Mathematics-II	3	1	0	4
2.	ECMN12 (EC402C)	Probability theory & Stochastic Process	1.Mathematics-I 2.Mathematics-II	3	1	0	4
3.	ECMN13 (EC405C)	Analog Communications	NIL	3	1	0	4
4.	ECMN14 (EC505C)	Digital Communications	1. Signals & Systems 2. Probability theory & Stochastic Process	3	1	0	4
5.	ECMN15 (EC504C)	Antenna Wave Propagation	Electromagnetic Waves and Transmission Lines	3	1	0	4
6.	ECMN16 (EC601C)	Microwave Engineering	Antenna Wave Propagation	3	1	0	4
7.	ECMN17 (EC602C)	Computer Networks	NIL	3	1	0	4
8.	ECMN18 (EC604C- Program Elective-II)	Cyber Security	NIL	3	1	0	4

Two courses to be pursued through MOOCS with duration of 8 weeks							
9.	ECMN19	Satellite Communications					2
10.	ECMN20	Fiber optic Communications					2
11.	ECMN21	Mobile Communications					2
			Total Credits				20

MA301B-Mathematics – III

Instruction: Hours/Week: **3L:1T:0P** Credits**: 4**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT – I
Complex analysis - I: Analytical functions - Cauchy- Reimann equations – Construction of Analytic functions-Complex integration - Cauchy's theorem - Integral formula - Evaluation of integrals.

UNIT – II
Complex analysis - II**:** Taylor's and Laurents' series- Transformations- Conformal mapping - Bilineartransformations - Transformation of 1/z, z^2, sin z and cos z.

UNIT – III
Complex anaylasis –III: Singularities - Poles - Residues - Residue theorem – Contour integration- Evaluationof real integrals

UNIT – IV
Partial differential equations - I : Formation of differential equations - Classification - First order linear partialdifferential equations – Legranges' linear equation - Method of multipliers - first order non-linear partial differential equations - Charpits method.

UNIT- V
Partial differential equations - II: Method of separation of variables - One dimensional wave equation - Heatequation – Laplace's equation.

Text/Reference Books:

1. Grewal B S, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. Venkataraman M K, Engineering Mathematics, Vol. I & II, National Publishing Company, 1993.
3. Venkataraman M K, Engineering Mathematics, National Publishing Company, 1995.
4. Grewal B S, Engineering Mathematics, 13th Edition, Khanna Publications.
5. Kreyszig E, Advanced Engineering Mathematics, 8th edition, Wiley, 1998.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO 1: After end of the course, students will be able to understand the analyticity of complex functions and conformal mappings. Apply Cauchy's integral formula and Cauchy's integral theorem to evaluate improper integrals along contours.
CO2: Describe conformal mappings between various plane regions. Apply the concepts of complex analysis in many branches of engineering including the branches of hydrodynamics, thermodynamics, and particularly quantum mechanics.
CO3: compute the residue of a function and use the Residue theory to evaluate a contour integrals or an integral over the real line.

CO4: Formulate Solve/Classify the solutions of partial differential equations Identify linear and nonlinear PDE and solve nonlinear PDE by Charpit;s method.
CO5: Apply variables separable methods to solve boundary value problems. Find the solutions of one-dimensional wave equation, heat equation and Laplace equation.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	-	1	2	1	1	1	3	-	-
CO2	2	1	2	1	1	-	1	2	1	1	1	3	-	-
CO3	2	1	2	1	1	-	1	2	1	1	1	3	-	-
CO4	3	1	3	1	1	-	1	1	1	1	1	3	-	-
CO5	3	2	3	3	1	-	1	2	2	2	2	3	-	-

EC302C-Network Theory

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT-I

Network Theorems: Superposition Theorem– Reciprocity theorem -Thevenin's and Norton's Theorems – Maximum Power Transfer Theorem- Millman's Theorem —Tellegen's Theorem – Compensation Theorem - Application of these Theorems for D.C. circuits and sinusoidal steady state A.C. circuits, Introduction to ThreePhase Circuits.

UNIT-II

Resonance: Series and Parallel Resonance – Resonant frequency, Half power frequencies, bandwidth and Quality Factor.

Locus diagrams: Current locus diagrams of RL and RC series circuits and two branch parallel circuits.

UNIT-III

Transient Analysis: Time domain analysis of RL, RC, and RLC circuits for D.C. and sinusoidal excitations – Determination of initial conditions – Concept of time constant –Laplace transforms of signals and periodic functions and initial and final value theorems – Transient response of RL, RC, and RLC circuits using LaplaceTransform techniques.

UNIT-IV

Network Functions: One-port and Two-port networks – Driving point and transfer functions of networks – Properties of driving point and transfer functions – Concept of complex frequency, poles and zeros – Time domain response from pole-zero diagram – Restrictions on pole-zero locations.

UNIT-V

Two-port Network Parameters: Open circuit impedance and short circuit admittance parameters – Hybrid andinverse-hybrid parameters – Transmission and inverse transmission parameters – Inter relationships between parameter sets – Series, Parallel, and Cascade connection of two-ports – Conditions for reciprocity and symmetry of two-port networks. Terminated two-port networks – Image parameters.

Text/Reference Books:

1. Sudhakar and Shyammohan: Circuits and Networks: Analysis and Synthesis, 5th Edition, Tata McGraw-Hill
2. Ravish R. Singh: Network Analysis and Synthesis, Tata Mc. Graw Hill.
3. Abhijit Chakrabarti: Circuit Theory Analysis and Synthesis, 7th Revised Edition, Dhanpat Rai & Co
4. M. E. Van Valkenburg; “Network analysis”; Pearson Education, Third Revised Edition.

Course Outcomes:
At the end of this course students will demonstrate the ability to

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
   Apply Laplace Transform for steady state and transient analysis. Determine different network functions.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	-	-	-	-	-	-	-	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2
CO3	2	2	3	2	-	-	-	-	-	-	-	2
CO4	2	2	2	2	-	-	-	-	-	-	-	2

EC303C-Signals and Systems
(Common to EEE, ECE and CSE)

Instruction: Hours/Week: **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT I

Introduction to Signals and Systems:

Definition and classification of signals and systems**,** Basic operations on signals, Elementary signals, Classification of Continuous-Time and Discrete-Time Systems, Basic System Properties, Linear Time- Invariant Systems - Discrete-Time LTI Systems, Convolution Sum, Continuous-Time LTI Systems Convolution Integral. Causal LTI Systems Described by Differential and Difference Equations.

Signal Analysis:

Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions.

UNIT II

Fourier series and Fourier Transform:

Fourier series Representation of Continuous-Time Periodic Signals, Dirichlet's conditions, Properties of Continuous-Time Fourier Series. Trigonometric Fourier Series and Exponential Fourier Series with examples,Complex Fourier spectrum.

Deriving Fourier Transform from Fourier series, Fourier Transform of standard signals, Fourier Transform ofPeriodic Signals, Properties of Continuous-Time Fourier Transform,
Magnitude-Phase responses, Parseval's theorem, Inverse Fourier transform.

Discrete-Time Fourier Transform – Properties, Inverse Discrete-time Fourier Transform. Introduction to Hilbert Transform.

UNIT III

Convolution and Correlation:

Continuous-time convolution, Convolution sum, Correlation between signals, Cross correlation, Autocorrelation, Properties, Energy spectral density, Power spectral density, Relation between convolution and correlation.

UNIT IV

Behavior of continuous time LTI systems:

Distortion less transmission through a system, signal bandwidth, system bandwidth, Ideal LPF, HPF and BPFcharacteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

Sampling:

Sampling Theorem, Reconstruction of a Signal from its Samples Using Interpolation, types of sampling-natural sampling, flat- top sampling and impulse sampling, Effect of under sampling - Aliasing.

UNIT V

System Analysis using Laplace and z -Transforms:

Laplace Transform - Region of Convergence – Relation between Laplace and Fourier Transform, Inverse Laplace Transform, Properties, Analysis and Characterization of LTI Systems Using Laplace Transform, Z- Transform -Region of Convergence - Properties, Inverse z-Transform, Analysis and Characterization of LTI Systems Using z-Transforms.

Reference Books:

1. Alan V. Oppenheim, Alan S. Willsky, & S. Hamid Nawab, "Signals and Systems," PearsonHigher Education, 2nd Ed., 1997.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, andApplications", Pearson, 2006.
3. Simon Haykin and B. Van Veen, "Signals & Systems," John Wiley and Sons, 2nd Edition, 2007.
4. B.P. Lathi, "Principles of LINEAR SYSTEMS and SIGNALS," Oxford Univ. Press, Second Edition,International version, 2009.
5. A. Anand Kumar, Signals & Systems, PHI, 2011.
6. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
7. Luis F. Chaparro, "Signals and Systems using MATLAB," Academic Press, 2011.
8. C. L. Philips, J. M. Parr and Eve A. Riskin, "Signals, Systems and Transforms," Pearson Education, 4th Edition, 2008.

Course Outcomes: At the end of this course students will have the ability to

1. Differentiate between various types of signals and understand the implication of operations ofsignals
2. Understand and classify systems based on the impulse response behavior of both continuous-timeand discrete-time systems
3. Perform domain transformation from time to frequency and understand the energy distribution as afunction of frequency and also usefulness of convolution for analyzing the LTI systems and understand the concepts of power spectral density through correlation.
4. Solve differential and difference equations with initial conditions using Laplace and Z- transforms.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	3
CO2	-	1	-	-	-	2	-	-	-	-	-	-
CO3	-	2	2	-	-	-	-	-	-	-	2	2
CO4	-	2	-	-	-	-	-	-	-	-	-	2

EC304C-ElectroMagnetic Waves and Transmission Lines

Instruction: (Hours/Week) **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT-I

Electrostatic Fields: Coulomb's law, Electric field intensity, Electric fields due to continuous charge distributions, Electric flux density, Gauss's law, Applications of Gauss's law, Electric scalar potential, Relation between E and V, Energy stored in electrostatic field, Electrostatic Boundary conditions, Capacitances.

UNIT-II

Magnetostatic fields: Biot-Savart's law, Magnetic field intensity, Magnetic fields due to continuous current distributions, Magnetic flux density, Ampere's circuital law, Applications of Ampere's circuital law, Magnetic vector potential, Relation between B and A, Energy stored in Magnetostatic field, Magnetostatic Boundary conditions, Inductances.

UNIT-III

Time-Varying EM Fields: Faraday's Law, Transformer EMF, Displacement current, Maxwell's Equationsin Point Form and in Integral Form, Phasor notation for fields, Maxwell's Equations in time harmonic form.**Introduction to waves:** Uniform plane wave, Wave equations, Derivation for **γ,** solutions for free space- conditions, Derivation for **α** and **β,** Derivation for ***η***,

UNIT-IV

EM waves in a homogeneous medium: Wave propagation in lossy dielectrics, Wave propagation in lossless dielectrics, Wave propagation in free space, Wave propagation in good conductors, Skin Depth, Skin Resistance, Polarization, Power, Poynting theorem and Poynting vector.
EM waves in a heterogeneous medium: Reflection of a plane wave at normal incidence: transmission coefficient, reflection coefficient, Reflection of a plane wave at oblique incidence: transmission coefficient,reflection coefficient and Brewster angle in both parallel and perpendicular polarizations.

UNIT-V

Transmission Lines: Transmission line parameters, Transmission line Equations, Input impedance,Reflection coefficient, VSWR and Power of Transmission line, Smith Chart.
Applications of transmission lines: Load matching measurement, Load impedance measurement.

Text/Reference Books:

1. Mathew N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", Oxford University Press
2. William H. Hayt, John A. Buck, "Engineering Electromagnetics", 8th Edition, McGraw-Hill, 2010.
3. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
4. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India Education, 2008
5. David K. Cheng, Field and Wave Electromagnetics, Pearson, second edition.

Course Outcomes: At the end of this course students will have the ability to

1. Solve electric field intensity and electric flux density in Electrostatic fields.
2. Solve magnetic field intensity and magnetic flux density in Magnetostatic fields.
3. Analyze Maxwell's equations in static fields, time varying fields, time harmonic fields and studyUniform plane wave characteristics.
4. Compute reflection coefficient and transmission coefficient of waves at media interface.
5. Understand characteristics of high frequency transmission lines and its applications.

Mapping of course outcomes with program outcomes:

PO/ CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	-	-	2	-	-	-	-	-	3
CO2	3	-	3	-	-	2	-	-	-	-	-	3
CO3	3	-	3	-	-	2	-	-	-	-	-	3
CO4	3	-	3	-	-	2	-	-	-	-	-	3
CO5	3	3	3	-	-	2	-	-	-	-	-	3

EC305C-Digital Logic Design

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT I
Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan'sTheorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, CodeConversion.

UNIT II
MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Halfand Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

UNIT III
Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM,Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudorandom Binary Sequence generator.

UNIT IV
Clock generation Logic Families and Semiconductor Memories: TTL NAND gate, Specifications,Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

UNIT V
VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Datatypes and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Text / Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd Edition,2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Course outcomes: At the end of this course students will demonstrate the ability to
1. Design and analyze combinational logic circuits.
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder.
3. Design & analyze synchronous sequential logic circuits.
4. Use HDL & appropriate EDA tools for digital logic design and simulation.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	1

EC306C-Analog Circuits	
Instruction: Hours/Week: **3L:0T:0P**	Credits: **3**
Sessional Marks: **40**	End Semester Examination Marks: **60**

UNIT-I

General Amplifiers Characteristics: Concept of Amplifier, Voltage gain, Current gain, Power gain, Input and Output resistances, Conversion efficiency, Frequency response, Bandwidth, Distortion,

BJT Amplifiers: Small signal low frequency model of the transistor, Analysis of CE, CB and CC amplifiers,Approximate model analysis, Effects of coupling and bypass capacitors on low frequency response, Hybrid-Π model at high frequencies, Calculation of High-Frequency parameters in terms of Low Frequency parameters, CE short circuit gain, CE current gain with resistive load.

UNIT-II

FET Amplifiers: Small signal model, Analysis of CS, CD and CG amplifiers, comparison of performance of the three configurations, High frequency FET circuits, CS amplifier at high frequencies, CD amplifier athigh frequencies.

Multistage Amplifiers: Types of coupling, Choice of amplifier configuration, overall voltage gain and Bandwidth of n-stage amplifier, Darlington and Bootstrap circuits.

UNIT-III

Feedback amplifiers: Feedback concept, Classification, Effects of negative feedback on gain, Stability, Noise, Distortion, Bandwidth, input resistance and output resistance.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Crystal oscillators.

UNIT-IV

Power Amplifiers: Series-Fed Class-A power amplifiers, Transformer coupled class-A power amplifiers, harmonic distortion, Push-pull amplifiers, Class-B amplifiers, Class-AB operation, Complementary symmetry Push-Pull class-B Power amplifiers, Cross-over distortion.

UNIT-V

Differential amplifier: Basic structure and principle of operation, calculation of differential gain, commonmode gain, CMRR, circuits to improve CMRR, transfer characteristics.

Operational Amplifier: Ideal op-amp characteristics, Op-amp internal circuit, examples of IC op-amps, DC and AC characteristics, Inverting and non-inverting modes of operation, voltage follower.

Text/Reference Books:

1. Millman and Halkias, “Integrated Electronics”, McGraw-Hill Co
2. Mottershed, “Electronic devices and circuits”, PHI
3. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
4. Salivahanan, “Electronic Devices and circuits”, TMH.
5. David A. Bell, “Electronic Devices and circuits”, PHI
6. D.Roy Choudary, Shail Bala Jain, “Linear Integrated circuits”, New Age International publishers, 2018

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Design and analyze various amplifier circuits.
2. Design sinusoidal oscillators.
3. Understand the functioning of OP-AMP and design OP-AMP based circuits.

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2

EC309S- Entrepreneurship and Design Thinking

Instruction: Hours/Week: **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT-I

Introduction to Entrepreneurship and Design Thinking

What is an idea, how to generate an idea, basic requirements to start an enterprise/start-up. Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

Activity: Form into groups and discuss about the requirements to start a business

UNIT-II

Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram/flow chart etc. Every student should explain about product development.

UNIT-III

Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT-IV

Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

UNIT-V

Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Textbooks:

1. Change by design, Tim Brown, Harper Bollins (2009)
2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.

Reference Books:

1. Design Thinking in the Classroom by David Lee, Ulysses press
2. Design the Future, by Shrrutin N Shetty, Norton Press
3. Universal principles of design- William lidwell, kritinaholden, Jill butter.
4. The era of open innovation – chesbrough.H

Course Outcomes: After completion of the course student will be able to:

1. Able to know the concepts related to Entrepreneurship & design thinking.
2. Explain the fundamentals of Design Thinking and innovation and will equip with design thinking techniques for solving problems in various sectors.
3. Analyse to work in a multidisciplinary environment and Evaluate the value of creativity
4. Formulate specific problem statements of real time issues

Mapping of course outcomes with program outcomes:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	2	3	1	1	3	3	-	1	-
CO2	3	3	3	2	3	1	3	3	3	-	3	-
CO3	2	2	2	3	3	1	1	3	3	-	2	-
CO4	-	2	2	2	3	1	2	3	3	-	1	-

MC310A Constitution of India

Instruction: Hours/Week: **2L:0T:0P** **Credits: 0**
Evaluation Scheme: 100 Marks

UNIT-I

History of Making of the Indian Constitution:
History Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution:
PreambleSalient Features

UNIT-II

- **Contours of Constitutional Rights & Duties:**
- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

UNIT-III

- **Organs of Governance:**
- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges,

QualificationsPowers and Functions

UNIT-IV

- **Local Administration:**
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of MunicipalCorporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

UNIT-V

- **Election Commission:**

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books/References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: At the end of this course students will demonstrate the ability to1 Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization ofsocial reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adultsuffrage in the Indian Constitution.Discuss the passage of the Hindu Code Bill of 1956.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	2	3		2	1	2	-	-
CO2	-	-	-	-	2	1	1	1	2	2	1	-
CO3	-	-	-	-	1	2	1	2	1	1	1	-

EC307L-Basic Electrical Engineering Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits: **1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

List of Experiments:

1. Basic safety precautions, Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope).
3. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
4. Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
5. Loading of a transformer: measurement of primary and secondary voltages and currents, andpower.
6. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging
   - slip ring arrangement) and single-phase induction machine.
8. Torque Speed Characteristic of separately excited dc motor.
9. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.
10. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
11. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the

use ofdc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Course Outcomes: After completion of the course student will be able to:

CO1: Get an exposure to common electrical components and their ratings.
CO2: Make electrical connections by wires of appropriate ratings.

CO3: Understand the usage of common electrical measuring instruments.

CO4: Understand the basic characteristics of transformers and electrical machines.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	2
CO2	2	2	1	1	-	-	-	-	-	-	-	2
CO3	2	2	1	1	-	-	-	-	-	-	-	2
CO4	2	2	1	1	-	-	-	-	-	-	-	2

EC308L-Electronic Devices Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits: **1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

Hands-on experiments related to the course contents Electronic Devices LaboratoryList of Experiments:

1. P-N Junction Diode Characteristics
2. Zener Diode Characteristics
3. Half Wave Rectifiers (without and with filter)
4. Full Wave Rectifiers (without and with filter)
5. CB Characteristics
6. CE Characteristics
7. CC Characteristics
8. FET Characteristics
9. BJT Biasing
10. SCR Characteristics
11. UJT Characteristics
12. LDR characteristics
13. LED Characteristics
14. Photodiode characteristics
15. Phototransistor characteristics.

Some of the experiments can be done using any Simulation Software.

Prerequisites: None

Course Outcomes: After completion of the course student will be able to:

CO1: Plot the characteristics of electronic devices to understand their behaviour.

CO2: Design, construct and test amplifier circuits, Rectifiers, Special devices and interpret theresults.

CO3: Operate electronic test equipment using hardware/software tools to characterize the behaviourof devices and circuits.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	-	-	-	1	2	-	-	3	-
CO2	3	2	3	-	-	-	-	2	-	-	3	-
CO3	3	3	3	3	-	-	-	2	-	-	3	-

EC311L-Simulation Laboratory

Instruction: Hours/Week: **0L:0T:2P**	Credits: **01**
Sessional Marks: **40**	End Semester Examination Marks: **60**

- **All the experiments are to be simulated using MATLAB or equivalent software.**
- **Minimum of 12 - 15 experiments are to be completed.**

List of Experiments:

1. Basic Operations on Matrices.
2. Generation of Various Signals and Sequences (Periodic and Aperiodic), such as UnitImpulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.
3. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting,Folding, Computation of Energy and Average Power.
4. Finding the Even and Odd parts of Signal/Sequence and Real and Imaginary parts ofSignal.
5. Convolution for Signals and sequences.
6. Auto Correlation and Cross Correlation for Signals and Sequences.
7. Verification of Linearity and Time Invariance Properties of a given Continuous/DiscreteSystem.
8. Computation of Unit sample, Unit step and Sinusoidal responses of the given LTI systemand verifying its physical realizability and stability properties.
9. Gibbs Phenomenon Simulation.
10. Finding the Fourier Transform of a given signal and plotting its magnitude and phasespectrum.
11. Waveform Synthesis using Laplace Transform.
12. Locating the Zeros and Poles and plotting the Pole-Zero maps in S-plane and Z-Plane for the given transfer function and verify its stability.
13. Generation of Gaussian noise (Real and Complex), Computation of its mean, M.S. Valueand its Skew, Kurtosis, and PSD, Probability Distribution Function.
14. Verification of Sampling Theorem. Write a program to generate discrete time sequenceby sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
15. Write a program to find autocorrelation and cross correlation of given

sequences. Removal of noise by Autocorrelation / Cross correlation.

16. Write a program to verify Linearity and Time Invariance properties of a givenContinuous/Discrete System
17. Extraction of Periodic Signal masked by noise using Correlation.
18. Write a program to find magnitude and phase response of first order low pass and highpass filter. Plot the responses in logarithmic scale.
19. Write a program to find response of a low pass filter and high pass filter, when a speechsignal is passed through these filters.
20. Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).
21. Generate a Random data (with bipolar) for a given data rate (say 10kbps). Plot the samefor a time period of 0.2 sec.

Prerequisites: None

Course Outcomes: After completion of the course student will be able to:

CO1: Learn how to use the MATLAB software and know syntax of MATLAB programming.CO2: Understand how to simulate different types of signals and system response.

CO3: Find the Fourier Transform of a given signal and plot amplitude and phasecharacteristics.

CO4: Analyze the response of different systems when they are excited by different signalsand plot power spectral density of signals

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	-	-	-	1	2	-	-	3	-
CO2	3	2	3	-	-	-	-	2	-	-	3	-
CO3	3	3	3	3	-	-	-	2	-	-	3	-
CO4	3	3	3	3	-	-	-	2	-	-	3	-

EC401C-Linear Control Systems

Instruction: Hours/Week: **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Unit-I
Introduction to control problem:

Industrial Control examples, System Representation, Classification of systems, Feedback Control, Benefits of Feedback- Open-Loop and Closed-loop systems, Advantages and Disadvantages of control systems, Industrial Control examples.

Mathematical models of physical systems: Electrical, Mechanical and Electro-Mechanical, Transfer function models of linear time-invariant systems: Potentiometers, Synchros, LVDT, dc and ac servomotors, Tacho- generators, electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems, Block diagram algebra, Reduction techniques and Signal flow graph.

Unit-II
Time Response Analysis:

Standard test signals, Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. Design specifications for second-order systems based on the time-response, Steadystate errors and error constants, Performance specifications in time-domain error, Static and Generalized error constants, Concept of stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique, Construction of Root-loci.

Unit-III
Frequency-response analysis:

Introduction to Frequency domain specifications -Relationship between time and frequency response, Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Performance specifications in frequency-domain, Frequency domainmethods of design.

Unit-IV
Introduction to Controller Design:

Compensation & their realization in time & frequency domain, Introduction to controllers (PI, PD, PID), Application of Proportional, Integral and Derivative Controllers, Need for Lead and Lag compensators, Applications of compensators, Comparison of controllers and compensators, Problems.

Unit-V

State variable Analysis:

Concepts of state, state variables, State space model for linear continuous time functions, Diagonalization of

State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability andobservability.

Text/Reference Books:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, Seventh edition, 1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, second edition, 1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009K. L. Chung.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Identify the various control system components and their representations.
2. Analyze the various time domain parameters.
3. Analysis the various frequency response plots and its system.
4. Apply the concepts of various system stability criterions and design various transfer functions of digitalcontrol system using state variable models.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	-	-	-	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2
CO3	3	2	2	2	-	-	-	-	-	-	-	2
CO4	2	1	2	2	-	-	-	-	-	-	-	2

EC402C-Probability Theory and Stochastic Processes

Instruction: Hours/Week: **3L:0T:0P**	Credits: **3**
Sessional Marks: **40**	End Semester Examination Marks: **60**

UNIT-I

Probability: Sets and set operations, Probability space, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Joint Probability, Conditional probability, Total Probability, and Bayestheorem, Combinatorial probability and sampling models.

Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete random variables, probability mass function, probability distribution function, example random variables and distributions. Continuous random variables, probability density function, probability distribution function, Properties, Mixed Random Variable, example distributions - Binomial, Poisson, Uniform, Gaussian, Exponential, Raleigh etc.

UNIT-II

Multiple Random Variables: Vector Random Variables, Joint distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, functions of one and two random variables, Conditional Distribution and Density, Methods of defining Conditioning Event, Conditional Density, Properties. Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Markov, Chebyshev and Chernoff bounds.

UNIT-III

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables, momentsof random variable, Characteristic functions of a random variable, Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions and Joint Gaussian Random Variables. Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square), Limit theorems: Strong and weak laws of large numbers, Central Limit Theorem, (Proof not expected), Unequal Distribution, Equal Distributions. Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNIT-IV

Random Process– Temporal Characteristics: The Random Process Concept, Classification of Processes,Stationary processes, First-Order Stationery Processes, Second- Order and Wide-Sense Stationarity, (N- Order) and Strict-Sense Stationarity, Mean and covariance functions, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function & Its Properties, Cross- Correlation Function & its Properties, Covariance Functions, Gaussian Random Processes, Poisson RandomProcess.

Random Processes – Spectral Characteristics: Power spectral density, Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

UNIT-V

Transmission of random process through LTI systems: System Response, Convolution, Mean and Mean- squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, properties of white noise, Band pass, Band-Limited and Narrowband Processes, Properties.

Text / Reference Books:

1. H. Stark and J. Woods, Probability and Random Processes with Applications to Signal Processing, 3rdEdition, Pearson Education.
2. Peyton Z. Peebles, Probability, Random Variables & Random Signal Principles, Tata McGraw Hill, 4thEdition, 2001.
3. Athanasios Papoulis and S. Unnikrishnan Pillai, Probability, Random Variables and StochasticProcesses, PHI, 4th Edition, 2002.
4. Hisashi Kobayashi, Brian L. Mark and William Turin, Probability, Random Processes, and StatisticalAnalysis, Cambridge University Press, 2012.
5. John J. Shynk, Probability, Random Variables, and Random Processes Theory and Signal ProcessingApplications, John Wiley & Sons, Inc., Hoboken, New Jersey, 2013, ISBN: 978-0-470-24209-4.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand representation of random signals.
2. Obtain Distribution function, Density functions, and Conditional density functions for different Randomvariables.
3. Make use of theorems related to random signals.
4. Investigate temporal and spectral characteristics of random processes.
5. Able to Model of different Noise Sources and understand propagation of random signals in LTI systems.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	-	-	-	3	-	-	2
CO2	3	3	2	2	1	-	-	-	3	-	-	2
CO3	2	2	2	2	2	-	-	-	3	-	-	2
CO4	3	2	3	3	2	-	-	-	3	-	-	1
CO5	3	3	3	2	3	-	-	-	3	-	-	2

HS403C-Managerial Economics and Accountancy

Instruction: Hours/Week: 3**L:0T:0P** Credits**: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT – I

Introduction to Engineering Economics, Fundamental concepts, Time value of money, Cash flow and Time Diagrams, choosing between alternative investment proposals, Methods of Economic analysis (pay back, ARR, NPV, IRR and B/C ratio), The effect of borrowing on investment, Equity vs Debt Financing, concept of leverage,Income tax leverage.

UNIT – II

Depreciation and methods of calculating depreciation (straight line, sum of the years digit method, Declining balance method, Annuity method, Sinking fund method), National income accounting Methods of estimation, Various concepts of National Income, Significance of National income Estimation and its limitations.

UNIT – III

Inflation: Definition, Process and Theories of inflation and Measure of control. New Economic Policy 1991(Industrial Policy, Trade Policy, Fiscal Policy), Impact on Industry.

UNIT – IV

Accounting Principles, procedure, Double entry system, Journal, ledger, Trial balance, Cashbook, preparation of Trading and Profit and Loss account, Balance sheet.

UNIT – V

Cost Accounting: Introduction, Classification of costs, Methods of costing, Techniques of costing, Cost sheet and preparation of cost sheet, Break-even Analysis, Meaning and its application, Limitation.

Text/ Reference Books:

1. Henry Malcom Steiner, Engineering Economics Principles, 2nd Edition, McGraw HillEducation, 1996.
2. Dewett. K.K., Modern Economic Theory, Sultan Chand and Co., 2006.
3. A.N. Agarwal, Indian Economy, Wiley Eastern Limited, New Delhi.
4. Jain and Narang, Accounting Part-I, Kalyani Publishers, 2011.
5. Arora, M.N. Cost Accounting: Principles and Practice, 12th Edition, Vikas Publication, 2012.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand Macro Economic environment of the business and its impact onenterprise.
2. Identify various cost elements of the product and its effect on decision making.
3. Understand the concepts of financial management and smart investment.
4. Prepare the Accounting records and interpret the data for Managerial Decisions.

Mapping of course outcomes with program outcomes:

PO/ CO	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-		2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	3	-
CO3	-	1	-	-	-	-	-	-	-	-	3	-
CO4	2	-	-	-	-	-	-	-	-	-	3	-

EC404C-IC Applications

Instruction: Hours/Week: 3**L:0T:0P** Credits**: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

UNIT – I

Op-Amp Applications: Scale changer/inverter, Summing amplifier, Instrumentation amplifier, Instrumentationamplifier IC-AD620, DC and AC amplifiers, V to I and I to V converters, Precision rectifiers, Log and Antilog amplifiers, multiplier and divider, Analog multiplier IC-AD633, Differentiator, Integrator, Analog computation.

UNIT – II

Comparators and waveform generators: Comparator, Regenerative comparator (Schmitt Trigger), Astable and mono-stable multi-vibrators using op-amp, Triangular wave generator, Sine wave generators using op-amp. ICwaveform generator (8038).

UNIT – III

Voltage regulators: Series op-amp regulator, IC voltage regulators, 723 General purpose regulator, Switching regulators. Active filters: Low pass, high pass, band pass, band reject and all pass filters, transformation, State variable filter, Switched capacitor filters, Switched capacitor filter ICs.

UNIT – IV

555 Timer: Description of functional diagram, Monostable operation. Applications in monostable mode, Astable operation, Applications in astable mode, Schmitt trigger. Phase Locked Loops: PLL-introduction, block schematic, principles and description individual blocks, IC PLL (565), Voltage controlled oscillator (566), PLLapplications- Frequency multiplication, Frequency translation, FM & FSK demodulation.

UNIT – V

D-A and A-D Converters: Basic DAC Techniques, Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R ladder, Monolithic DAC IC-1409, A-D converters, direct type ADCs, the parallel comparator(flash) A/D converter, The counter type A/D converter, Servo tracking A/D converter, Successive approximation converter,Integrating type of ADCs, Charge balancing ADC, Dual-slope ADC, DAC/ADC specifications.

Text/ Reference Books:

1. D.Roy Choudary, Shail Bala Jain, “Linear Integrated circuits”, New Age International publishers, 2018.
2. Ramakant A.Gayakward, “Op-amps and linear Integrated circuits”, LPE, 4th edition, PearsonEducation.
3. S.Salivahanan, V.S.Kanchana Bhaaskaran “Linear Integrated circuits”, TMH, 2008.
4. David A. Bell, “Operational amplifiers and Linear ICs”, PHI, EEE, 1997.
5. 5. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the functioning of OP-AMP and design OP-AMP based circuits.
2. Understand the functioning of voltage regulators and design IC based voltage regulators,
3. Understand the functioning of 555 timer and design 555 timer-based circuits.
4. Understand the functioning of PLL and design PLL based circuits.
5. Design ADC and DAC circuits

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	1
CO5	3	3	2	2	-	1	-	-	-	-	1	1

EC405C-Analog Communications

Instruction: (Hours/Week) **3L:0T:0P** Credits: **3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Unit – I

Introduction: Elements of communication systems, Information, Messages and Signals, Modulation, Modulation Methods, Modulation Benefits and Applications.
Amplitude Modulation & Demodulation: Baseband and carrier communication, Amplitude Modulation (AM), Rectifier detector, Envelope detector, Double sideband suppressed carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Frequency mixer, sideband and carrier power of AM, Generation of AM signals, Single sideband (SSB) transmission, Time domain representation of SSB signals & their demodulation schemes (with carrier, and suppressed carrier), Generationof SSB signals, Vestigial sideband (VSB) modulator & demodulator, Frequency division multiplexing (FDM),Illustrative Problems.

UNIT-II

Angle Modulation & Demodulation: Concept of instantaneous frequency, Generalized concept of angle modulation- Frequency Modulation & Phase modulation : Bandwidth of angle modulated waves, Narrow bandfrequency modulation (NBFM) and Wide band FM (WBFM), Verification of Frequency modulation bandwidthrelationship, Features of angle modulation, Generation of FM waves-Indirect method, Direct generation; Demodulation of FM, Band pass limiter, Practical frequency demodulators, Small error analysis, Pre-emphasis,& De-emphasis filters, FM Capture Effect, Illustrative Problems.

UNIT-III

Noise in Communication Systems: Thermal noise, Time domain representation of narrowband noise, filteredwhite noise, Quadrature representation of narrowband noise, Envelope of narrowband noise plus sine wave, Signal to noise ratio & probability of error, Noise equivalent bandwidth, Effective noise temperature, and Noisefigure, Baseband systems with channel noise, Performance analysis (i.e. finding SNR expression) of AM, DSB-SC, SSB-SC, FM, PM in the presence of noise, Illustrative Problems.

UNIT-IV

Radio Receivers: Working principle of Super heterodyne AM and FM Receivers along with suitable block diagrams, Sensitivity, Selectivity and fidelity.

Analog Pulse Modulation Schemes: Pulse amplitude modulation – Natural sampling, flat top sampling and Pulse amplitude modulation (PAM) & demodulation, Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, and demodulation schemes, PPM spectral analysis, Illustrative Problems.

UNIT-V

Information Theory: Introduction, Information and Entropy, and its properties, source coding Theorem, DataCompaction – Prefix coding, Huffman coding, Discrete Memory less channels, Mutual Information, and its properties, Channel capacity, Channel coding Theorem, Application to binary symmetric channels, differential entropy and mutual information, Information capacity theorem, implication of information capacity theorem, Rate Distortion, Illustrative problems

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Text Books:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006.
2. Simon Haykin, "Communication Systems," by John Wiley & Sons,3rdEdition, 2010.
3. Sham Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2006.

REFERENCES:

1. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise inElectrical Communication", McGraw-Hill International Edition, 5th Edition, 2010.
2. Herbert Taub&Donald L Schilling, "Principles of Communication Systems", Tata McGraw-Hill, 3rdEdition, 2009.
3. R.E. Ziemer& W.H. Tranter, "Principles of Communication-Systems Modulation & Noise", JaicoPublishing House, 5thedition, 2001.
4. George Kennedy and Bernard Davis, "Electronics & Communication System", TMH,2004.

Course Outcomes: At the end of this course students will have the ability to

CO1: Understand the concepts of various Amplitude, Angle and Pulse Modulation schemes. Understand theconcepts of information theory with random processes. (L1)

CO2: Apply the concepts to solve problems in analog and pulse modulation schemes. (L2)

CO3: Analysis of analog communication system in the presence of noise. (L3)

CO4: Compare and contrast design issues, advantages, disadvantages and limitations of various modulationschemes in analog communication systems. (L4)

CO5: Solve basic communication problems & calculate information rate and channel capacity of a discretecommunication channel. (L5)

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	_	1	1	_	_	_	_	_	1
CO2	2	2	1	_	1	1	_	_	_	_	_	1
CO3	2	2	1	_	1	1	_	_	_	_	_	1
CO4	2	2	1	_	1	1	_	_	_	_	_	-

EC409S- Python Programming

Instruction: (Hours/Week) **1L:0T:2P** Credits: **2**
Evaluation Scheme: **100 Marks**

Unit – I

Introduction to Python Programming Language

Introduction to Python Language: What is Python? Why Python? Installing Python on Windows, Python IDLE,Python Literals, Python Data Types Basic Input-Output operations, Operators in Python, Decision making in Python, Conditional execution in Python, Logical and bit operations in Python, Naming Conventions, String Operations, String Slices, String Operators, Numeric Data Types, Conversions, Data type conversion, Built in Functions.

UNIT-II

Python Built-in Data Structures

Introduction, List, Tuples, Dictionary, Sets, List Operations append, extend, insert, remove, pop, slice, andreverse, List Comprehension, Dictionary operations, Sorting Dictionaries, Copying Collections, Set operations. Standard python modules math, time, IO and time, Regular expressions, multi-threading.

UNIT-III

Classes & Objects

Classes in Python, Principles of Object-Oriented programming, Creating Classes, Instance Methods, File Organization, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, CustomException Classes.

UNIT-IV

Functions, I/O, Exception Handling in Python

Introduction: Defining your own functions, keyword and optional parameters, mapping functions, lambda functions, ·Data Streams · Creating Your Own Data Streams · Access Modes · Writing Data to a File · Reading Data from a File · Additional File Methods · Using Pipes as Data Streams · Handling IO Exceptions ·Working with Directories · Metadata · Errors · Run Time Errors · The Exception Model · Exception Hierarchy
· Handling Multiple Exceptions.

UNIT-V

Python API development.

Introduction to API, Python API programming, Python web application frameworks, REST API, Python Flask,Flask Environment, Routing, Cookies, Sessions, Running Flask Application, Testing API with POSTMAN client

Text Books:

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher,Revised and Expanded version (Referred by MIT)
2. Python Programming using problem solving Approach by Reema Thareja, Oxford University, HigherEducation Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173
3. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, MichealS Goldwasser, Wiley Publisher (2016)
4. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material CourseTechnology Inc. 1 st edition (6th February 2009)

REFERENCES:

1. Dive into Python, Mike 2. Learning Python, 4th Edition by Mark Lutz 3. Programming Python, 4th Edition by Mark L
2. Fundamentals of Python Programming, Richard L. Halterman Updated content of the book ismaintained under the URL:http://python.cs.southern.edu/pythonbook/pythonbook.pdf
3. The official Python Tutorial. http://docs.python.org/tut/ How to think like a computer scientist(interactive) http://interactivepython.org/runestone/static/thinkcspy/index.html
4. How to think like a computer scientist http://openbookproject.net/thinkcs/python/english3e/
5. Code Academy Python http://www.codecademy.com/tracks/python
6. A useful hands-on book: http://anh.cs.luc.edu/python/hands-on/3.1/Hands-onPythonTutorial.pdf

Course Outcomes: At the end of this course students will have the ability to

1. Apply the OOP principles and best practices of python programming.
2. Write clear and effective pythonic code.
3. Create applications using python programming.
4. Implementing databases using SQLite and Access databases using python programming.
5. Understand and feel comfortable in working with web application frameworks.
6. Develop APIs required for the web applications using web frameworks like Flask and Fast API.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

EC406L-Digital Logic Design Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits: **1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

LIST OF EXPERIMENTS

1. Realization of Boolean Expressions using Gates
2. Design and realization of logic gates using universal gates
3. Design and realization of a 4 – bit Gray to Binary and Binary to Gray Converter
4. Verify the functionality of Mux and Decoder ICs
5. Design and realization of 4-bit comparator
6. Verify the functionality of Flip-Flop ICs
7. Mod-N counter using 7490 and 74190.
8. Shift register IC 7495.

Note: Implement using digital ICs.VHDL Programming:

1. Write structural and dataflow VHDL models for
   a) 4-bit ripple carry adder. b) 4-bit carry Adder – cum Subtractor.
   c) 2-digit BCD adder /subtractor d) 4-bit carry look ahead adder e) 8-bit comparator

2. Write a VHDL program in structural model for
   a) 16:1 mux realization b) 3:8 decoder realization through 2:4 decoder
3. Write a VHDL program in behavioral model for
   a) 16:1 mux b) 3:8 decoder c) 8:3 encoder d) 8 bit parity generator and checker

4. Write a VHDL program in structural and behavioral models for
   a) 8 bit asynchronous up-down counter b) 8 bit synchronous up-down counter

5. Write a VHDL program for 4-bit sequence detector through Mealy and Moore state machines.

6. Write a VHDL program in behavioral model for 8-bit shift and add multiplier.

7. Write a VHDL program in structural model for 8-bit Universal Shift Register.

Some of the experiments can be done using any Simulation Software.

Course Outcomes: At the end of this course students will have the ability to

1. Construct Basic combinational Circuits and Verification of its functionality
2. Construct Sequential Circuits and Verification of its functionality
3. Write structural, behavioral and data flow models for digital circuits
4. Simulate VHDL models of digital circuits

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	1

EC407L-Analog Circuits Laboratory

Instruction: Hours/Week: **0L:0T:3P**	Credits**: 1.5**
Sessional Marks: **40**	End Semester Examination Marks: **60**

Hands-on experiments related to the course contents Analog Circuits.
Prerequisites: Electronic Devices Laboratory.

Course Outcomes:

After completion of the course student will be able to:

List of Experiments:

1. Common Emitter Amplifier.

2. Common Collector amplifier

3. Two Stage RC coupled amplifier

4. Voltage series feedback amplifier

5. Voltage shunt feedback amplifier

6. Current series feedback amplifier

7. Current shunt feedback amplifier

8. RC phase shift oscillator

9. Wien bridge oscillator

10. LC/ crystal oscillator.

11.Class A Power Amplifier (Transformer

less) 12.Class B Complementary Symmetry

Amplifier12.Differential amplifier

13.Operational amplifier as (i) Inverting amplifies, (ii) Non-Inverting amplifier (III) Voltagefollower

Some of the experiments can be done using any Simulation Software.

Course Outcomes:
At the end of this course students will have the ability to

1. Know about the usage of equipment/components/software tools used to conduct the experiments in analog circuits.
2. Conduct the experiment based on the knowledge acquired in the theory about various analogcircuits using BJT/MOSFETs to find the important parameters of the circuit (viz. Voltage gain, Current gain, bandwidth, input and output impedances etc) experimentally.
3. Analyze the given analog circuit to find required important metrics of it theoretically and Compare the experimental results with that of theoretical ones and infer the conclusions.
4. Draw the relevant graphs between important metrics of the system from the observed measurements.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	2

EC408L-IC Applications Laboratory

Instruction: Hours/Week: **0L:0T:3P** Credits**: 1.5**
Sessional Marks: **40** End Semester Examination Marks: **60**

Hands-on experiments related to the course contents

EC408L.List of Experiments:

1. Study and Operation of IC testers, pulse generator and digital trainer.
2. Frequency response of inverting and non-inverting amplifier.
3. Measurement of Op.amp parameters: (i) Offset voltage (ii) Offset current (iii) CMRR and (iv)Slew rate
4. Op-amp monostable and astable multivibrators.
5. Design 2's complement adder/subtractor using IC74283 and verify experimentally.
6. Low voltage regulator IC 723.
7. 555 timer: Monostable and astable multivibrators.
8. IC PLL (565) applications- Frequency multiplication, Frequency translation, FM & FSKdemodulation.
9. Voltage controlled oscillator (566)

Course Outcomes: After the completion of the course the student will be able to

1. Measure the parameters of IC 741 Op-amp.
2. Design applications of IC 741 Op-amp
3. Realize analog filters using Op-amp.
4. Design multivibrators using 555 IC.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	1	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2
CO4	3	3	2	2	-	1	-	-	-	-	1	1

SYLLABUS

FOR

Honors Degree, Minors in Electronics and Minors in Communications

Courses offered for Honors degree

ECHN01- Advanced Digital Signal Processing

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: Digital signal processing is a method of processing real world signals (represented by a sequence of numbers) using mathematical techniques to perform transformations or extract information.

Course Objectives:

1. To analyze multirate DSP systems.
2. To determine coefficients for perfect reproduction filter banks and wavelets.
3. To choose parameters to take a wavelet transform, and interpret and process the result.

UNIT-I

Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub band coding

UNIT-II

Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

UNIT-III

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm

UNIT-IV

Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigenanalysis Algorithms for Spectrum Estimation.

UNIT-V

Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.

Text Books :

1.J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2.N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
3.Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.
4.M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
5.S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
6.D.G.Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. To understand theory of different filters and algorithms
2. To understand theory of multi rate DSP, solve numerical problems and write algorithms
3. To understand theory of prediction and solution of normal equations
4. To know applications of DSP at block level

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1					1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	2	2					3	3	3	3
CO4	3	2	2	2	2	2					3	3	3	3

ECHN02- Antennas and Radiating Systems

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: Radiation intensity, or the antenna power pattern, in a given direction is defined as the power radiated from an antenna per unit solid angle. The radiation intensity is a far field parameter which can be obtained by simply multiplying the radiation power density by the square distance

Course Objectives:

1. To fundamental antenna parameters and numerical methods to analyze and differentiate the antennas.
2. To concept of radiation mechanism of various antennas.
3. To mechanism and models for radio-wave propagation.

UNIT-I

Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna.

Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

UNIT-II

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects.

Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

UNIT-III

LinearArrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

UNIT-IV

Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture.

Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

UNIT-V

Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch, Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

Text Books :

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
3. R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
4. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
2. Estimate the input impedance, efficiency and ease of match for antennas.
3. Compute the array factor for an array of identical antennas.
4. Design antennas and antenna arrays for various desired radiation pattern characteristics.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1					1			
CO2	2	1	3	-	1	1					2			
CO3	3	2	2	2	2	2					3	2	2	2
CO4	2	2	2	2	2	1					3	2	2	2

CHN03- Wireless and Mobile Communications

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course offers an insight into the concepts of mobile and wireless data communication technologies. The objective of this course is to enable the student to understand the emerging technologies of wireless and mobile communications and simulate them.

Course Objectives:

1. To understand the new trends in mobile/wireless communications networks.
2. To understand multiple radio access techniques.
3. To analyze various routing algorithms used in mobile/wireless networks.
4. To identify the issues in transport and application layers.

UNIT-I

Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE.

. **UNIT-II**

Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)

UNIT-III

Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading

UNIT-IV

Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving

UNIT-V

Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.

Text Books :

1. V.K.Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education, 5th edition, 2008.
2. V.K.Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education, 4th edition, 2009.
3. T.S.Rappaport, “Wireless Communications Principles and Practice”, 2nd edition, PHI,2002.
4. William C.Y.Lee, “Mobile Cellular Telecommunications Analog and Digital Systems”, 2nd edition, TMH, 1995.
5. Asha Mehrotra, “A GSM system Engineering” Artech House Publishers Bosten, London, 1997.

Course outcomes :
Upon successful completion of the course, the student will be able to:

1. Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques .
2. Distinguish various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
3. Analyze path loss and interference for wireless telephony and their influences on a mobile-communication system's performance.
4. Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1					1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	1	1					3	3	3	3
CO4	3	2	2	2	1	1					3	3	3	3

ECHN04- Voice and Data Networks

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description:
This course provides an introduction to voice and data networking technologies, including public and priv ate voice services, Ethernet and Internet data technologies, network security, business applications and net work management. The structure, regulation, andhistory of the telecom and data network industry will be discussed as well.

Course Objectives:

1. To protocol, algorithms, trade-offs rationale.
2. To routing, transport, DNS resolutions
3. To network extensions and next generation architecture.

UNIT-I

Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks

. **UNIT-II**

Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

UNIT-III

Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

UNIT-IV

Queuing Models of Networks , Traffic Models , Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols , Aloha System , Carrier Sensing , Examples of Local area networks.

UNIT-V

Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR) , IP address lookup , Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery, Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks, Network Calculus, Packet Scheduling Algorithms.

Text Books :

1. D. Bertsekas and R. Gallager, “Data Networks”, 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, “Computer Networks: A Systems Approach”,5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, “Communication Networking: An analytical approach”, 1st Edition, Morgan Kaufman, 2004.
4. Walrand,“Communications Network: A First Course”, 2nd Edition, McGraw Hill, 2002.
5. Leonard Kleinrock, “Queueing Systems,Volume I: Theory”, 1st Edition, John Wiley and Sons, 1975.
6. Aaron Kershenbaum,Telecommunication Network Design Algorithms,McGraw Hill, 1993.
7. Vijay Ahuja, “Design and Analysis of Computer Communication Networks”, McGraw Hill, 1987

Course outcomes :
Upon successful completion of the course, the student will be able to:

1. Understand Protocol, algorithms, trade-offs rationale.
2. Analyze Routing, transport, DNS resolutions
3. Know about Network extensions and next generation architectures
4. Analyze and design voice and data networking technologies

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1						1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	2							3	3	3
CO4	3	2	2	2	2	2						3	3	3

ECHN05- Advanced Communication Networks

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: Basic techniques for modeling and analyzing communication networks. Fairness and utility functions, routing, congestion control, pricing, queuing models, loss networks, multi-class queues and scheduling.

Course Objectives:

1. To fairness and network utility maximization
2. To optimization based routing and congestion control
3. To basic queuing models and their application to switching and scheduling in networks.

UNIT-I

Overview of Internet-Concepts, challenges and history. Overview of -ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

. **UNIT-II**

Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.
Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket Algorithm and its properties.

UNIT-III

Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.;
Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management

UNIT-IV

IP address lookup-challenges. Packet classification algorithms and Flow Identification-Grid of Tries, Cross producting and controlled prefix expansion algorithms.
Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework

UNIT-V

IPV4, IPV6, IP tunnelling, IPswitching and MPLS, Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.

Text Books :

1. Jean Wairand and Pravin Varaiya, “High Performance Communications Networks”, 2nd edition, 2000.
2.Jean Le Boudec and Patrick Thiran, “Network Calculus A Theory of Deterministic Queueing Systems for the Internet”, Springer Veriag, 2001.
3.Zhang Wang, “Internet QoS”, Morgan Kaufman, 2001.
4.Anurag Kumar, D. Manjunath and Joy Kuri, “Communication Networking: An Analytical Approach” , Morgan Kaufman Publishers, 2004.
5.George Kesidis, “ATM Network Performance”, Kluwer Academic, Research Papers, 2005.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand advanced concepts in Communication Networking.
2. Design and develop protocols for Communication Networks.
3. Understand the mechanisms in Quality of Service in networking.
4. Optimise the Network Design.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1					1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	2	2					3	3	3	3
CO4	3	2	2	2	2	2					3	3	3	3

ECHN06- Pattern Recognition and Machine Learning

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course introduces fundamental concepts, theories, and algorithms for pattern recognition and machine learning, which are used in computer vision, speech recognition, data mining, statistics, information retrieval, and bioinformatics. Topics include: Bayesian decision theory, parametric and non-parametric learning, data clustering, component analysis, boosting techniques, support vector machine, and deep learning with neural networks.

Course Objectives:

1. To understand, describe and critique pattern recognition, machine learning and deep learning techniques.
2. To identify and select suitable modeling, learning and prediction techniques to solve a problem.
3. To design and implement a machine learning solution.
4. To appraise ethical and privacy issues of artificial intelligence techniques.

UNIT-I

Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

UNIT-II

Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification.

UNIT-III

Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

UNIT-IV

Linear discriminant functions - decision surfaces, two-category, multi-category, minimum-squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

UNIT-V

Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering

Text Books :

1. Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, 2nd Edition John Wiley & Sons, 2001.
2.Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, “The Elements of Statistical Learning”, 2nd Edition, Springer, 2009.
3.C. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Study the parametric and linear models for classification
2. Design neural network and SVM for classification
3. Understand Linear discriminant functions
4. Develop machine independent and unsupervised learning techniques.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1					1			
CO2	3		3		1	1					2			
CO3	3	2	2	3	2	2					3	3	3	3
CO4	3	2	2	2	2	2					3	3	3	3

Courses offered for Minors in Electronics

ECMN01(EC 104)- Electronic Devices

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course develops a basic understanding of the fundamentals and principles of analog and digital circuits and electronic devices. This understanding is a critical step towards being able to design new electronic circuits or use them appropriately as part of a larger engineering system.

Course Objectives:

1. To familiarize the student with the principal of operation, analysis and design of junction diode, BJT and FET transistors and amplifier circuits.
2. To understand diode as a rectifier.
3. To study basic principal of filter of circuits and various types

UNIT-I

Semiconductor Materials: Atomic structure, Electrons in periodic Lattices, Classifying Materials: Semiconductors, conductors and insulators, Semiconductor material groups, Covalent bonding, Energy Band gaps, Energy bands in intrinsic and extrinsic silicon /Germanium, Density of Impurity States, Electrical Conductivity and Mobility, , Electronic Properties of N-type and P-type semiconductors, Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors. Generation and recombination of carriers; Poisson and continuity equation, P-N junction characteristics, I-V Characteristics, and small signal switching models, Diode resistances and diode capacitances.

UNIT-II

Diode models, Avalanche breakdown, Zener diode, Schottky diode, Tunnel diode, Varactor diode and their applications, Testing a diode.

Rectifiers: Diode equivalent circuits, Analysis of diode circuits, Characteristics and comparison of Half-wave, Full-wave and Bridge rectifiers, Analysis of filters (C, L, LC, and CLC) used with Full-wave rectifiers, line regulation and load regulation.

UNIT-III

Bipolar Junction Transistors: Bipolar Junction Transistor action, PNP and NPN transistors, CB, CE, and CC configurations and their I-V characteristics, Analytical expressions for transistor characteristics, Typical junction voltages and maximum ratings. Determination of h-parameters from BJT characteristics, Ebers-Moll Model, Multi Emitter transistor.

UNIT-IV

Bipolar Junction Transistor Biasing: Operating point, stabilization, thermal runaway.

Field Effect Transistors: Characteristics and parameters of JFET, Pinch off and saturation regions, MOS capacitor, Depletion and Enhancement type of MOSFET, I-V characteristics, and small signal models of MOS transistor, UJT and its I-V characteristics, Metal Semiconductor FET, FET biasing schemes.

UNIT-V

Optoelectronic Devices: Principle of operation and characteristics of LED. LCD, LDR, Photoconductor, Photodiode, Phototransistor, Solar cell, PIN photodiode, Charge-Coupled Devices, APD (avalanche photodiode) and their applications.

Power Semiconductor Devices: Device structure, equivalent circuit and characteristics of PNPN Diode, SCR, DIAC and TRIAC. .

Text Books :

1. 1.Ben G. Steetman and Sanjay Kumar Banerjee, “Solid State Electronic Devices,” 7th edition,

Pearson Publishers, 2015.

2. Jacob Millman, Christos Halkias, Chetan D Parikh, "**Integrated Electronics**: Analog and Digital Circuits and Systems", 2nd Edition, Tata Mcgraw Hill Ed. Private Limited, 2011.
3. Allen Mottershead, "Electronic Devices and Circuits**:** An Introduction", PHILearning , 2011.
4. D. Neamen , D. Biswas "Semiconductor Physics and Devices", McGraw-Hill Education.
5. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.
6. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
7. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford University Press, 2011.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the principles of semiconductor physics of the intrinsic, *p* and *n* type materials.
2. Understand the characteristics of the diode and some special function diodes and their application in electronic circuits and rectifier circuits
3. Understand basics of transistors for circuits and systems.
4. Understand the characteristics of the Transistors biasing opto-electronic devices and Power Semiconductor Devices and their application in electronic circuits.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**		
CO2	**3**	**3**	**2**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**-**	**2**	1	
CO3	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**2**		
CO4	**3**	**2**	**3**	**3**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**1**		1

ECMN02(EC305C)**- Digital Logic Design**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course develops a basic understanding of the fundamentals and principles of Logic circuits and VLSI Design flow. This understanding is a critical step towards being able to design new Logic circuits or use them appropriately as part of a larger engineering system

Course Objectives:
1. To familiarize the student with Basic Logic circuits and designing.
2. To learn the design concepts of MSI devices, Sequential Logic Design and VLSI Design flow.

UNIT I

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

UNIT II

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

UNIT III

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudorandom Binary Sequence generator.

UNIT IV

Clock generation Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

UNIT V

VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Text / Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd Edition,2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Design and analyze combinational logic circuits.
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder.
3. Design & analyze synchronous sequential logic circuits.
4. Use HDL & appropriate EDA tools for digital logic design and simulation

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	1	-	-	2	1	
CO2	3	3	2	2	1	-	2	-	1	-	-	2		
CO3	2	2	2	2	1	-	-	-	1	-	1	2		1
CO4	3	2	3	3	1	-	2	-	1	-	1	1		

ECMN03(EC306C)**- Analog Circuits**	
Instruction: Hours/Week: **3L:0T:0P** Sessional Marks: **40**	**Credits: 3** End Semester Examination Marks: **60**

Course Description: This course develops a basic understanding of the fundamentals and principles of analog circuits and electronic devices in electrical and electronic engineering.

Course Objectives:

1. To specify the small signal equivalent model of transistors
2. To analyze transistor amplifier circuits
3. To design multistage transistor amplifier circuits
4. To identify and discuss operating principles of differential amplifiers
5. To design and analyze integrated circuit biasing
6. To analyze frequency response of linear amplifiers

UNIT-I

General Amplifiers Characteristics: Concept of Amplifier, Voltage gain, Current gain, Power gain, Input and Output resistances, Conversion efficiency, Frequency response, Bandwidth, Distortion,

BJT Amplifiers: Small signal low frequency model of the transistor, Analysis of CE, CB and CC amplifiers, Approximate model analysis, Effects of coupling and bypass capacitors on low frequency response, Hybrid-Π model at high frequencies, Calculation of High-Frequency parameters in terms of Low Frequency parameters, CE short circuit gain, CE current gain with resistive load.

UNIT-II

FET Amplifiers: Small signal model, Analysis of CS, CD and CG amplifiers, comparison of performance of the three configurations, High frequency FET circuits, CS amplifier at high frequencies, CD amplifier at high frequencies.

Multistage Amplifiers: Types of coupling, Choice of amplifier configuration, overall voltage gain and Bandwidth of n-stage amplifier, Darlington and Bootstrap circuits.

UNIT-III

Feedback amplifiers: Feedback concept, Classification, Effects of negative feedback on gain, Stability, Noise, Distortion, Bandwidth, input resistance and output resistance.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Crystal oscillators.

UNIT-IV

Power Amplifiers: Series-Fed Class-A power amplifiers, Transformer coupled class-A power amplifiers, Push-pull amplifiers, Class-B amplifiers, Class-AB operation, Complementary symmetry Push-Pull class-B Power amplifiers

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load

UNIT-V

Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR, circuits to improve CMRR, transfer characteristics.

Operational Amplifier: Ideal op-amp characteristics, Op-amp internal circuit, examples of IC op-amps, DC and AC characteristics, Inverting and non-inverting modes of operation, voltage follower.

Text Books :

1. Millman and Halkias, “Integrated Electronics”, McGraw-Hill Co
2. Mottershed, “Electronic devices and circuits”, PHI
3. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
4. Salivahanan, “Electronic Devices and circuits”, TMH.
5. David A. Bell, “Electronic Devices and circuits”, PHI
6. D.Roy Choudary, Shail Bala Jain, “Linear Integrated circuits”, New Age International publishers,

2018.
7. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
8. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
9. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Saunder's College Publishing, IV Edition.
10. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition.

Course outcomes :
Upon successful completion of the course, the student will be able to:

1. Design and analyze various amplifier circuits.
2. Design sinusoidal oscillators.
3. Understand the functioning Power Amplifiers, Differential amplifier..
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	1	-	-	2	1	-
CO2	2	2	2	2	1	-	1	-	1	1	-	2	-	-
CO3	2	2	2	2	1	-	-	-	1	-	-	2	-	-
CO4	3	2	3	2	1	-	-	1	1	-	-	1	-	1

ECMN04(EC404C) - IC Applications

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: The main aim of this lab is to teach the linear and non-linear applications of operational amplifiers (741). Students are made familiar with theory and applications of 555 timers. Students are made to Design combinational logic circuits using digital ICs.

Course Objectives:

1. To introduce the basic building blocks of linear integrated circuits.
2. To teach the linear and non - linear applications of operational amplifiers
3. To introduce the theory and applications of analog multipliers and PLL.
4. To understand and implement the working of basic digital circuits

UNIT-I

Op-Amp Applications: Scale changer/inverter, Summing amplifier, Instrumentation amplifier, Instrumentation amplifier IC-AD620, DC and AC amplifiers, V to I and I to V converters, Precision rectifiers, Log and Antilog amplifiers, multiplier and divider, Analog multiplier IC-AD633, Differentiator, Integrator, Analog computation.

. **UNIT-II**

Comparators and waveform generators: Comparator, Regenerative comparator (Schmitt Trigger), Astable and mono-stable multi-vibrators using op-amp, Triangular wave generator, Sine wave generators using op-amp. IC waveform generator (8038).

UNIT-III

Voltage regulators: Series op-amp regulator, IC voltage regulators, 723 General purpose regulator, Switching regulators.
Active filters: Low pass, high pass, band pass, band reject and all pass filters, transformation, State variable filter, Switched capacitor filters, Switched capacitor filter ICs.

UNIT-IV

555 Timer: Description of functional diagram, Monostable operation. Applications in monostable mode, Astable operation, Applications in astable mode, Schmitt trigger.
Phase Locked Loops: PLL- introduction, block schematic, principles and description individual blocks, IC PLL (565), Voltage controlled oscillator (566), PLL applications- Frequency multiplication, Frequency translation, FM & FSK demodulation.

UNIT-V

D-A and A-D Converters: Basic DAC Techniques, Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R ladder, Monolithic DAC IC-1409, A-D converters, direct type ADCs, the parallel comparator(flash) A/D converter, The counter type A/D converter, Servo tracking A/D converter, Successive approximation converter, Integrating type of ADCs, Charge balancing ADC, Dual-slope ADC, DAC/ADC specifications.

Text Books :

1. D.Roy Choudary, Shail Bala Jain, “Linear Integrated circuits”, New Age International publishers, 2018.
2. Ramakant A.Gayakward, “Op-amps and linear Integrated circuits”, LPE, 4th edition, Pearson Education.
3. S.Salivahanan, V.S.Kanchana Bhaaskaran “Linear Integrated circuits”, TMH, 2008.
4. David A. Bell, “Operational amplifiers and Linear ICs”, PHI, EEE, 1997.
5. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992. Sons, 1975.

Course outcomes :
Upon successful completion of the course, the student will be able to:

1. Understand the functioning of OP-AMP and design OP-AMP based circuits.
2. Understand the functioning of voltage regulators and design IC based voltage regulators,
3. Understand the functioning of 555 timer and design 555 timer based circuits.
4. Understand the functioning of PLL and design PLL based circuits.
5. Design ADC and DAC circuits.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	-	1	-	-	2	1	-
CO2	2	2	2	2	1	-	1	-	1	1	-	2	-	-
CO3	2	2	2	2	1	-	-	-	1	-	-	2	-	-
CO4	3	2	3	2	1	-	-	1	1	-	-	1	-	1

ECMN05(EC604C-Program Elective-II)- Electronic Instrumentation

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course deals with the basics of electronic instruments used in laboratory and industry. In the process they learn different type of instruments like voltmeter, ammeter, Q meter, Bridges, transducers and display devices CRO, CRT. After learning this subject student will be master in working principle and application of all types of instruments.

Course Objectives:

1. To explain basic concepts and definitions in measurement.
2. To describe the bridge configurations and their applications.
3. To understand, design aspects and performance criterion of measuring instruments.
4. To understand the working principle of various transducers.

UNIT-I

Measurement and Error: Definitions, accuracy and precision, types of errors.
DC Ammeters, DC Voltmeters, Series type ohmmeter, Shunt type ohmmeter. AC Voltmeter using rectifiers, True RMS responding voltmeter. Analog Instruments – Transistor voltmeter, micro voltmeter (chopper type) - DC differential voltmeter - AC voltmeters.

UNIT-II

Cathode Ray Oscilloscopes : Motion of electron in electric field and in magnetic field – Block diagram of CRO, CRT, Electrostatic deflection sensitivity – Vertical and Horizontal deflection systems – Principle of operation of Dual beam, Digital, Dual trace, Sampling and Storage CROs – Measurements with CRO (voltage, current, time, frequency, phase angle, Lissajous figures).

UNIT-III

Q meter and measurement methods.
Bridges: Wheatstone, Kelvin's, Maxwell, Hay and Schering bridges.
Wave analyzers (AF & RF) - Harmonic distortion analyzers – Spectrum analyzer.

UNIT-IV

Digital instruments – Digital voltmeters (Ramp, Dual slope, stair case, successive approximation types) Digital Multimeter, universal counter, Digital tachometer, Digital phase meter IEEE 488 Bus.

UNIT-V

Transducers – Classification and selection of transducers – strain gauges – Temperature measurement (resistance thermometer, thermo couples and thermistors) LVDT – Peizo electric transducer..

Text Books :

1. 1. H.S.Kalsi, "Electronic Instrumentation" TMH, 1995.
2. Helfric and Cooper, "Modern Electronic Instrumentation and measurement techniques", PHI, 1995.
3. A.K.Sawhney , " Electrical and electronic measurements and instrumentation", Danapat Rai & Co.,18th edition., 2007.

E-resources and other digital material
1.https://nptel.ac.in/courses/108106070
2.https://nptel.ac.in/courses/108106070

Course outcomes :
Upon successful completion of the course, the student will be able to:

1. Emphasize the basic electronics measurement concepts & Design the different analog and digital electronics voltmeters
2. Identify and use different analyzers oscilloscopes.
3. Design the Measurement of different bridges& generators to make measurements and analyze measurement.
4. Analyze the concepts of Transducers based on application

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**		
CO2	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	1	
CO3	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**2**		1
CO4	**3**	**2**	**3**	**3**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	1	

ECMN06(EC603C --Program Elective-I)**- CMOS VLSI Design**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This is an introductory course that covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems including CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation and testing, low power techniques, design tools and methodologies, VLSI architecture.
Prerequisite Courses: Electronic Devices, Analog Circuits and Digital Logic Design.

Course Objectives:

1. To learn basic CMOS Circuits.
2. To learn CMOS process technology.
3. To learn techniques of chip design using programmable devices.
4. To learn the concepts of designing VLSI Subsystems

UNIT-I

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.
Brief Introduction to MOS, PMOS, NMOS, CMOS & BiCMOS technologies. Review of MOS transistor models, Non-ideal behavior of the MOS Transistor, $I_{ds} – V_{ds}$ relationships, MOS transistor threshold Voltage, Transistor as a switch, Inverter characteristics**.**

UNIT-II

Integrated Circuit Layout: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for CMOS Inverters and Gates, Scaling of MOS circuits.
Basic Circuit Concepts: Sheet Resistance R_s and its concepts to MOS, Area Capacitance calculations, Inverter Delays, driving large Capacitive Loads, Wiring Capacitances. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout

UNIT-III

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic, Switch logic, Alternate gate circuits. Shifters, Adders, Parity generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multipliers, Counters, High Density Memory Elements.

UNIT-IV

Sequential Circuit Design: Static Circuits, Design of latches and Flip-flops.
Test and Testability: Fault-modeling and simulation, test generation, design for testability, Built-in-self-test.

UNIT-V

Physical Design: Floor-Planning, Placement, routing, Power delay estimation, Clock and Power routing.
Design styles: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices. .

Text Books :

1. 1 Neil H.E. Weste and David Money Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2015.
2. Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, Essentials of VLSI circuits and systems, PHI, 2005 Edition.
3. John M. Rabaey, A. Chandrakasan, B. Nikolic, Digital Integrated Circuits: A Design Perspective", 2nd Edition, Pearson, 2016.

Course outcomes :
Upon successful completion of the course, the student will be able to:

1. Learn CMOS process technology.
2. Analyze and implement various CMOS static logic circuits using Lambda based design rules.
3. Design different CMOS circuits using various logic families along with their circuit layouts for subsystem design.
4. To learn techniques of chip design using programmable devices and use HDL tools for designing VLSI Subsystems.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**					**-**	**-**	**-**		**-**	**-**			
CO2	**2**	**1**	**3**							**-**	**-**		1	
CO3	**2**			**3**		**-**	**-**	**-**		**-**	**-**			
CO4	**2**	**1**				**-**	**-**	**-**		**-**	**-**			1

Courses offered for Minors in Communications

ECMN11((EC303C))- Signals and Systems

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course focuses on analyzing signals (sound, voltage, communication transmissions, pressure, images, etc.) and the systems that act on them (circuits, physical echos, mechanical dynamics, modulation, etc.). We concentrate on the Fourier transform and linear-time invariant systems, providing a depth of tools for sampling, manipulating, preserving, and interpreting information signals

Course Objectives:

1. To represent and classify signal and systems.
2. Represent and apply singularity functions.
3. Obtain the response of a continuous, linear, time-invariant, causal system by using convolution.
4. Obtain the Fourier series expansion of a periodic signal and apply it to continuous, linear, time-invariant systems.
5. Obtain and plot the Fourier transform for simple a periodic continuous-time signals.

UNIT-I

Introduction to Signals and Systems:

Definition and classification of signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character, Elementary signals such as Impulse, step, ramp, sinusoidal and exponential signals, Operations on signals. Basic System Properties (Continuous-Time and Discrete-Time): linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability, Examples, Causal LTI Systems Described by Differential and Difference Equations.

Signal Analysis:

Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions.

UNIT-II

Fourier series and Fourier Transform:

The Response of LTI Systems to Complex Exponentials. Fourier series Representation of Continuous-Time Periodic Signals, Convergence of the Fourier series, Properties of Continuous-Time Fourier Series. The Continuous-Time Fourier Transform – properties. Discrete-Time Fourier Transform – Properties, Basic Fourier Transform Pairs. Introduction to Hilbert Transform.

UNIT-III

Convolution and Correlation of Signals:

Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Convolution property of Fourier transforms, Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation, Extraction of signal from noise by filtering.

UNIT-IV

Behaviour of continuous and discrete-time LTI systems:

The Magnitude-Phase Representation of the Fourier Transform, The Magnitude-Phase Representation of the Frequency Response of LTI Systems, Distortion less transmission through a system, signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time, State-space Representation of systems, State-Space Analysis, Multi-input, multi-output representation.

Sampling and Reconstruction:

The Sampling Theorem and its implications, Spectra of sampled signals, Reconstruction: ideal interpolator, zero-order hold, first-order hold, Aliasing and its effects. Relation between continuous and discrete time systems, Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

UNIT-V

The Laplace Transform -The Region of Convergence - Properties, The Inverse Laplace Transform, Laplace Transform Pairs, Analysis and Characterization of LTI Systems Using the Laplace Transform, Unilateral Laplace Transform. The Z-Transform -Region of Convergence - Properties, The Inverse z-Transform, Common z-Transform Pairs, Analysis and Characterization of LTI Systems Using z-Transforms, Unilateral z-Transform.

Text Books :

1. 1.Alan V. Oppenheim, Alan S. Willsky, & S. Hamid Nawab, “Signals and Systems,” Pearson Higher Education, 2nd Ed., 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. Simon Haykin and B. Van Veen, “Signals & Systems,” John Wiley and Sons, 2nd Edition, 2007.
4. B.P. Lathi, “Principles of LINEAR SYSTEMS and SIGNALS,” Oxford Univ. Press, Second Edition, International version, 2009.
5. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
6. Luis F. Chaparro, “Signals and Systems using MATLAB,” Academic Press, 2011.
7. C. L. Philips, J. M. Parr and Eve A. Riskin, “Signals, Systems and Transforms,” Pearson Education, 4th Edition, 2008.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Analyze different types of signals
2. Understand the concepts of continuous time and discrete time systems.
3. Analyze systems in complex frequency domain.
4. Investigate whether the system is stable or not.
5. Understand sampling theorem and its implications

Mapping of course outcomes with program outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	--	--	--	--	--	--	--	--	--	--	3	1	--
CO2	--	1	--	--	--	2	--	--	--	2	--	2	--	1
CO3	2	2	2	--	--	--	--	--	--	--	2	2	1	--
CO4	2	2	--	--	--	--	--	--	--	--	--	2	--	1

ECMN12(EC402C)**- Probability theory & Stochastic Process**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course explanations and expositions of probability and stochastic processes concepts which they need for their experiments and research. It also covers theoretical concepts of probability and stochastic processes pertaining to handling various stochastic modeling.

Course Objectives:

1. To provide mathematical background and sufficient experience so that student can read, write and understand sentences in the language of probability theory.
2. To introduce students to the basic methodology of "probabilistic thinking" and apply it to problems.
3. To understand basic concepts of Probability theory and Random Variables, how to deal with multiple Random Variables.
4. To understand the difference between time averages statistical averages

UNIT-I

Sets and set operations, Probability space, Conditional probability Total Probability, and Bayes theorem, Combinatorial probability and sampling models.

Discrete random variables, probability mass function, probability distribution function, example random variables and distributions. Continuous random variables, probability density function, probability distribution function, example distributions

UNIT-II

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments, Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

UNIT-III

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, Central Limit Theorem, (Proof not expected), Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNIT-IV

Random Process: Classification of Processes, Stationary processes, Mean and covariance functions, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function & Its Properties, Cross-Correlation Function & its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

Power spectral density, Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

UNIT-V

Transmission of random process through LTI systems: System Response – Convolution, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, properties of white noise, Band pass, Band-Limited and Narrowband Processes, Properties

Text Books :

1. H. Stark and J. Woods, “Probability and Random Processes with Applications to Signal Processing”, 3rd Edition, Pearson Education.
2. Athanasios Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes”, PHI, 4th Edition, 2002.
3. Peyton Z. Peebles, “Probability, Random Variables & Random Signal Principles”, Tata McGraw Hill, 4th Edition, 2001.
4. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International.
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
6. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers.
7. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand representation of random signals.
2. Investigate characteristics of random processes.
3. Make use of theorems related to random signals.
4. Able to Model of different Noise Sources and to understand propagation of random signals in LTI systems

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	--	--	--	--	--	--	--	--	--	--	3	1	--
CO2	--	1	--	--	--	2	--	--	--	2	--	2	--	1
CO3	2	2	2	--	--	--	--	--	--	--	2	2	1	--
CO4	2	2	--	--	--	--	--	--	--	--	--	2	--	1

ECMN13 (EC405C)**- Analog Communications**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**

Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: This course gives concepts of Different Analog communications which they need for their experiments and research.

Course Objectives: To understand

1. The concepts of various Amplitude, Angle and Pulse Modulation schemes and information theory with random processes.
2. The working principle of Radio Receivers

. **Unit – I**

Introduction: Elements of communication systems, Information, Messages and Signals, Modulation, Modulation Methods, Modulation Benefits and Applications.

Amplitude Modulation & Demodulation: Baseband and carrier communication, Amplitude Modulation

(AM), Rectifier detector, Envelope detector, Double sideband suppressed carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Frequency mixer, sideband and carrier power of AM, Generation of AM signals, Single sideband (SSB) transmission, Time domain representation of SSB signals & their demodulation schemes (with carrier, and suppressed carrier), Generation of SSB signals, Vestigial sideband (VSB) modulator & demodulator, Frequency division multiplexing (FDM), Illustrative Problems.

UNIT-II

Angle Modulation & Demodulation: Concept of instantaneous frequency, Generalized concept of angle

modulation- Frequency Modulation & Phase modulation : Bandwidth of angle modulated waves, Narrow band frequency modulation (NBFM) and Wide band FM (WBFM), Verification of Frequency modulation bandwidth relationship, Features of angle modulation, Generation of FM waves-Indirect method, Direct generation; Demodulation of FM, Band pass limiter, Practical frequency demodulators, Small error analysis, Pre-emphasis, & De-emphasis filters, FM Capture Effect, Illustrative Problems.

UNIT-III

Noise in Communication Systems: Thermal noise, Time domain representation of narrowband noise, filtered white noise, Quadrature representation of narrowband noise, Envelope of narrowband noise plus sine wave, Signal to noise ratio & probability of error, Noise equivalent bandwidth, Effective noise temperature, and Noise figure, Baseband systems with channel noise, Performance analysis (i.e. finding SNR expression) of AM, DSBSC, SSB-SC, FM, PM in the presence of noise, Illustrative Problems.

UNIT-IV

Radio Receivers: Working principle of Super heterodyne AM and FM Receivers along with suitable block diagrams, Sensitivity, Selectivity and fidelity.

Analog Pulse Modulation Schemes: Pulse amplitude modulation – Natural sampling, flat top sampling and Pulse amplitude modulation (PAM) & demodulation, Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, and demodulation schemes, PPM spectral analysis, Illustrative Problems.

UNIT-V

Information Theory: Introduction, Information and Entropy, and its properties, source coding Theorem, Data Compaction – Prefix coding, Huffman coding, Discrete Memory less channels, Mutual Information, and its properties, Channel capacity, Channel coding Theorem, Application to binary symmetric channels, differential entropy and mutual information, Information capacity theorem, implication of information capacity theorem, Rate Distortion, Illustrative problems

Text Books:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006.
2. Simon Haykin, "Communication Systems," by John Wiley & Sons,3rdEdition, 2010.
3. Sham Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2006.

REFERENCES:

1. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", McGraw-Hill International Edition, 5th Edition, 2010.
2. Herbert Taub&Donald L Schilling, "Principles of Communication Systems", Tata McGraw-Hill, 3rd Edition, 2009.
3. . R.E. Ziemer& W.H. Tranter, "Principles of Communication-Systems Modulation & Noise", Jaico Publishing House, 5thedition, 2001.
4. George Kennedy and Bernard Davis, "Electronics & Communication System", TMH,2004.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the concepts of various Amplitude, Angle and Pulse Modulation schemes and information theory with random processes and to solve problems in analog and pulse modulation schemes
2. Analysis of analog communication system in the presence of noise.
3. Compare and contrast design issues, advantages, disadvantages and limitations of various modulation schemes in analog communication systems.
4. Solve basic communication problems & calculate information rate and channel capacity of a discrete communication channel.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	--	--	--	1	--	--	--	--	--	--	3	1	--
CO2	3	1	2	--	2	2	--	1	--	2	--	2	--	1
CO3	2	2	2	--	--	--	--	1	--	--	2	2	1	--
CO4	2	2	2	--	1	--	--	--	--	--	--	2	--	1

ECMN14(EC505C) **- Digital Communications**	
Instruction: Hours/Week: **3L:0T:0P**	**Credits: 3**
Sessional Marks: **40**	End Semester Examination Marks: **60**

Course Description:
This course provides an introduction to voice and data networking technologies, including public and pri vate voice services, Ethernet and Internet data technologies, network security, business applications and network management. The structure, regulation, andhistory of the telecom and data network industry wil l be discussed as well.

Course Objectives:

1. To protocol, algorithms, trade-offs rationale.
2. To routing, transport, DNS resolutions
3. To network extensions and next generation architecture.

UNIT I

Source Coding Systems: Sampling, Quantization, Quantization noise, Encoding, Pulse Code Modulation (PCM), Line codes, Regeneration, Decoding and Filtering, Noise considerations in PCM systems, Time-Division Multiplexing (TDM), Synchronization, Differential encoding, Delta modulation (DM), Differential Pulse Code Modulation (DPCM), Processing gain, Adaptive Delta Modulation (ADM).

UNIT II

Introduction to Baseband Pulse Transmission, Matched filter and it's Properties,Matched filter for rectangular pulse, Error rate due to noise, Inter-symbol Interference (ISI), Nyquist's criterion for distortion less baseband binary transmission, Duo binary, Modified duo binary in Correlative-level coding, Baseband M-array PAM transmission, Eye diagrams.

UNIT III

Signal Space Analysis: Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Conversion of the Continuous AWGN channel into a vectorchannel, Coherent detection of signals in noise, Correlation receiver, Probability of error**.**

UNIT IV

Passband Data Transmission: Introduction, Passband transmission model, ASK, Coherent Phase Shift Keying – Binary phase shift keying (BPSK), Quadrature shift keying (QPSK), Binary Frequency shift keying (BFSK), M-array Quadrature Amplitude Modulation (M-array QAM), Non-coherent orthogonal modulation schemes-Differential PSK, Non-Coherent Binary FSK.
(Error probability, Generation and Detection, Power spectra, signal constellation diagram of above schemes)

UNIT-V

Error Control Coding: Repetition & Parity Check Codes, Interleaving, Code Vectors and Hamming Distance, Forward Error Correction (FEC)Systems, Linear Block Codes, Cyclic Codes, Convolutional Encoding methods- Code Tree, Trellis and State Diagram, Decoding Methods- Sequential, Viterbi.

Text Books :

1. Simon Haykin, "Communication Systems," by John Wiley & Sons,3rd Edition, 2010.
2. Sam Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2006.

REFERENCES:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006.
2. J.S. Chithode, "Digital Communications", Technical Publications, Ist Edition, 2020

3. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", McGraw-Hill International Edition, 5th Edition, 2010.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the Digital communication System and able to analyse the different Digital modulation techniques.
2. Understand the concepts of baseband digital modulation schemes and Inter Symbol Interference.
3. Analyze Signal space concepts, probability of error performance of various digital binary modulation systems and are able to design digital communication systems.
4. Design a system with Error correcting codes by learning Block Codes, Cyclic Codes and Convolution Codes.

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	-	-	-	3	2
CO2	2	1	1	2	-	-	-	-	-	-	-	-	2	3
CO3	1	1	1	1	-	-	-	-	-	-	-	-	3	2
CO4	1	1	1	2	1	-	-	-	-	-	-	1	2	2

ECMN15(EC504C) **Antenna Wave Propagation**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: Antennas and propagation effects play a crucial role in RF systems. In practice, the design of a working system such as mobile phone networks, WiFi, RFID, Satellite communication and GPS requires a good understanding of these components. This course teaches the fundamentals of antenna and propagation and shows the application in practical examples. The course covers the theory of radiation, fundamental antenna parameters and concepts, wire antennas such as dipoles and loop antennas, antenna arrays, aperture antennas, microstrip antennas, numerical analysis, communication & radar systems and propagation effects.

Course Objectives:

1. To understand the concept of radiation, antenna definitions and significance of antenna parameters, to derive and analyze the radiation characteristics of thin wire dipole antennas and solve numerical problems.
2. To analyse the characteristics and design relations of UHF, VHF and Microwave Antennas.
3. To identify the antenna array requirements, to determine the characteristics of ULAs and estimate the patterns of BSA, EFA, and Binomial Arrays.
4. To understand the concepts and set-up requirements for microwave measurements, and familiarize with the procedure to enable antenna measurements.
5. To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.

UNIT-I

Antenna Basics: Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Fields from Oscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation,
Retarded Potentials–Helmholtz Theorem
Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths. Loop Antennas.

UNIT-II

Antenna Arrays: Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays.

UNIT-III

VHF, UHF and Microwave Antennas - I: Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics, Helical Antennas – Helical Geometry, Helix Modes, Practical Design

Considerations for Monofilar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types,Fermat's Principle, Optimum Horns, Design Considerations of Pyramidal Horns.

UNIT-IV

VHF, UHF and Microwave Antennas - II: Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas – Geometry and Parameters, Characteristics of Microstrip Antennas. Reflector Antennas – Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features.

UNIT-V

Ground Wave Propagation –Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation –Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering phenomena, Troposphere Propagation. Sky Wave Propagation –Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation.

Text Books :

1. Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4th ed., (Special Indian Edition), 2010.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd edition,2000.
3. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
4.. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications,New Delhi, 2001..

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand the basic parameters of antenna (L1) and apply the concepts to various antennas based on frequency, configuration and establish the radiation patterns of antenna arrays (L2)
2. Analysis of VHF, UHF and Microwave Antennas (L3)
3. Design and analysis of microstrip antennas (L4)
4. To understand the wave propagation in different frequency ranges (L5)

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	2	1	2	1	3	3		
CO2	3	3	2	2	1	2	3	2	2	1	3	3		
CO3	3	2	2	2	1	2	3	1	1	1	2	3		
CO4	3	3	2	3	2	2	3	-	1	1	2	3		

ECMN16((EC601C)- **Microwave Engineering**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: The course will be broadly focusing on analysis, design and development of microwave circuits and systems. The course will cover introduction to Microwaves, Microwave transmission modes, Transmission lines, Impedance Matching, Microwave Network Analysis, Directional Coupler, Power Divider, Microwave Filters, Microwave Attenuator, RF switches and phase shifters, Microwave Amplifiers, Low Noise Amplifier, Microwave Mixers and Oscillators, Microwave Antennas, Microwave Measurements, Microwave Systems.

Course Objectives:

1. To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
2. To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
3. To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S-Matrix for various types of microwave junctions.
4. Understand the utility of Optical Fibres in Communications

UNIT – I

Microwave Tubes: Limitations and Losses of conventional Tubes at Microwave frequencies,
Cavity Klystrons – Structure, Re-entrant Cavities, Velocity Modulation Process, Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics. Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process(qualitative treatment), Suppression of Oscillations, Gain Considerations**.**

UNIT - II

M-Type Tubes: Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical Traveling Wave Magnetron – Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics,
Microwave Solid State Devices: Introduction, Classification, Applications. Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

UNIT - III

Waveguide Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees. Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components – Gyrator, Isolator**.**

UNIT – IV

Scattering matrix: Importance of S-matrix, Scattering Matrix Properties, Directional Couplers – 2 Hole, Bethe Hole S Parameters, [s] matrix of Magic Tee and Circulator, Measurement of S-parameters.
MICs : Advantages of MIC’s, Hybrid MIC’s, Strip lines and microstrip lines, Monolithic MICs

UNIT V

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, Measurement of Low and High VSWR., Cavity Q-factor and Impedance Measurements. Antenna gain measurements.

Text Books :

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition
3. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 4t.
4. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012
5. Kulkarni, "Microwave and Radar Engineering", Umesh publications, 1998.
6. Annapurna Das and Sisir K.Das, "Microwave Engineering" Tata Mc Graw-Hill, 2000.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Known power generation at microwave frequencies and derive the performance characteristics. (L2)
2. Understand the principles of solid state devices. (L1)
3. Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications (L4)
4. Understand the utility of S-parameters in microwave component design (L3) and to know the measurement procedure of various microwave parameters. (L5)

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	1	2	1	2	2	3	3	1	
CO2	3	2	2	2	1	2	2	2	2	2	3	2		
CO3	3	2	2	3	1	2	2	2	1	2	3	2		1
CO4	3	2	3	3	2	2	2	1	2	1	3	3		

ECMN17(EC602C-)- Computer Networks
Instruction: Hours/Week: **3L:0T:0P** **Credits: 3** Sessional Marks: **40** End Semester Examination Marks: **60**
Course Description: **:** Computer Networks plays an vital role in the era of communication systems in resources sharing applications. The aim of this course is to introduce the concepts of Computer networking and its applications.
Course Objectives: To gain knowledge in developing different applications 1. To understand the basic concepts of computer networks and internet 2. To gain knowledge about the design issues of link layer and internet layer 3. To gain knowledge about the concept of connection oriented and connection less Protocols.
Unit -I Introduction to Computer Networks and the Internet: Principles of network applications and Internet Challenges &Layering concepts. OSI Reference Model & TCP/IP Reference Model. **Unit -II** **Link layer:** ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, Ethernet, Wireless LAN,Flow Control, Error Detection and Error Correction. **Unit -III** **Internet Layer**: IP Addressing, IP Protocol, Routing Algorithms, queuing disciplines. Congestion Control Algorithms, Resource Reservation ,Admission Control and Differentiated services **Unit -IV** **Transport Layer:** User Datagram Protocol, Connection oriented transport protocol– Transmission Control Protocol, Remote Procedure Call. Port Addressing and Socket Programming. **Unit –V** **Application layer**: The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing,JPEG,MPEG . Network Security: DES & RSA
Text Books : 1. J.F. Kurose and K. W. Ross, 1.“Computer Networking – A top down approach Pearson Education, 5th Edition 2. Andrew S Tanenbaum, “Computer Networks”, Prentice Hall India Fourth Edition. 3. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 4th Edition 4. D. Comer, “Computer Networks and Internet/TCP-IP”, Prentice Hall 5. William Stallings, “Data and Computer Communication, 8th Edition, Pearson Prentice
Course outcomes : Upon successful completion of the course, the student will be able to: 1. Design of computer networks in Internet.

2. Understand the concepts of error handling ,flow control ,IP Addressing and Routing.
3. Understand the concept of TCP and UDP protocols.
4. Develop several protocols foe web Applications

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	3	2	2	2	_	3	3		
CO2	1	1	1	1	1	1	3	3	2	3	1	_	1	
CO3	1	1	1	1	1	1	3	3	2	3	1	_		1
CO4	3	3	3	3	2	3	2	2	3	_	3	_		

ECMN18(EC604C-Program Elective-II)**- Cyber Security**

Instruction: Hours/Week: **3L:0T:0P** **Credits: 3**
Sessional Marks: **40** End Semester Examination Marks: **60**

Course Description: The course deals with the underlying principles of cryptography and network security. It develops the mathematical tools required to understand the topic of cryptography. Starting from the classical ciphers to modern day ciphers, the course provides an extensive coverage of the techniques and methods needed for the proper functioning of the ciphers. The course deals with the construction and cryptanalysis of block ciphers, stream ciphers and hash functions. The course defines offers the construction and cryptanalysis of public key ciphers, namely RSA. The key exchange problem and solutions using the Diffie-Hellman algorithm are discussed. Message Authentication Codes (MAC) and signature schemes are also detailed. The course deals with modern trends in asymmetric key cryptography, namely using Elliptic Curves. The course ends with the awareness about different network attacks and precautions to be taken for the security.

Course Objectives:
1. To know the basics of Cryptography and Network Security.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4. To have the knowledge of security requirements for a network against various threats.

Unit -I

Introduction: OSI Security Architecture - Classical Encryption techniques – Cipher Principles – Data Encryption Standard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES – AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality

Unit –II

Public Key Cryptography Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography - Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography and RSA.

Unit -III

Authentication And Hash Function: Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm - Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard.

Unit -IV

Network Security Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME - IP Security – Web Security.

Unit –V

System Level Security Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

TextBook:

1. William Stallings, “Cryptography And Network Security – Principles and Practices”, Prentice Hall of India, Third Edition, 2003.

References:

1. Atul Kahate, “Cryptography and Network Security”, Tata McGraw-Hill, 2003.
2. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2001.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Third Edition, Pearson Education.

Course outcomes :

Upon successful completion of the course, the student will be able to:

1. Understand different encryption techniques
2. Implement basic security algorithms required by any computing system
3. Analyze the vulnerabilities in any computing system to design a security solution
4. Analyze the possible security attacks and their effective countermeasures in real time systems

Mapping of course outcomes with program outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	1	-	-	-	-	2	-	-	-
CO2	3	3	3	2	1	2	-	-	-	-	2	-	-	-
CO3	3	3	2	3	2	2	-	-	-	-	3	3	3	3
CO4	3	3	3	2	2	2	-	-	-	-	3	3	3	3