Panchajanya Vidya Peetha Welfare Trust (Regd)

Dr. Ambedkar Institute of Technology

An Autonomous Institution, Affiliated to Visvesvaraya Technological University, Belagavi,
Aided by Govt. of Karnataka, Approved by All India Council for Technical Education (AICTE), New Delhi
Accredited by NBA and NAAC with 'A' Grade
BDA Outer Ring Road, Mallathalli, Bengaluru - 560 056

Ref. No. ..... Date : .....

Department of Electronics and Telecommunication

Subject	Subject code	Remarks	Year
Microcontroller using Assembly and C Language	18ET41	Skill development	2021
Fundamentals of Telecommunications	18ET42	Skill development	2021
Fundamentals of Hardware Language Description	18ET44	Skill development	2021
Transmission Lines & Wave guides	18ET45	Skill development	2021
Microcontroller using Assembly and C Language	18ET41	Skill development	2021
Object Oriented Programming using C++	18ET552	Employability	2021
VLSI in Telecommunication Engineering	18ET553	Employability	2021
Principles of RADAR Engineering	18ET554	Employability	2021
Embedded System Design	18ET561	Employability	2021
Digital Image Processing	18ET562	Employability	2021
Object Oriented Programming using C++	18ET552	Employability	2021
Satellite Communication	18TE653	Skill development	2020
Digital Communication Lab	18TEL66	Employability	2020
Computer Communication Networks	18TEL67	Employability	2020
Microwave Engineering	18TE71	Skill development	2020
Wireless And Mobile Networks	18TE72	Employability	2020
Optical Networking	18TE73	Employability	2020
Mobile Communication	18TE732	Skill development	2020
Control System	18TE551	Employability	2019
Object Oriented Programming using C++	18TE552	Skill development	2019
Signals and systems and DSP Lab	18TEL57	Skill development	2019
Analog Communication & LIC Lab	18TEL58	Skill development	2019
Computer Communication Networks	18TE61	Employability	2019
Information Theory and Coding	18TE62	Employability	2019
Digital Communication	18TE63	Skill development	2019
Control System	18TE551	Employability	2019
Object Oriented Programming using C++	18TE552	Skill development	2019
Wireless & Mobile Networks	TE72	Employability	2018
Cryptography and Network Security	TE832	Employability	2018
Digital Image Processing	TE744	Skill development	2018
GSM	TE835	Employability	2018
High performance computer networks	TE834	Employability	2018
Internet of Things	TE746	Skill development	2018
Transmission Lines and Control Systems	TE42	Skill development	2018

Signature of BOS Chairman

Signature of Principal

PRINCIPAL
Dr. Ambedkar Institute of Technology
Bengaluru-560 056

Dr. Ambedkar Institute of Technology
Department of Electronics & Telecommunication Engineering

The enclosed documents are verified and approved.

for HoD H. O. D
Dept. of Electronics & Telecommunication Engg.
Dr. Ambedkar Institute of Technology
Bengaluru-560 056

Sub Title : DIGITAL SYSTEM DESIGN		
Sub Code:TE32	**No. of Credits 4 = 4 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours :52**

Course Objectives:

1. To learn the methods of simplifying the digital circuits.
2. To design combinational circuits like arithmetic circuits, code converters multiplexers and de-multiplexers.
3. To design and analyse sequential circuits such as registers and counters using flip-flops.
4. To design and analyse digital circuits using Mealy and Moore models.
5. To apply combinational and sequential circuits in the design of digital systems.

UNIT No.	Syllabus Content	No. of Hours
1.	**Principles of combinational logic:** Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3 and 4 variables, Incompletely specified functions (Don't Care terms), Simplifying Max term equations. Quine-McCluskey minimization technique- Quine-McCluskey using don't care terms, Reduced Prime Implicant Tables, Map entered variables.**(Text 1)**	**12**
2.	**Design of combinational logic:** General approach, Decoders-BCD decoders, Encoders. Digital multiplexers - Using multiplexers as Boolean function generators. Adders and subtractors- Cascading full adders, Look ahead carry adder, Binary comparators.**(Text 1)**	**12**
3.	**Sequential Circuits-I:** Basic Bistable Element, Latches, SR Latch, Application of SR Latch, A Switch Debouncer, The Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, the Master-Slave JK Flip- Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop.**(Text 2)**	**09**
4.	**Sequential Circuits-II:** Characteristic Equations of flip-flops, Registers, Counters - Binary Ripple Counters, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-6 Counter using clocked JK Flip-Flops Design of a Synchronous Mod-6 Counter using clocked D, T, or SR Flip-Flops.**(Text 2)**	**09**
5.	**Sequential Design:** Introduction, Mealy and Moore Models, State Machine notation, Synchronous Sequential Circuit Analysis and Design. Construction of state Diagrams, Counter Design, introduction to Programmable logic devices.**(Text 2)**	**10**

Note 1: Unit 3 and Unit 4 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5

Course Outcomes :

CO1: Learnt the simplification of Boolean expressions and realize with minimum logic gates.
CO2: Analyze the given digital circuits.
CO3: Design various types of combinational and sequential circuits.
CO4: Realize higher order digital circuits using lower order digital circuits.
CO5: Apply combinational and sequential circuits in the design of digital systems.

COs	Mapping with Pos
CO1	PO1, PO2, PO7, PO10
CO2	PO2, PO3, PO4, PO8
CO3	PO3, PO4, PO7
CO4	PO3, PO4, PO9
CO5	PO5, PO6, PO9

TEXT BOOKS:

1. "**Digital Logic Applications and Design**", John M Yarbrough, Cengage Delmar Learning India Pvt, 2015.
2. "**Digital Principles and Design**", Donald D. Givone, Tata McGraw Hill, 1st Edition, 2007.

REFERENCE BOOKS/WEBLINKS:

1. "**Fundamentals of logic design**", Charles H Roth, Larry N. Kinney, Cengage Learning, 7th Ed., 2014.
2. "**Logic and computer design Fundamentals**", M. Morris Mono and Charles R. Kime, Pearson Publishers, 4th Edition, 2007.
3. http://elearning.vtu.ac.in/elcmys/CS33.html

Sub Title : CIRCUIT THEORY		
Sub Code: TE33	**No. of Credits: 3=3:0:0 (L:T:P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours :39**

Course Objectives :

1. To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
2. To understand the need of simplification techniques of complicated circuits using network theorems.
3. To learn about the comprehensive insight into the principle techniques available for characterizing Resonance circuits, networks and their evaluation of initial and final conditions and implementation in practice.
4. To learn applications of Laplace transforms in network applications
5. To gain knowledge of two-port network parameters modelling and their implementation.

UNIT No.	Syllabus Content	No. of Hours Teaching
1	**Basic Concepts:** Practical sources, Source transformations, Network reduction using Star – Delta transformation, Loop and Node analysis With linearly dependent and independentsources for DC and AC networks, Concepts of super Node and super Mesh, relevant problems.	8
2	**Network Theorems:** Superposition, Reciprocity and Millman's theorem, Thevinin's and Norton's theorems;Maximum Power transfer theorem, relevant problems.	8
3	**Resonant Circuits:** Series and parallel resonance, frequency response of series and parallel circuits, Q-factor, Bandwidth relevant problems.	7
4	**Transient behavior and initial conditions :** Behaviors of circuit elements under switching condition andtheir Representation, Evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations, relevant problems.	8
5.	**Laplace Transformation :** Solution of networks, step,ramp and impulse responses, waveform Synthesis, definition of transfer function, relevant problems **Two port network parameters :** Definition of z, y, h and transmission parameters .	8

Note 1: Unit 4 and Unit 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1:State and understand various Network theorems.
CO2: Understand basic concepts of Network Reduction techniques.
CO3: Apply knowledge of mathematics to solve and understand Network theorems related to network, initial conditions, Laplace Transformations, Two port network parameters
CO4: Analyse networks in terms of different two port network parameters.
CO5: Evaluate the transient behaviour of different networks, and quality factor of resonant

COs	Mapping with POs
CO1	PO1,PO2,PO4
CO2	PO2,PO4
CO3	PO1,PO2,PO3,PO4,PO5
CO4	PO1,PO4
CO5	PO1,PO4

TEXT BOOKS:

1. "**Network Analysis**", M. E. Van Valkenburg, PHI / Pearson Education, 3rd Edition. Reprint 2002.
2. "**Networks and systems**", Roy Choudhury,2nd edition,2009, New Academic Science Ltd.

REFERENCE BOOKS/WEBLINKS :

1."**Basic Circuit Analysis**" by John O'Maley, 2nd Edition, Schaum's Outlines,2011.
2."**Engineering Circuit Analysis**", Hayt, Kemmerly and Durbin, 8th Edition, TMH, 2013.
elearning.vtu.ac.in/06ES34.html

Sub Title : MEASUREMENTS AND INSTRUMENTATION		
Sub Code: TE34	**No. of Credits 3= 3:0:0(L:T:P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours : 39**

Course objectives :

1. To study different types of errors, instruments used to measure precision of electrical components.
2. To study various devices for the frequency measurement
3. To study the different types of Signal Generators.
4. To understand basic principles of oscilloscopes and other special oscilloscopes.
5. To study various types of transducers and display devices.

UNIT No.	Syllabus Content	No. of Hours
1	**Introduction** **(a) Measurement Errors:** Gross errors and systematic errors, Absolute and relative errors, Accuracy, Precision, Calibration of Instruments, Resolution and Significant figures. Problems (Text 1) **(b)Voltmeters and Multimeters :** Introduction, Multi range voltmeter, Extending voltmeter ranges, Loading, AC voltmeter using Rectifiers – Half wave and full wave, Peak responding and True RMS voltmeters, Calibration of DC Instruments & Ohmmeter. Problems (Text 1)	**08**
2	**Digital Instruments : Digital Voltmeters** – Introduction, DVM's based on V – T, V – F and Successive approximation principles, Problems Resolution and sensitivity, General specifications, Digital Multi-meters, Digital frequency meters, Digital measurement of time.(Text 1)	**06**
3	**Signal Generators** Introduction, Fixed and variable AF oscillator, Standard signal generator, Laboratory type signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator, Sweep frequency generator, Frequency synthesizer (Text 1) **Primary Sensors and Transducers**: Introduction, Electrical Transducers, LVDT , Piezoelectric transducer, Photoelectric transducer, Photovoltaic transducer , Types of Sensors and its applications, (Text 1)	**09**
4	Oscilloscopes Introduction, Basic principles. (Text 1) Special Oscilloscopes Delayed time-base oscilloscopes, Analog storage, Sampling and Digital storage oscilloscopes. Spectrum Analyzers: (Text 2)	07
5	Application of Transducers Active and Passive transducers, Digital and Analog Transducers, Resistive transducers, potentiometer, Strain gauges. (Text 1) Display devices: Digital display system, classification of display devices, LED's, LCD displays. Bolometer and RF power measurements using bolometer. (Text 1)	09

Note 1: Unit 3 and Unit 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4, Assignment – 3 from unit 5.

Course Outcomes :

CO1: Remember and define types of errors , precision, accuracy.
CO2: Understand different types of signal , function Generators.
CO3: Analyse different types of Oscilloscopes, Transducers, display devices.
CO4: Evaluate relative & absolute errors, and voltmeter readings.
CO5: Develop and execute the successive approximation in voltmeters.

Cos	Mapping with POs
CO1	PO1,PO2,PO3
CO2	PO1,PO3,PO4,PO6,PO8,PO10
CO3	PO1,PO2,PO3,PO4,PO10
CO4	PO1,PO2,PO3,PO6,PO10
CO5	PO1, PO2,PO3,PO4,PO10

TEXT BOOKS:

1. "**Electronic Instrumentation**", H. S. Kalsi, Tata McGraw-Hill Education, 2nd edition,2004.
2. "**Electronic Instrumentation and Measurements**", David A Bell, Prentice-Hall ofIndia Publication / Pearson Education, 2nd edition, 2006.

REFERENCE BOOKS/WEBLINKS:

1. "**Electronics and Electrical Measurements**", A K Sawhney, Dhanpat Rai Publications,9th edition, Reprint 2013.
2. "**Principles of Measurement Systems**", John P. Beately, 3rd Edition, Pearson Education,2000.
3. "**Modern Electronic Instrumentation and Measuring Techniques**", Cooper D and AD Helfrick, Prentice-Hall of India Publication, 2nd edition, 2007.
4. ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-071j-introduction-to-electronics-signals-and measurements

Subject Title : FIELD THEORY		
Sub Code: TE35	**No. of Credits:4= 3:1:0 (L:T:P)**	**No. of hours/week : 3(L)+2(T) = 5**
Exam Duration : 3 hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours : 65**

Course objectives :

1. To introduce the fundamental principles of static electric fields.
2. To understand the concepts of energy and potential.
3. To study Laplace's equations and Poisson's equations and its applications.
4. To introduce the principles of time-varying magnetic field.
5. To learn the use of time-varying Maxwell's equations for analyzing wave propagation.

UNIT No.	Syllabus Content	No. of Lecture Hours	No. of Tutorial Hours
1	**a. Coulomb's Law and electric field intensity**: Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge **,** relevant problems **b. Electric flux density, Gauss' law and divergence:** Electric flux density, Gauss' law, Divergence, Maxwell's First equation(Electrostatics), vector operator ∇ and divergence theorem, relevant problems	07	06
2	**Energy and potential :** Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and Potential, The potential field of a point charge and system of charges, Potential gradient , Energy density in an electrostatic field, relevant problems	08	05
3	**Conductors, dielectrics, boundary conditions :** Current and current density, Continuity of current, metallic conductors, Conductor properties and boundary conditions between conductor and dielectric material ,boundary conditions for perfect Dielectrics, relevant problems . **Poisson's and Laplace's equations:** Derivations of Poisson's and Laplace's Equations, Uniqueness theorem, relevant problems	09	05
4	The steady magnetic field: Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and Vector magnetic potentials, Relevant problems. Time Varying Maxwell's equations: Faraday's Law, Equation of Continuity.	07	05

5	Uniform Plane wave : Wave Propagation in free space and dielectrics, Poynting's theorem and Wave power, Propagation in good conductors – Skin Effect, Depth of penetration ,Normal incidence at dielectric-dielectric interface, Normal incidence at conductor-dielectric interface, relevant problems	08	05

Note 1: Unit 3 and Unit 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1: Understand the concepts of energy expended in moving a charge, potential gradient, vector magnetic potential, wave propagation in free space.
CO2: Remember Coulomb's law, Gauss's law, Ampere's law, Biot-Savart's law.
CO3: Evaluate Laplace's and Poisson's equations.
CO4: Apply knowledge of Maxwell's equations for interpretation of uniform plane wave.
CO5: Analyze the variations in EM waves at interface between two media.

COs	Mapping with Pos
CO1	PO1, PO2, PO10
CO2	PO1, PO2
CO3	PO1, PO2
CO4	PO1, PO2
CO5	PO1, PO2

TEXT BOOKS:

1. **"Engineering Electromagnetics",** William H Hayt Jr. and John A Buck**,**Tata McGraw- Hill, 8th edition, 2012
2. **"Electromagnetic Waves And Radiating Systems,"** Edward C. Jordan and Keith G Balmain, Prentice – Hall of India / Pearson Education, 2nd edition, 1968.Reprint 2002

REFERENCE BOOKS/WEBLINKS:

1. **"Electromagnetics",** Joseph A.Edminister, Mahmod Nahvi, Schaum Outline series, McGraw Hill,4th edition,2013
2. **"Fundamentals of Electromagnetics with MATLAB",** Karl Erik Lonngren,Sava Vasilev Savov, Randy J. Jost, SciTech Publication, 2nd edition,2007.
3. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013-electromagnetics-and-applications-spring-2009/lecture-notes/

Sub Title : TRANSMISSION LINES AND CONTROL SYSTEMS		
Sub Code: TE42	**No. of Credits : 4=4:0:0(L:T:P)**	**No. of lecture hours/week : 4**
Exam Duration : 3	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours : 52**

Course Objectives :

1. To introduce the types of Transmission Lines and analyze of their circuit equivalent.
2. To understand the concept of Standing waves.
3. To learn use of Smith chart.
4. To learn mathematical modeling of a system and finding the transfer function.
5. To learn block diagram reduction rules and finding transfer function using Signal flow graphs.

UNIT No.	Syllabus Content	No. of Hours Teaching
1	**Transmission – Line Theory** :The transmission Line general solution, Physical significance of the equations; the infinite line, The distortion less Line, The telephone cable, Reflection on a Line not terminated in Z_0, Open and short circuited Lines, Reflection loss, Insertion loss, T and PI sections equivalent to Lines, relevant problems .(**Text 1)**	**10**
2	**The Line at radio frequencies**: Parameters of open wire Line at high frequencies, parameters of the coaxial Line at high frequencies, Constants for the Line of zero dissipation, problems, standing waves; nodes ; standing wave ratio.**(Text 1)**	**10**
3	**Impedance matching :** input impedance of dissipationless line, input impedance of open- and short-circuited lines, single-stub impedance matching, The quarter wave Line and its applications, relevant equations and problems **Smith Chart and its applications :** Smith Circle diagram, Applications ofSmith chart, Single-stub impedance matching with Smith Chart.**(Text 1)**	**12**
4	**Mathematical Modeling of Systems:** Introduction to Control Systems, Types of Control Systems, Differences between Open loop and closed loop systems, Differential equations of Physical Systems - Mechanical systems both translational and rotational systems, Analogous networks using both Force-voltage and force-currentanalogy, problems **(Text 2)**	**10**
5.	**Block diagrams and signal flow graphs:** Transfer function, Block diagram reduction techniques, Signal Flow graph, Mason's gain formula, problems. **(Text 2)**	**10**

Note 1: Unit 4 and Unit 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1: Understand the types and parameters of transmission line, various classifications of control systems, transfer function.

CO2: Remember general solution for transmission line, parameters of open-wire and co-axial line, Mason's gain formula.

CO3: Analyze different types of transmission lines.

CO4: Application of Smith chart to solve problems associated with transmission lines and impedance matching.

CO5: Evaluate transfer function using Block diagram reduction techniques and signal flow graph.

Cos	Mapping with Pos
CO1	PO1,PO2,PO8
CO2	PO1,PO2,PO3
CO3	PO1,PO2
CO4	PO1,PO2,PO10
CO5	PO1,PO2,PO3

TEXT BOOKS:

1."**Network Lines and Fields**" , John D Ryder, 2 edition, PHI, 2005.

2.**"Control Systems Engineering",** J. Nagarath and M.Gopal, New Age International,Fifth edition, 2008.

REFERENCE BOOKS/WEBLINKS:

1. "**Transmission Lines and Networks**", Umesh Sinha, 8th edition, Satya Prakashana (TechIndia Publication), 2003.
2. "**Control Systems Engineering**", Norman S. Nise, Wiley-India (P) Ltd., 6th Edition,2010
3. http://personal.delen.polito.it/Renato.Orta/PassOpticalComp/TransmissionLinesLecture NotesNov2012.pdf
4. http://www.bput.ac.in/lecture_notes/Control_System.pdf

Sub Title : SIGNALS AND SYSTEMS		
Sub Code: TE43	**No. of Credits:4= 3:1:0(L:T:P)**	**No. of lecture hours/week : 3(L)+2(T)=5 hours**
Exam Duration : 3 hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours : 65**

Course Objectives :

1. To study the basics of signals, systems and their properties.
2. To learn impulse response representation of Linear Time Invariant systems.
3. To understand properties of impulse response representation, difference and differential equation and block diagram representation.
4. To study and compute Z – transform, its inverse and RoC. To learn unilateral Z-Transforms for solving difference equation.
5. To study Fourier series and transform of signals. To compute frequency domain representation of signals.

UNIT No.	Syllabus Content	No. of Hours	
		Teaching	Tutorial
1	**Basics of Signals and Systems:** Definitions of signal and system, Classification of signals, Sampling of Signals, Basic operations on signals, elementary signals: basic continuous-time signals and discrete-time signals, Properties of systems. Problems.	7	5
2	**Linear Time Invariant system – 1 :** Introduction, Convolution: Impulse responserepresentation for LTI Systems, Convolution sum and Convolution Integral. Problems. Autocorrelation and cross correlation.	7	5
3	**Linear Time Invariant system – 2 :** Properties of impulse response representation for LTI systems, Differential and Difference equationrepresentations. Problems. Block diagram representations.	7	4
4	**Z-Transforms:** Introduction, Z – transform,Properties of ROC, Properties of Z – transforms, Problems Inversion of Z – transforms, Transform analysis of LTI Systems, Unilateral Z- Transform and its application to solve difference equations, Problems.	9	6
5.	**Fourier Analysis of Continuous Time Signals and systems**: Introduction, Fourier Series representation of periodic signals, Fourier Transform, Properties of Fourier Transforms, Problems. **Fourier Analysis of Discrete Time signals and systems :** Introduction, Discrete Fourier series, Fourier Transform, Properties of Fourier Transforms, Problems.	9	6

Note 1: Unit 4 and Unit 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1: Understand signals, systems & their representation in time and frequency domains.CO2: Evaluate the response of the system in time and frequency domains.
CO3: Analyze frequency domain representation of continuous time and discrete time systems.
CO4: Apply transformation to analyze signal characteristics in time and frequency domain.CO5: Apply properties of transforms to solve problems on LTI systems.

Cos	Mapping with POs
CO1	PO1, PO 2, PO 3, PO 5, PO 8
CO2	PO 2, PO 3, PO 5, PO 8
CO3	PO 2, PO 3, PO 5, PO 8
CO4	PO1, PO 2, PO 3, PO 8
CO5	PO1, PO 2, PO 3, PO 5, PO 8

TEXT BOOKS:

1. Simon Haykin and Barry Van Veen "Signals and Systems", Wiley India Pvt Ltd, 2nd Edition, 2007.

REFERENCE BOOKS / WEBLINKS :

1. M J Roberts, "Signals and Systems", Mc Graw Hill, 2nd Edition, 2011.
2. I J Nagrath, S N Sharan, R Ranjan and S Kumar. "Signals and Systems" TMH, 2002.
3. H P Hsu "Signals and Systems", Scham's outlines, TMH, 2008.
4. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems",Pearson Education Asia / PHI, 2nd Edition, 2015.

https://engineering.purdue.edu/ChanGroup/ECE302Notes/Book_v1.pdf

Sub Title : OP AMP AND ITS APPLICATIONS		
Sub Code: TE45	**No. of Credits: (L:T:P)** **3= 3 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE +Assignment + SEE =** **45 + 5 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives :

1. To Learn basic concepts of Op Amp, Parameters, Opamps as DC Amplifiers, Opamp as Inverting, Non Inverting, Summing, Difference Circuits.
2. To design Op-Amps as AC Amplifiers, High Z_{in} Capacitor Coupled Voltage Follower, Inverting, Non Inverting Op Amp.
3. To understand Op-Amps frequency response and compensation.
4. To understand and design waveform generation circuits, and understand various linear applications of Op-amp.
5. To understand various Non-linear applications of Op-amp and 555 Timer.

UNIT No.	Syllabus Content	No. of Hours Teaching
1	**Operational Amplifier Fundamentals:** Basic Op-Amp circuit, Op-Amp parameters – Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedances, Slew rate and Frequency limitations; Op-Amps as DC Amplifiers- Biasing Op-Amps, Direct coupled -Voltage Followers, Non-inverting Amplifiers, Inverting amplifiers, Summing amplifiers,Difference amplifier. **(Text 1)**	**08**
2	**Op-Amps as AC Amplifiers:** Capacitor coupled Voltage Follower, High input impedance - Capacitor coupled Voltage Follower, Capacitor coupled Non-inverting Amplifiers, High input impedance - Capacitor coupled Non-inverting Amplifiers,Capacitor coupled Inverting amplifiers, setting the upper cut-off frequency. **(Text 1)**	**08**
3	**Op-Amps frequency response and compensation:** Circuit stability, Frequency and phase response, Frequency compensating methods, Band width, Slew rate effects, Z_{in} Mod compensation, and circuit stability precautions.**(Text 1)**	**06**
4	**Op-Amp Applications:** Voltage sources, current sources and current sinks, Current amplifiers, instrumentation amplifier, Integrator, Comparator, sample and hold circuits, V to I and I toV converters, phase shift oscillator, Wein bridge oscillator. **(Text 1)**	**08**
5.	**Non-linear circuit applications:** Crossing detectors, inverting Schmitt trigger circuits, Active Filters –First and second order Low pass and High pass filters. **Other Linear IC applications:** 555 timer - Basic timer circuit, 555 timer used as astable and monostable multivibrator, Schmitt Trigger, Square Wave Generator, PLL-operating principles, VCO.**(Text 1)**	**09**

Note 1: Unit 4 and Unit 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1: An ability to Remember Op-Amp basics and parameters like Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedances, Slew rate and Frequency limitations

CO2: To Understand Opamp Applications like Linear and Non Linear applications

CO3: Design all basic Opamp circuit like Inverting, Non Inverting, Summing, DifferenceCircuit, High capacitance Voltage Follower, Inverting, Non Inverting Circuits.

CO4: To analyze Op-Amps frequency response and different compensation techniques.CO5: Implementation of various applications using Opamp and 555 timer.

Cos	Mapping with POs
CO1	PO1,PO2,
CO2	PO1, PO3,
CO3	PO1,PO2
CO4	PO2, PO5,PO9
CO5	PO2

TEXT BOOKS:

1. **"Operational Amplifiers and Linear IC's"** , David A. Bell, 3rd edition. Oxford University Press, 2011.

2. **"Linear Integrated circuits"**, D. Roy Choudhary and Shail B. Jain, 3rd edition, New Academic Science Ltd. 2010.

REFERENCE BOOKS/WEBLINKS:

1. **"Op - Amps and Linear Integrated Circuits"**, James M. Fiore, Thomson Learning,2001.

2. **"Design with Operational Amplifiers and Analog Integrated Circuits"**, Sergio Franco,TMH, 3rd edition,2005.

3. **"Op Amps and Linear Integrated circuits"**, Ramakant .A. Gayakwad, 4th edition, PHI,2009.

4. http://www.electronics-tutorials.ws/opamp/opamp_1.html

Sub Title :Analog Communication		
Sub Code: TE52	**No of Credits : 4=4:0:0 (L-T-P)**	**No of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours : 52**

Course Objectives:

1. Ability to apply Mathematical concepts of convolution and Fourier Transforms to arrive at the time-domain and frequency-domain representation of amplitude modulated and angle and its generation methods, DSBSC modulation.
2. Ability to apply Mathematical concepts of convolution, correlation and Fourier Transforms to arrive at the canonical representation of band-pass signals and SSBSC generation methods, time- domain description of SSB using canonical representation
3. Ability to understand concept of VSB both in time and frequency-Domain.
4. To understand the concept of Angle modulation.
5. To learn the impact of noise in modulated waves.

Unit No	Syllabus	No of hours
1	**Standard AM:** Introduction to AM, Time-Domain and Frequency – Domain descriptions of Standard AM, Generation of AM wave: square law modulator, switching modulator. Detection of AM waves : square law detector, envelop detector. **Double side band suppressed carrier modulation (DSBSC):** Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves, Costas loop.	12
2	**Single Sideband Suppressed Carrier (SSBSC) :** Hilbert transform, properties of Hilbert transform, Pre-envelope, Frequency-Domain description of SSB wave, Time- Domain Description of SSB using canonical representation, Phase discrimination method for generating an SSB modulated wave, Time-Domain description, Phase discrimination method for generating an SSB modulated wave, Demodulation of SSB waves.	12
3	**Vestigial Sideband Modulation (VSB)and Applications of AM :** Frequency – Domain description, Generation of VSB modulated wave, Time – Domain description, Envelop detection of VSB wave plus carrier, Frequency translation, Frequency division multiplexing, Application : AM radio .	08
4	**Angle Modulation :**Basic definitions, Comparison of FM and PM narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM. Demodulation of FM waves, Phase-locked loop, Nonlinear model of the phase – locked loop, Linear model of the phase – locked loop, Applications - stereo multiplexing, FM Radio	10

5	**Noise :** Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Narrow bandwidth, Noise Figure, Equivalent noise Temperature, cascade connection of two-port networks. **Noise in Continuous wave Modulation Systems :** Introduction, Noise Power Spectral Density, Receiver model, Noise in DSB-SC receivers, Noise in SSB receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, Pre-emphasis and De-emphasis in FM.	10

NOTE 1 : Unit number 4 & 5 will have internal choice

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes:

1. Understand the concept of amplitude modulation and its generation methods ,DSBSC modulation and to solve related problems.
2. Understand the concept of SSBSC generation methods, time- domain description of SSB using canonical representation, Phase discrimination method and to solve related problems.
3. Understand the concept of VSB both in time and frequency-Domain along with various problem solving.
4. Understand the concept of Angle modulation FM generation PLL modeling along with various problem solving.
5. Understand the concept of different types of Noise, derivation with Equivalent noise Temperature, also noise in Continuous wave Modulation Systems.

Cos	Mapping with Pos
CO1	PO1,PO2, PO5, PO10
CO2	PO1, PO2, PO5, PO10
CO3	PO1, PO2, PO5, PO10
CO4	PO1, PO2, PO10
CO5	PO1, PO2, PO5, PO10

TEXT BOOKS :

1. An Introduction to Analog and Digital Communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008.
2. Communication Systems, Simon Haykin, 5th Edition, John Willey India Pvt. Ltd, 2009.

REFERENCE BOOKS:

1. Modern digital and analog Communication systems B. P. Lathi,3rd Ed 2005 Oxford University press.
2. Communication Systems : A Bruce Carlson, Paul Crilly and Janel C Rutledge, McGraw-Hill
3. Higher Education, 4th edition.
4. Communication Systems: Analog and digital, Singh and Sapre ,TMH 2nd , Ed 200

Subject Title : ANTENNA AND WAVE PROPAGATION		
Sub Code : TE53	**No of credits : 3=2:1:0(L-T-P)**	**No of hrs/week : 3**
Exam duration : 3hrs	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours : 39**

Course Objectives:

1. To understand the radiation mechanisms of antennas and also to learn about basic parameters of antennas.
2. To understand the concepts of point sources and arrays.
3. Have an insight into various Broad band antennas.
4. To study various narrow band antennas.
5. Learn to acquire thorough understanding of the radio wave propagation.

UNIT No	Syllabus Content	No. of Hours Teaching
1	**Fundamental Concepts:** Basic Antenna Parameters(concept of radiation), Antenna parameters: Radiation pattern, gain, directivity, effective aperture, Effective Height, Beam Efficiency, Retarded Potential A Far field due to an alternating current element, Antenna field zones. **(Text 1)**	08
2	**Point Sources:** Introduction, Power theorem and its applications, Radiation intensity, Power patterns, Examples of Power patterns, Field patterns, Phase patterns. **Antenna arrays:** Arrays of two isotropic point sources, Arrays of Non-isotropic sources, Pattern multiplication, Array of n- isotropic point sources with equal amplitude and spacing, Broadside and End fire arrays. **(Text 1)**	08
3	**Antennas:** Small Loop, Horn Antenna, Helical Antenna, (Geometry and modes), Frequency independent concepts: Rumsey's principle; log spiral antenna and log periodic antenna.. Reflector Antennas(9.1),Corner Reflector(9.3),The parabola general properties, The paraboloidal reflector, Feed methods for parabolic reflectors.**(Text 1)**	08
4	**Microstrip Antenna:** Introduction, Salient features, advantages, limitations, feed methods, method of analysis, Techniques for size reduction, Applications, Design considerations for the lab experiments. **(Text 1)**	08
5	Wave Propagation: The Fundamental equation for free space propagation, modes of propagation, Structure of atmosphere, Characteristics of different ionized regions, sky wave propagation and Definitions, Skip distance, optimum working frequency, Ionospheric abnormalities(11.16.1-11.16.5), Ionospheric absorption and multi hop propagation, space wave propagation(11.9.1 and 11.19.4),Duct propagation. (Text 2)	07

NOTE1 : Unit number 3 & 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes:

1. Describe the basic concept of antenna, its significance in wireless communication and understand the general terms associated to design antenna with its working conditions.
2. Define, describe the array of antennas, point sources, isotropic and non-isotropic sources and conditions to increase the directivity of array antennas.
3. Apply and Simulate the concepts of point sources and arrays of antennas.
4. Demonstrate and Simulate the importance of all types of antennas is realized with practical implication of antennas
5. Understand the knowledge of the structure of atmosphere, modes of propagation methods.

COs	**Mapping with PO's**
CO1	P01,PO2,PO3, PO6,PO10
CO2	PO2,PO3,PO6,PO8
CO3	PO4, PO5,PO9
CO4	PO2,PO3,PO4,PO9
CO5	PO1,PO2,PO3,PO4.PO5,PO10

TEXT BOOKS:

1. **"Antenna and Wave Propagation**", John D Kraus, Ronald J. Marhefka and Ahmed S Khan, Fourth edition, Mc Graw Hill Publication, 2010.
2. "**Antenna and Wave Propagation**", Prasad K D , 3rd edition, Satya Prakashan, NewDelhi 1996.

REFERENCE BOOKS/WEBLINKS:

1. Antenna Theory Analysis and Design - C A Balanis, 3rd Edn, John Wiley India Pvt. Ltd.,2008.
2. Antennas and Propagation for Wireless Communication Systems - Sineon R Saunders, JohnWiley India Pvt. Ltd., 2008.
3. Prasad K D, "Antenna and Wave Propagation", 3rd edition, Satya Prakashan, New Delhi(1996).
4. studynama.com/community/threads/207-Antenna-Wave-propagation-(AWP)-pdf-notes- ebook-download

Subject Title : FUNDAMENTALS OF CMOS VLSI		
Sub Code : TE55	**No of credits : 3=3:0:0(L-T-P)**	**No of hrs/week : 3**
Exam duration : 3hrs	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours : 39**

Course objectives :

1. To teach the Basic MOS technology.
2. To design the Basic circuit and Layout diagram.
3. To teach CMOS subsystem design and basic circuit concepts.
4. To analyze scaling of MOS circuits and process illustration.
5. To teach the basics of memory, registers clocks in MOS technology.

Unit No	Syllabus	No of hours
1	**BASIC MOS TECHNOLOGY:** Integrated circuit's era. Enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication. BiCMOS technology. **MOS TRANSISTOR THEORY:** Introduction, MOS Device Design Equations.	8
2	**CIRCUIT DESIGN PROCESSES:** The Complementary CMOS Inverter –DC Characteristics. MOS layers. Stick diagrams. Design rules and layout – lambda-based design and other rules. Examples. Layout diagrams. Symbolic diagrams.	8
3	**CMOS SUBSYSTEM DESIGN:** Architectural issues. Switch logic. Gate logic, Design examples – combinational logic, CMOS Complementary, Pseudo NMOS, Dynamic CMOS, Clocked CMOS, Pass Transistor logic, Clocked circuits. **BASIC CIRCUIT CONCEPTS:** Sheet resistance. Area capacitances. Capacitance calculations. The delay unit. Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances.	8
4	**SCALING OF MOS CIRCUITS:** Scaling models and factors. **CMOS SUBSYSTEM DESIGN PROCESSES:** General considerations. Process illustration. ALU subsystem. Adders. Multipliers, Serial Parallel, Braun Array, Baugh -Wooley.	8
5	**MEMORY, REGISTERS AND CLOCK:** Timing considerations. 4Transistor Dynamic Memory, One Transistor Dynamic Memory, 4Transistor Dynamic & 6 Transistor Static, Memory elements. Memory cellarrays.	7

NOTE 1 : Unit number 3 & 4 will have internal choice

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2.
Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes:

1. An ability to apply to apply knowledge about basic MOS technology.
2. An ability to design and implement MOS transistor, layout and symbolic diagrams.
3. An ability to design architectural issues and basic circuit concepts.
4. An ability to identify scaling models and their limitations with subsystem processillustration.
5. The broad education necessary to understand the impact of CMOS in storage devices andclocks

COs	Mapping with POs
CO1	PO1,PO2,PO4,PO5 ,PO7
CO2	PO1, PO2,PO3,PO4,PO6
CO3	PO2, PO3,PO4,PO6
CO4	PO1,PO2, PO4,PO5
CO5	PO2,PO3,PO4,PO5,PO10

TEXT BOOKS:

1. Basic VLSI Design - Douglas A. Pucknell & Kamran Eshraghian, PHI 3rd Edition (original Edition – 1994), 2005.
2. Principles of CMOS VLSI Design: A Systems Perspective, Neil H. E. Weste and K. Eshragian, 2nd edition, Pearson Education (Asia) Pvt. Ltd., 2000.

REFERENCE BOOKS:

1. **Fundamentals of Semiconductor Devices**, M. K. Achuthan and K. N. Bhat, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.

http://www.scrbd.com/doc/121356137/CMOS-VLSI-VTU-full-notes

Sub Title : Embedded System Design		
Sub Code: TE62	**No of Credits : 3=2:1:0 (L-T-P)**	**No of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours :52**

Course Objectives:

1. To learn system design for measurement of embedded system operating characteristicsand to determine system performance relative to functional requirements.
2. Studying complete design of an embedded system with functional requirements forhardware and software components including processor.
3. To learn design and implementation of software systems to provide an interface betweenhardware peripheral sensors and systems.
4. To learn designing of an embedded system with functional requirements for RTOS architecture.
5. To study design of an embedded system with functional requirements for RTOSarchitecture Principles also memory space and memory power.

Unit No	Syllabus	No of Hours	
		Lecture	Tutorial
1	**INTRODUCTION**: Overview of embedded systems, embedded system design challenges, common design metrics and optimizing them. Survey of different embedded system design technologies, trade-offs.	05	05
2	**SINGLE-PURPOSE PROCESSORS**: Hardware, Combinational Logic, Sequential Logic, RT level Combinational and Sequential Components, Optimizing single-purpose processors. Single-Purpose Processors: Software, Basic Architecture, Operation	05	05
3	**Standard Single-Purpose Peripherals**: Timers, Counters, UART, PWM, LCD Controllers, Keypad controllers, Stepper Motor Controller, A to D Converters, Examples. **MEMORY**: Introduction, Common memory Types, Compulsory memory, Memory Hierarchy and Cache, Advanced RAM. Interfacing, Communication Basics, Microprocessor Interfacing,	05	05
4	**INTERRUPTS** : Basics - Shared Data Problem - Interrupt latency. Survey Of Software Architecture, Round Robin, Round Robin with Interrupts - Function Queues - scheduling - RTOS architecture. **INTRODUCTION TO RTOS** : Tasks - states - Data - Semaphores and shared data.	05	05
5	**Basic Design Using RTOS, Principles-** An example, Encapsulating semaphores and Queues. Hard real-time scheduling considerations – Saving Memory space andpower. Hardware software co-design aspects in embedded systems.	06	06

NOTE 1 : Unit number 4 & 5 will have internal choice

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes:

1. Complete system design for measurement of embedded system operating characteristics andto determine system performance relative to functional requirements.
2. Complete design of an embedded system with functional requirements for hardware and software components including processor.
3. Design and implement software systems to provide an interface between hardware peripheral sensors and systems.
4. Complete design of an embedded system with functional requirements for RTOS architecture.
5. Complete design of an embedded system with functional requirements for RTOS architecture ,Principles also memory space and memory power.

COs	**Mapping with POs**
CO1	PO1,PO2,PO5,PO6
CO2	PO1,PO5, PO6, PO8,PO10
CO3	PO1, PO5,PO6
CO4	PO1,PO5,PO6,PO8
CO5	PO1, PO5,PO6

TEXT BOOKS:

1. Embedded System Design A unified hardware/software introduction– Frank Vahid,Tony Givargis, John Wiley & Sons, Inc.2002
2. An Embedded software Primer – David E. Simon, Pearson Education, 1999.

REFERENCE BOOKS:

1. "Introduction to Embedded systems", by SHIBU.K.V McGRaw Hill Education(India) Private limited.
2. Embedded Systems: Architecture and Programming – Raj Kamal, TMH.
3. Embedded Systems Architecture – Tammy Noergaard.
4. Comprehensive Guide for Engineer and Programmers Elsevier Publication2005
5. Embedded C programming – Barnett, Cox & O'cull , Thomson (2005).

Subject Title : Satellite Communication		
Sub Code : TE63	**No of credits : 3=3:0:0(L-T-P)**	**No of hrs/week : 3**
Exam duration : 3hrs	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours: 39**

Course Objectives:

1. To become familiar with the different satellite services, orbit concepts.
2. To understand look angles and eclipse effect on communication satellites.
3. To understand the concept of link budget calculation.
4. To learn different subsystems and interference between satellites.
5. To become familiar with different earth segments and satellite access schemes.

Unit No	Syllabus	No of hours
1	**Orbits :** Introduction, Kepler's Laws, Definitions, Orbital Elements, Apogee and Perigee Heights, Orbital perturbations, Sidereal Time, The Orbital Plane, Sun-synchronous Orbit, Radio wave propogation. - relevant problems	09
2	**Geostationary Orbit :** Antenna Look Angles, Polar Mount Antenna, Limits of Visibility, Earth Eclipse of Satellite, Sun Transit Ouage, Launching Orbits.- relevant problems	06
3	**Space Link :** EIRP, Transmission Losses, Link Power budget equation, System noise, CNR , Uplink, Downlink, Combined CNR.- relevant problems	06
4	**Space Segments :** Power supply, Attitude Control, Station Keeping, Thermal Control, TT&C Subsystem, Transponders **Interference :** Interference between Satellite circuits, Coordination-Interference levels, Transmission gain, Resulting noise-temperature rise.- relevant problems	09
5	**Earth Segment :** Receive only home TV system, out door unit, indoor unit, MATV, CATV,Tx-Rx earth station **Satellite Access :** Single Access, Preassigned FDMA, Demand Assigned FDMA, Spade System, PreassignedTDMA,Demand-assigned TDMA	09

NOTE 1 : Unit number 4 & 5 will have internal choice

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes:

1. Student can analyze different satellites and orbits.
2. Calculation of look angle for a satellite.
3. Computation of different losses.
4. Analysis of different satellite subsystems.
5. Knowledge of various multiple access schemes.

Cos	Mapping with POs
CO1	PO1,PO2,PO5,PO6
CO2	PO1,PO2,PO5,PO8
CO3	PO1,PO4,PO5,PO6
CO4	PO1,PO2,PO6, PO8
CO5	PO2,PO5,PO6,PO9

TEXT BOOK :

1. Satellite Communications – Dennis Roddy, 4th Edition, McGraw Hill International edition, 2006

REFERENCE BOOKS/WEBLINKS :

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley & Sons, 2003
2. Satellite Communication Systems Engineering – W.L.Pitchand, H.L. Sudyderhoud, R.A.Nelson, 2nd Ed., Pearson Education , 2007.
3. www.nptel.ac.in/.../108105057/

Subject Title : Information Theory and Coding		
Sub Code : TE65	**No. of credits : 4=4:0:0 (L-T-P)**	**No of hrs/week : 4+0=4**
Exam duration : 3hrs	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours: 52**

Course Objectives :

1. To understand the measure of information content of a Message.
2. To study Coding Techniques using different Algorithms with examples.
3. To analyze the different types of Errors and introduce Error control coding.
4. To study Binary cyclic codes and the calculation of syndrome.
5. To study BCH codes and Burst error correcting codes

Unit No	Syllabus	No of hours
1	**Information Theory:** Introduction, Measure of Information, Information Content of a Message, Average Information Content(Entropy) of Symbols in Long Independent Sequences, Average Information Content of Symbols in Long Dependent Sequences, Markoff Statistical Model for Information Sources, Entropy and Information rate of Markoff Sources.	10
2	**Source Coding :** Encoding the source output, Shannon's Encoding Algorithm, Huffman Coding, Source Coding theorem	08
3	**Fundamental Limits on Performance :** Discrete Memoryless Channels, Mutual Information and its properties, Channel capacity, Channel Coding theorem, Channel Capacity Theorem.	10
4	**Introduction to Error Control Coding :** Introduction, Methods of Controlling Errors, Types of errors, Types of codes, Linear Block Codes – Matrix Description ,Error Detection and Error correction capabilities .	12
5	**Binary Cyclic Codes :** Algebraic Structure of Cyclic Codes, Encoding using (n-k) bit shift register, Syndrome calculation. **Convolutional Codes :** Time domain Approach, Transform domain approach, Trellis and State diagram.	12

NOTE 1: Unit number 4 & 5 will have internal choice

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes : Students will be able to:

1. Compute entropy and information rate of a source
2. Encode the source output using encoding algorithms and coding techniques
3. Determine the channel capacity of different channels and also the mutual information.
4. Implement the error control coding, methods of controlling errors and Error correction and detection.
5. Encode using bit shift register and syndrome calculation.

COs	Mapping with POs
CO1	PO1, PO5
CO2	PO1,PO2,PO5
CO3	PO4,PO5, PO8
CO4	PO1, PO2, PO10
CO5	PO2,PO6, PO10

TEXT BOOKS :

1. Digital and Analog Communication Systems, K. Sam Shanmugam, John Wiley India Pvt. Ltd., 2008.
2. Digital Communication, Simon Haykin, John Wiley India Pvt. Ltd,2008.

REFERENCE BOOKS /WEBLINKS:

1. Concepts of Information Theory & Coding, Dr.P.S.Satyanarayana, Dynaram Publication,2005
2. Digital Communications Fundamentals and Applications, Bernard Sklar, Prentice Hall International,1988
3. Error Control coding : Fundamentals and Applications, Shu Lin and Costello, New Jersey, 1983
4. Information theory and Coding, K. Giridhar. Pooja Publications, 2010.
5. www.mit.edu/6.933/www/Fall2001/Shannon2.pdf

Sub Title : COMPUTER COMMUNICATION NETWORKS		
Sub Code: TE73	**No of Credits : 3=2:1:0(L-T-P)**	**No of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE+SIE=50+50=100**	**Total No of Contact Hours : 52**

Course Objectives:

1. To define and understand the Layer functions of OSI model and TCP/IP Suite.
2. To study framing, flow control and error control.
3. To understand the different Multiple accesses techniques.
4. To study the standards and protocols of Wired and Wireless LANs.
5. To understand the different addressing modes, IPV4, IPV6 and to implement the different Routing algorithms.

UNIT No	Syllabus Content	No of Hours	
		Theory	Tutorial
1	Layered tasks: OSI Model, Layers in OSI model, TCP/IP Suite, Addressing. Circuit switched Network , Data gram Networks, Virtual circuit Networks	06	06
2	Data Link Control: Framing, Flow and error control, Protocols, Noiseless channels and Noisy channels, HDLC.	04	04
3	Multiple Access: Random access –CSMA, CSMA/CD, CSMA/CA, Controlled access – Reservation, Polling and Token Passing, Channelization – FDMA, TDMA, CDMA.	04	04
4	LANs: Ethernet: IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet. Wireless LANS: IEEE 802.11, Bluetooth, Connecting Devices: Passive Hubs, Repeaters, Active Hubs, Bridges and Routers.	06	06
5	Network Layer: Internetworking, IPV4, IPV6, Transition from IPV4 to IPV6, Delivery, Forwarding techniques and Process, Unicast Routing Protocols: Distance vector Routing, Link State Routing, Dijktras Algorithm	06	06

Note 1:- Unit number 4 & 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes : Students will be able to:

1. Understand the architecture of OSI model and TCP/IP model and the switchingtechniques.
2. To implement Framing of the data, controlling the errors using DLL protocols in HDLC formats.
3. Access the channels in a random and controlled manner using different techniques.
4. Analyze the Ethernet standards and wireless LANs.
5. Implement routing in network layer using different algorithms and analyze IPV4and IPV6 address and their transitions.

COs	Mapping with POs
CO1	PO1, PO5, PO6,PO8
CO2	PO1, PO5, PO6,PO8
CO3	PO2, PO3, PO4
CO4	PO3, PO4, PO10
CO5	PO3, PO4, PO10

TEXT BOOK:

1. **Data Communication and Networking,** B Forouzan, 4th Ed, TMH , 2006.

REFERENCE BOOKS/WEBLINKS:

1. **Computer Networks**, Andrew Tanenbaum, Pearson Education 2008
2. **Computer Networks, James F. Kurose, Keith W. Ross**: Pearson education, 2nd Edition, 2003
3. **Introduction to Data communication and Networking, Wayne Tomasi:** Pearson education 2007

www.tutorialspoint.com/...communication_computer_network/data_communication

Sub Title : Digital Image Processing		
Sub Code: TE744	**No of Credits : 3=3:0:0 (L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3	**CIE+SIE=50+50=100**	**No of working hours:39**

Course Objectives :

1. Understand the basic principles and methods of digital image processing.
2. Be able to formulate solutions to general image processing problems.
3. To learn various image enhancement techniques.
4. To study segmentation techniques used in different applications.
5. To introduce concept of color image processing.

UNIT No	Syllabus Content	No of Hours
1	**DIGITAL IMAGE FUNDAMENTALS** Background, fundamental steps in Digital Image Processing, Components of an Image processing system, elements of Visual Perception, Image sensing and acquisition, Image Sampling and Quantization, Some basic relationships between pixels, Linear and Nonlinear operations	**9**
2	**IMAGE ENHANCEMENT IN SPATIAL DOMAIN** Background, Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/ Logic Operations	**8**
3	**IMAGE ENHANCEMENT IN FREQUENCY DOMAIN** Introduction to Fourier Transform and the Frequency domain fo image, Smoothing Frequency Domain Filters, Sharpening Frequ domain filters, homomorphic filtering	**7**
4	**IMAGE SEGMENTATION:** Detection of discontinuities, edge linking and boundary detection, Thresholding, region oriented segmentation, segmentation of morphological watersheds, the use of motion in segmentation	**8**
5.	**COLOR IMAGE PROCESSING** : Color Fundamentals, Color Models, Pseudo color Image Processing, processing basics of full color image processing	**7**

Note 1 : Unit 4 and Unit 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

1. Student will have a clear understanding of representation of a digital image.
2. Student will be able to appreciate the effect of applying various enhancement techniques in spatial domain.
3. Student will be able to observe the impact of frequency domain techniques on images.
4. Relating computer-vision applications with various segmentation techniques.
5. Knowing the applications of various color-models.

COs	Mapping with Pos
CO1	PO1, PO3, PO9,PO10
CO2	PO2, PO3, PO9
CO3	PO3, PO9,PO10
CO4	PO3, PO9,PO10
CO5	PO3, PO9,PO10

TEXT BOOKS

1.Rafel C Gonzalez and Richard E. Woods, "Digital Image Processing", PHI 3rd Edition 2005.
2. S.Jayaraman, S.Esakkirajan, T.Veerakumar," Digital Image Processing,TMH Publication, 2011 edition

REFERENCE BOOKS / WEBLINKS:

1. Anil K.Jain, "Fundamentals of Digital Image Processing", PHI Learning , 3rd Edition
2. Madhuri A Joshi "Digital Image Processing –an alogorithm approach", PHI Learning, 2006
3. http://eeweb.poly.edu/~onur/lectures/lecture8.pdf

Sub Title: Optical Networking		
Sub Code: TE81	**No of Credits: 3=3:0:0 (L-T-P)**	**No of lecture hours/week: 3(L)+ (T) = 39 Hours**
Exam Duration: 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No of Contact Hours: 39**

Course Objectives :

(1) To study the environment of optical networks
(2) To study the components both active and passive required for optical networks
(3) To study the design considerations for optical networks
(4) To study the requirement of WDM networks
(5) To understand the functions required for maintenance and control of optical networks

UNIT No	Syllabus Content	No of Hours	
		Teaching	Tutorial
1	**INTRODUCTION TO OPTICAL NETWORKS**: Telecommunication Network Architecture; Optical Networks--Multiplexing techniques, Second-Generation Optical Networks; The Optical Layer; Transparency and All-Optical Networks; Optical Packet Switching; Network Evolution –Early Days-Multimode Fiber, Single-Mode Fiber, Optical Amplifiers and WDM, Beyond Transmission Links to Networks; Nonlinear Effects – Propagation in a Nonlinear Medium, Self-Phase Modulation, SPM –Induced Chirp for Gaussian Pulses, Cross-Phase Modulation , Four Wave Mixing .	09	
2	**COMPONENTS**: Couplers – Principle of Operation, Conservation of Energy; Isolators and Circulators – Principle of Operation; Multiplexes and Filters ; Optical Amplifiers—Raman Amplifiers, Semiconductor Optical amplifiers, Crosstalk in SOAs; Transmitters – Lasers, Principle of Operation, Longitudinal Modes, Distributed Feedback Lasers, External Cavity Lasers, Vertical Cavity Surface-Emitting Lasers; Switches–Large Optical Switches; Wavelength converters—Optoelectronic Approach, Optical Gating, Interferometric Techniques, Wave Mixing.	06	
3	**TRANSMISSION SYSTEM ENGINEERING**: System model, Power Penalty , Transmitter, Receiver; Optical Amplifiers—Gain saturation in EDFAs, Gain Equalization in EDFAs, Amplifier Spacing Penalty, Power Transients and Automatic Gain Control, Lasing Loops; Crosstalk—Intrachannel Crosstalk, Interchannel Crosstalk; Dispersion—Dispersion Compensation—Dispersion Compensating Fibers, Chirped Fiber Bragg Gratings, Dispersion Slope Compensation; Overall Design Considerations.	09	
4	**SECOND GENERATION NETWORKS -WDM NETWORK ELEMENTS**: Optical Line Terminals, Optical Line Amplifiers, Optical Add/drop Multiplexers, OADM Architectures, Optical Crossconnects. **ACCESS NETWORKS:** Network Architecture Overview, Enhanced HFC.	07	

5.	**CONTROL AND MANAGEMENT :** Network Management Functions – Management Framework, Information Model; Optical Layer Services and Interfacing; Layers within the Optical Layer; Multivendor Interoperability; Performance and Fault Management—The Impact of Transparency, BER Measurement, Optical Trace, Alarm Management, Optical safety—Open Fiber Control Protocol.	08	

Note 1: Unit 3 and Unit 5 have internal choice.

Note 2 : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Assignment :

Course Outcome :

(1) To analyze the need for overall optical networks
(2) To analyze the working principle of various components of optical networks
(3) To analyze the impact of design considerations of optical networks.
(4) To analyze the components of WDM networks
(5) To analyze the maintenance and control functions required for optical networks

TEXT BOOKS:

1. Optical Networks: A Practical Perspective. Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki, 3rd Ed., Morgan Kauffman, 1998 & 2010.

REFERENCE BOOKS:

1. Optical Networks – Ulysees Black, 2nd Ed., Pearson education 2007.

Sub Title :MULTIMEDIA COMMUNICATION		
Sub Code: TE82	**No of Credits : 3=3:0:0 (L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours : 39**

Course Objectives :

1. To study the different types of Media and their representation in different forms.
2. To understand the different compression techniques for Tex with examples.
3. To understand the different compression techniques for Image with examples.
4. To study the different compression techniques for Audio.
5. To study the different compression techniques for video.

UNIT No	Syllabus Content	No of Hours
1	**MULTIMEDIA COMMUNICATIONS:** Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, multipoint conferencing, network QoS, Application QoS.	07
2	**TEXT AND IMAGE COMPRESSION**: Introduction, compression principles, text compression – Arithmetic coding, Lempel-ziv and Welsh coding, Image compression- GIFF, TIFF, Digitized documents and Pictures, JPEG.	07
3	**AUDIO COMPRESSION:** Introduction, audio compression, LPC, Code excited LPC, Perceptual coding, MPEG Audio coders, Dolby Audio coders. **VIDEO COMPRESSION** : Video compression principles, H.261, H.263, MPEG, MPEG-1, MPEG-2, and MPEG-4.	07
4	**THE INTERNET**: IP addresses, ARP, RARP, Routing Algorithms-Flooding, Distance vector Routing, Link State & Hierarchical Routing, ICMP, Broadcast Routing, Multicast Routing.	09
5	**BROADBAND ATM NETWORKS:** Cell format and Switching principles, Switching architectures, Protocol architectures. **TRANSPORT PROTOCOLS**: TCP, UDP, RTP and RTCP.	09

Note 1:- Unit number 4 & 5 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes : Students will be able to:

1. Understand types of Multimedia networks and applications.
2. Illustrate representation of the information of text, images, audio and video.
3. Implement the text and image, Audio and Video compression using different techniques and Standards.
4. Analyze the various Routing algorithms.
5. Understand different Architectures and Protocols.

COs	Mapping with POs
CO1	PO1,PO5
CO2	PO1,PO2,PO5
CO3	PO2, PO6,PO8
CO4	PO2,PO10
CO5	PO1,PO2,PO10

TEXT BOOK:

1. **Multimedia Communications: Applications, Networks, Protocols, and Standards** – Fred Halsall, Pearson Education, Asia, Second Indian reprint 2002.

REFERENCE BOOKS:

1. **Multimedia Information Networking** –, Nalin K. Sharda, PHI, 2003.
2. **Multimedia Fundamentals: Vol 1-Media Coding and Content Processing** – RalfSteinmetz, KlaraNarstedt, Pearson Education, 2004.
3. **Multimedia Systems Design** – Prabhat K. Andleigh, KiranThakrar, PHI, 2004

Sub Title : GSM		
Sub Code:TE835	**No of Credits : 4=4:0:0 (L-T-P)**	**No of lecture hours/week : 4**
Exam Duration : 3Hrs	**CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours : 52**

Course Objectives:

1. To become familiar with concepts and standards in wireless communication.
2. To become familiar with the architecture, structure and services offered in GSM.
3. To understand functions and operational principles of the various components of GSM networks, logical channels and frame structures.
4. To learn different coding techniques and call flows.
5. To study different data services and privacy/security.

UNIT No	Syllabus Content	No of Hours
1	**STANDARDS FOR WIRELESS COMMUNICATION SYSTEMS** :Introduction, Cordless systems, GSM, UPT, IMT-2000, UMTS, North American Standards, Japanese Standards **CELLULAR COMMUNICATIONS FUNDAMENTALS :** Introduction, Cellular Systems, Geometry of a Hexagon Cell, Cochannel Interference Ratio, Cellular System Design in Worst case with an omnidirectional antenna, Cochannel interference reduction, directional antennas in 7-cell reuse pattern, Cell splitting	07
2	**GSM ARCHITECTURE AND INTERFACES**: Introduction, GSM frequency bands, GSM PLMN, Objectives of a GSM PLMN, GSM PLMN Services, GSM Subsystems, GSM Subsystems entities, GSM interfaces, The radio interface (MS to BSC), Abits interface (BTS to BSC), A interface (BSC to MSC), Interfaces between other GSM entities, Mapping of GSM layers onto OSI layers. **RADIO LINK FEATURES IN GSM SYSTEMS**: Introduction, Radio link measurements, Radio link features of GSM, Dynamic power control, Discontinuous transmission (DTX), SFH, Future techniques to reduce interface in GSM, Channel borrowing, Smart antenna	07
3	**GSM LOGICAL CHANNELS AND FRAME STRUCTURE:** Introduction, GSM logical channels, Allowed logical channel combinations, TCH multi frame for TCH/H, CCH multi frame, GSM frame structure, GSM bursts, Normal burst, Synchronization burst, Frequency correction channel burst, Access burst, Data encryption in GSM, Mobility management, Location registration, Mobile identification.	07
4	(a). **SPEECH CODING IN GSM** : Introduction, Speech coding methods, Speech code attributes, Transmission bit rate, Delay, Complexity, Quality, LPAS, ITU-T standards, Bit rate, Waveform coding, Time domain waveform coding, Frequency domain waveform coding, Vocoders, Full-rate vocoder, Half-rate vocoder (b)**MESSAGES, SERVICES, AND CALL FLOWS IN GSM:** Introduction, GSM PLMN services. GSM messages, MS-BS interface, BS to MSC messages on the A interface, MSC to VLR and HLR, GSM call setup by an MS, Mobile-Terminated call,Call release, Handover.	12

5	(a) **DATA SERVICES IN GSM:** Introduction, Data interworking, GSM data services, Interconnection for switched data, Group 3 fax, Packet data on the signaling channel, User-to-user signaling, SMS, GSM GPRS. (b) **PRIVACY AND SECURTIY IN GSM**: Introduction, Wireless security requirements, Privacy of communications, Authentication requirements, System lifetime requirements, Physical requirements, SIM cards, Security algorithms forGSM, Token-based authentication, Token-based registration, Token-based challenge	10

NOTE 1 : Unit number 4 & 5 will have internal choice

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

1. Knowledge of concepts and standards used in wireless communication.
2. Understanding of the architecture, structure and services offered in GSM.
3. Understanding functions and operational principles of the various components of GSM networks, logical channels, channel burst and frame structures.
4. Analysis of different coding techniques and call flows.
5. Different services offered by GSM like Group 3 fax, Packet data on the signaling and privacy/security.

Cos	Mapping with POs
CO1	PO1,PO2,PO5,PO6
CO2	PO1,PO2,PO5,PO8
CO3	PO1,PO2,PO5,PO6
CO4	PO1,PO2,PO3
CO5	PO2,PO5,PO6,PO9

TEXT BOOKS:

1.Principles of Applications of GSM – Vijay K. Garg& Joseph E. Wilkes, Pearson education, 1999.

REFERENCE BOOKS/WEBLINKS:

1. Z. Zvonar Peter Jung. GSM: Evolution towards 3rd Generation Systems, (Editor), Karl Kammerlander Springer; 1st edition 1998.
2. The Creation of Global Mobile Communication – Friedhelm Hillebrand, GSM & UMTS, John Wiley & Sons; 2001
3. . http://www.tti.unipa.it/~ilenia/course/intro.pdf

Sub Title : MICROCONTROLLERS		
Sub Code: TE41	**No. of Credits:4= 4:0:0 (L:T:P)**	**No. of lecture hours/week : 4**
Exam Duration : 3 hrs	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours : 52**

Course Objectives :

1. To understand the architecture of Microcontrollers and to summarise the instruction set.
2. To learn basic programming for Intel 8051 Microcontroller using Assembly and C language.
3. To study programming Intel 8051 Microcontroller using Assembly and C language for timers, serial communication and interrupts.
4. To learn basic programming for MSP430 Microcontroller using assembly and C language.
5. To study interfacing programs for MSP430 Microcontroller in assembly and C language.

Unit No.	Syllabus Content	No. of hrs.
1.	**Introduction:** A Historical background, the microprocessor based Personal Computer System. Architecture of 8086: Internal Microprocessor architecture, Real Mode Memory addressing. Introduction to 80386, 80486 & Pentium Processors. Microprocessors and microcontroller. Introduction, Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture, Computer software. (Text 1 & Reference 1)	**10**
2.	**The 8051 Architecture:** Introduction, Architecture of 8051, Pin diagram of 8051, Memory organization, External Memory interfacing, Stacks.**Instruction set:** Instruction timings, 8051 instructions: Data transfer instructions, Arithmetic instructions, Logical instructions, Branchinstructions, Subroutine instructions, Bit manipulation instruction. Instruction syntax, **Addressing modes:** Immediate addressing, Register addressing, Direct addressing, Indirect addressing, relative addressing, Absolute addressing, Long addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. (Text 2)	**10**
3.	**8051 programming in C:** Introduction to Embedded C**,** data types,Programming using Embedde C, logic operation, data conversion programs accessing code ROM space. Time delay calculations in 8051C. I/O programming. **Timers/counters:** Timers and Counters, 8051 timers/counters, programming 8051 timers in assembly and C . (Text 2)	**12**
4.	**8051 Serial Communication:** Data communication, Basics of Serial Data Communication, 8051 Serial Communication, connections to RS-232,Serial communication Programming in C. (Text 2) **Interrupts:** Basics of interrupts, 8051 interrupt structure (Text 2)	**12**
5	**On-chip peripherals:** Watchdog Timer, Comparator, Real Time Clock (RTC), ADC, DAC, LCD, keyboard, stepper motor interfacing. (Text 2)	**08**

Note 1: Unit 3 and Unit 4 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course outcomes:

CO1: Learnt the concepts of Microprocessors and Microcontrollers.
CO2: Studied basic programming for Intel 8051 Microcontroller using assembly and Clanguage.
CO3: Learnt programming Intel 8051 Microcontroller using assembly and C language fortimers, serial communication and interrupts.
CO4: Able to execute basic programs for MSP430 Microcontroller using assembly and Clanguage.
CO5: Studied and able to write interfacing programs for MSP430 Microcontroller inassembly and C language.

COs	Mapping with Pos
CO1	PO1,PO 2,PO7, PO10
CO2	PO1,PO 2,PO3, PO4, PO8
CO3	PO1,PO2, PO3, PO4, PO7
CO4	PO1,PO2, PO3, PO4, PO9
CO5	PO1,PO 2, PO3, PO5,PO6, PO9

TEXT BOOKS:

1. **The Intel Microprocessors, Architecture, Programming and Interfacing –** Barry B. Brey, 8e, Pearson Education / Phi, 2009.
2. **"The 8051 Microcontroller and Embedded Systems – using assembly and C",** Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, Pearson, 2006.

REFERENCE BOOKS/WEBLINKS:

1. **"The 8051 Microcontroller Architecture, Programming and Applications",** 2e Kenneth J. Ayala, Thomson Learning 2005.
2. **Microcontrollers: Architecture, Programming, Interfacing and System Design",**Raj Kamal, " Pearson Education, 2005.
3. http://elearning.vtu.ac.in/elcmys/06ES42.html
4. "**The 8051 Microcontroller**", V.Udayashankar and MalikarjunaSwamy, TMH,2009.

Sub Title : DIGITAL COMMUINICATION		
Sub Code: TE61	**No of Credits : 3= 2:1:0(L-T-P)**	**No of lecture hours/week : 4**
Exam Duration : 3 hours	**Exam Marks : CIE+SEE = 50 + 50 =100**	**Total No of Contact Hours : 52**

Course Objectives :. The objective of this course is

1. Introduce the concept of sampling theorem, practical application of sampling theorem and time division multiplexing.
2. Extend the knowledge of PCM, DPCM, DM and different companding techniques.
3. To understand the concept of ISI and different methods to overcome the same.
4. To learn and apply the concept of Gram-Schmidt orthogonalization procedure for the signals andto understand and concept of detection and estimation.
5. To make the students to understand the concept of different digital modulation techniques including the Spread Spectrum modulation technique

UNIT No	Syllabus Content	No of Hours	
		Teaching	Tutorials
1	**Basic signal processing operations in digital communication:** Sampling Principles, Sampling Theorem, Quadrature sampling of Band pass signal, Practical aspects of sampling and signal recovery PAM, TDM.	5	5
2	**Waveform Coding Techniques:** PCM, Quantization noise and SNR, robust quantization DPCM, DM, Adaptive Delta modulation, applications & Problems	5	5
3	**Base-Band Shaping for Data Transmission:** Discrete PAM signals, power spectra of discrete PAM signals. ISI, Nyquist's criterion for distortion less base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems, adaptive equalization for data transmission.	4	4
4	**Digital Modulation Techniques:** Digital Modulation formats, Coherent binary modulation techniques, Coherent quadrature modulation techniques. Non-coherent binary modulation techniques. **Spread Spectrum Modulation:** Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum, coherent binary PSK, frequency hop spread spectrum, applications.	7	7
5	**Detection And Estimation:** Model of DCS, Gram- Schmidt Orthogonalization procedure, geometric interpretation of signals, response of bank of correlators to noisy input Detection of known signals in noise, correlation receiver, matched filter receiver, detection of signals with unknown phase in noise.	5	5

Note 1:- Unit number 3 & 4 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcome :

1. Knowledge and design of Sampling technique, and design of TDM .
2. Analysis and design of PCM, DPCM and DM systems
3. Knowledge of ISI and different methods to overcome the same
4. Ability to apply the concept of Gram-Schmidt orthogonalization procedures applied to signals and the concept of detection and estimation
5. Ability to analyze the different digital modulation techniques including the Spread Spectrum modulation technique

COs	Mapping with POs
CO1	PO1,PO2,PO10
CO2	PO1,PO2,PO5,PO10
CO3	PO1,PO2,PO5,PO10
CO4	PO1,PO2,PO5,PO10
CO5	PO1,PO2,PO5,PO10

TEXT BOOK:

1. Digital Communications, Simon Haykin, John Wiley India Pvt. Ltd, 2008.

REFERENCE BOOKS/WEBLINKS:

1. Digital and Analog Communication Systems, Simon Haykin, John Wiley India Pvt. Ltd., 2008.
2. An introduction to Analog and Digital Communication, K. Sam Shanmugam, John Wiley India Pvt. Ltd., 2008.
3. Digital communications - Bernard Sklar: Pearson education 2007.
4. www.nptel.ac.in/downloads/117105077

Sub Title: Microwave Engineering		
Sub Code: TE64	**No of Credits: 3= 2:1:0 (L-T-P)**	**No of lecture hours/week: 3 (L)+ (T)= 39 Hours**
Exam Duration: 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No of Contact Hours: 39**

Course Objectives :

(1) To study the principle of working of microwave generators and applications
(2) To study the working of passive microwave devices and its applications
(3) To understand the working principle of solid state microwave devices
(4) To study the impact of strip lines
(5) To understand the application of microwave in radars

UNIT No	Syllabus Content	No of Hours	
		Teaching	Tutorial
1	**Microwave Vacuum Devices**: Introduction and applications of microwaves, Microwave frequency bands, Klystrons (oscillator and two-cavity klystron), Travelling Wave Tube Amplifiers, Magnetron Oscillator, Relevant problems.	08	
2	**Microwave Passive Devices:** Introduction, Waveguide Microwave Junctions (S-Matrix representation of multiport networks), Microwave Tee Junctions, Directional couplers, Microwave Attenuator and Phase shifter, Isolators and Circulators (No detailed mathematical Derivation)	08	
3	**Solid State Microwave Devices:** Transfer Electron Devices: Introduction, GUNN diode, RWH Theory. Avalanche Transit Time Devices : IMPATT Diode, BARITT Diode, Parametric Amplifier, Other diodes : PIN Diode, Schottky Barrier Diode (No mathematical Derivation)	07	
4	**Strip Lines:** Introduction, Microstrip Lines, Parallel strip lines, Coplanar strip-lines, Shielded strip-lines.	08	
5.	**Introduction to Radar**: Origins of Radar, Radar frequencies, Basic Radar block diagram, Simple form of Radar equation, Doppler and MTI Radar, Digital MTI Processing, Delay line cancellers, Moving Target detector (MTD)	08	

Note 1 : Unit 3 and Unit 5 have internal choice.

Note 2 : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcome :

(1) To analyze microwave generators with numericals.
(2) To analyze and represent S-matrix of various passive microwave devices.
(3) To analyze the working principle of microwave solid state devices
(4) To analyze the design of strip lines
(5) To analyze various radars with numericals.

TEXT BOOKS:

1. Microwave Engineering-Annapurna Das, Sisir K Das, 2nd Ed., TMH Publication, 2010.
2. Microwave Devices and circuits- Liao, 3rd Ed., Pearson Education, 2009.
2. Introduction to Radar systems-Merrill L Skolnik, 3rd Ed., TMH, 2001.

REFERENCE BOOK:

1. Microwave & RADAR Engineering– M. Kulkarni, 2nd Ed., Umesh Publications, 2001.
2. Microwave Engineering–David M Pozar, 3rd Ed., John Wiley India Pvt. Ltd., 2008.
3. . http://webee.technion.ac.il/people/schachter/Teaching/Microwaves%202011-2012-locked.pdf

Sub Title : Object Oriented Programming using C++		
Sub Code: TE661	**No of Credits :4= 4-0-0(L-T-P)**	**No of lecture hours/week : 4**
Exam Duration : 3 hours	**Exam Marks : CIE + SEE = 100**	**Total No of Contact Hours : 52**

Course Objectives:

1. To learn the concepts of object oriented programming.
2. To learn the basic concepts and functions in C++.
3. To learn programming in C++ using classes and objects.
4. To study constructors, destructors and operator overloading concepts.
5. To study inheritance and virtual functions in C++.

UNIT No	Syllabus Content	No of Hours
1	**Beginning with C++:** Object Oriented Programming Paradigm**,** Basic concepts of OOP**,** Benefits of OOP, Applications of C++,Structure of C++ program, Tokens, Keywords, Identifiers, Data types, User Defined Data types, Derived Data types, Symbolic constants, Dynamic Initialization of variables.	10
2	Reference Variables**,** Operators in C++, Scope Resolution Operators, Memory Management Operators, Manipulators, Type-cast operators, Operator precedence, Control Structures, Functions prototyping, Call by reference, Return by reference, Inline function, Default arguments, Function Overloading.	10
3	**Classes and objects** : Specifying the class, Defining member functions, Nesting of member functions, Private Member functions, Arrays within a class, Memory allocation for objects, Static Data members, Static ember functions, Arrays of objects, Objects as function arguments, Friendly functions, Returning objects.	12
4	**Constructors, Destructors and operator overloading :** Parameterized Constructors, Constructors with default arguments, Copy constructor, Const Objects, Destructors Operator Overloading Unary and binary operators, Overloading binary operators using friends, Manipulation of strings using operators, Rules for overloading operators, type conversion.	10
5	Inheritance, Defining Derived classes, Single, Multilevel, Multiple hierarchical and hybrid inheritance, Virtual base classes, Abstract classes, Constructors and derived classes, Pointers, Pointers to objects, *this* pointer, Pointers to derivedclasses, Virtual functions, Pure Virtual functions. C++ Streams and C++ Stream Classes.	10

Note 1:- Unit number 3 & 4 will have internal choice.

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

1. The basics of Object Oriented Programming.
2. The programming concepts of C++.
3. The usage of objects and classes.
4. The use of constructors, destructors and operator overloading in C++ programs.
5. The use of inheritance and virtual functions in C++.

COs	Mapping with POs
CO1	PO1, PO2
CO2	PO1,PO3,PO7
CO3	PO2,PO6, PO7
CO4	PO1, PO5,PO6
CO5	PO6,PO8 PO9, PO10

TEXT BOOK:

1. Object Oriented Programming with C++, E. Balaguruswamy, Galgotia Publications, 2004.

REFERENCE BOOKS/WEBLINKS :

1. Object Oriented Programming using C++, Robert Lafore, Galgotia publications.
2. C++ Primer , Lippman and Lajoie, 3rd edition, Addison Wesley.

www.atilim.edu.tr/~mcs215/Lecture%20Notes/book.pdf

Sub Title : MOBILE COMMUNICATION

Course Objectives:

After completing the course, the students should:

1. Analyse the environment in which the wireless industry operates.
2. Understand the different propagation mechanisms of wireless signals.
3. Understand different modulation schemes used in wireless communications.
4. Understand the concepts of different multiple access techniques used for wireless communication.
5. Become familiar with 3G technologies.

Sub Code: TE72	No of Credits : 4=4:0:0 (L-T-P)	No of lecture hours/week : 4
Exam Duration : 3 hours	CIE+SEE = 50 + 50 =100	Total No of Contact Hours : 52

Unit No	Syllabus	No of hours
1	**Introduction to wireless communication system:** Evolution of mobile radio communication, mobile radio system around the world, examples of wireless communication system. **The cellular concept:** Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, trunking and grade ofservice, improving coverage and capacity in cellular systems.	10
2	**Mobile radio propagation(large scale path loss):**Free space propagation model, relating power to electric field, three basic propagation mechanisms, reflection, Two-ray model, diffraction, outdoor and indoor propagation models	10
3	**Mobile radio propagation(Small scale fading and multipath):**Small scale multipath propagation, impulse response model, small scale multipath measurement, parameters of mobile multipath channels, types of small scale fading. **Digital modulation:** Overview , line coding, pulse shaping techniques, linear modulation techniques.	11
4	**Speech coding:** Characteristic, quantization, ADPCM, frequency domain coding ofspeech, vocoders, linear predictive coders. **Multiple access techniques for wireless communication:** FDMA , TDMA, Spreadspectrum multiple access, space division multiple access	11
5	3G Digital cellular technology:2.5G TDMA,GPRS ,EDGE Technologies,Need for 3G cellular network,IMT-2000 global standard,UMTS technology,W-CDMA air interface,TD-SCDMA technology,CDMA 2000 cellular technology.	10

Note 1 :- Unit number 3 & 4 will have internal choice

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes:

1. Demonstrate cellular radio concepts in the design of wireless communication systems
2. Analyse different propagation mechanisms.
3. Study small scale propagation models and modulation scheme of wireless communication systems .
4. Understand different multiple access schemes and speech coding
5. Learn about 3G wireless technology

Cos	Mapping with POs
CO1	PO1,PO2,PO5,PO6
CO2	PO1,PO2,PO5,PO8
CO3	PO1,PO4,PO5,PO6
CO4	PO1,PO2,PO6,PO8
CO5	PO2,PO5,PO6,PO9

TEXT BOOKS:

1. **Wireless communications –Theodore.S.Rappaport**.PHI,second edition.
2. **Wireless communications**-T.L.Singal, McGraw Hill

REFERENCE BOOKS/WEBLINKS:

1. **Mobile Cellular Telecommunication** – Lee W.C.Y, MGH, 2002.
2. **Wireless communication** – D P Agrawal: 2nd Edition Thomson learning 2007.
3. **Fundamentals of Wireless Communication** – David Tse, PramodViswanath, Cambridge

Sub Title : CRYPTOGRAPHY & NETWORK SECURITY		
Sub Code:TE832	**No of Credits : 4=4:0:0 (L-T-P)**	**No of lecture hours/week : 4**

Exam Duration : 3 hours	CIE+SEE = 50 + 50 =100	Total No of Contact Hours : 52

Course Objectives:

1. To provide an introduction to the fundamental principles of cryptography and itsapplications on the network security domain.
2. To study various approaches to Encryption techniques, Design Principles and Modes of operation.
3. To study a given system with respect to security of the system.
4. To analyze the given system with respect to digital signature and intruders.
5. To analyze the given system with respect to malicious software and firewalls.

UNIT No	Syllabus Content	No of Hours
1	**Introduction:** Services, mechanisms and attacks, The OSI security architecture, A model for network security. **Symmetric Ciphers**: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Simplified DES, Data encryption standard (DES), The strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of Operation, Evaluation Criteria for Advanced Encryption Standard, The AES Cipher (In brief).	12
2	**Principles of Public-Key Cryptosystems**:Public-key cryptosystems, Applications for public-key cryptosystems, requirements for public-key cryptography,The RSA algorithm, Key Management, Diffie – Hellman KeyExchange.	8
3	**Web Security Consideration**: Security socket layer (SSL), SSL architecture, Transport layer security, Secure Electronic Transaction.	8
4	**Digital signatures**: Requirements, direct digital signature, arbitrated digital signature,Digital Signature Standard , DSS approach, digital signature algorithm.**Intruders**:Intruders, Intrusion techniques, Intrusion Detection, distributed intrusion detection, honeypots, Intrusion detection exchange format.	12
5	**Malicious software**: Viruses and Related Threats, malicious programs, nature of viruses, virus structure, types, Virus Countermeasures, antivirus approaches, advanced antivirus techniques, . **Firewalls**:Firewalls Design Principles, firewall characteristics, types offirewalls, firewall configurations, Trusted Systems, data access control ,concept of trusted systems.	12

Note 1 : unit no. 4 & 5 will have internal choice

Note 2: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes:

1. To become familiar with the cryptographic techniques that provides information and network security.
2. To impart knowledge on Encryption techniques, Design Principles and Modes of operation.
3. To analyze a given system with respect to security of the system.
4. To analyze the concept of digital signatures and intruders.
5. To create an understanding of malicious software and firewalls.

Cos	Mapping with POs
CO1	PO2,PO5, PO10
CO2	PO2,PO5, PO10
CO3	PO2,PO5, PO10
CO4	PO2,PO5, PO10
CO5	PO2,PO5, PO10

TEXT BOOK:

1. **Cryptography and Network Security**– William Stalling, Pearson Education, 2003.

REFERENCE BOOKS:

1. **Cryptography and Network Security** – Behrouz A. Forouzan, TMH, 2007.
2. **Cryptography and network security**– Atul Kahate, , TMH, 2003.
3. williamstallings.com/Extras/Security-Notes/

Sub Title : INTERNET OF THINGS

Sub Code:TE746	No of Credits : 3 = 3 : 0 : 0 (L-T-P)	No of lecture hours/week : 3
Exam Duration : 3hours	CIE+SEE = 50 + 50 =100	Total No of Contact Hours :39

Objectives:

1. To study the basics framework and architecture of Internet of Things (IoT).
2. To gain knowledge of IoT design principles.
3. To understand the Internet connectivity principles in IoT.
4. To study sensor & RFID technology for IoT.
5. To gain knowledge on prototyping embedded devices for IoT and M2M.

Unit No	Syllabus	No. of Hours
1	**Internet of things: An overview-** Internet o things, IoT Conceptual Framework, IoT Architectural view, Technology behind IoT, Sources of IoT, M2M Communication.	8
2	**Design Principles Of Connected Devices:** Introduction, IoT/M2Msystems layers and design standardization, Communication Technologies, Data enrichment, data consolidation and device management at gateway.	7
3	**Internet Connectivity Principles:** Introduction, Internet connectivity, Internet based communication, IP addressing in the IoT, Media Access control, Application Layer protocols	9
4	**Sensors, Participatory sensing, RFIDs, and Wireless Sensor Networks:** Introduction, Sensor Technology, Participatory sensing, Industrial IoT, Automotive IoT, Actuator, Sensor data communication protocols, Radio Frequency Identification Technology, Wireless Sensor Network Technology	9
5	**Prototyping the Embedded Devices for IoT and M2M:** Introduction, Embedded Computing basics, Embedded platforms for prototyping, Things always connected to the internet/cloud.	6

NOTE 1: Unit number 3 and 4 will have internal choice

NOTE 2 : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and . Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Outcomes:

1. Knowledge of framework and architecture of IoT.
2. Knowledge of IoT Design principles.
3. Understand the Internet connectivity principles in IoT.
4. Knowledge of sensor and RFID technology for IoT.
5. Knowledge of prototyping embedded devices for IoT and M2M

TEXT BOOKS:

1. "**Internet of Things – Architecture and Design Principles",** Raj Kamal, 2017 McGraw Hill publications.

REFERENCE MATERIALS:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",** 1st Edition, Academic Press, 2014.(**ISBN-13:** 978-0124076846)
2. Vijay Madisetti and ArshdeepBahga, **"Internet of Things (A Hands-on-Approach)",** 1stEdition, VPT, 2014.(**ISBN-13:** 978-8173719547)

COs	**Mapping with POs**
CO1	PO1, PO2,PO3, PO4,PO5,PO6,PO8
CO2	PO2,PO3, PO4,PO5,PO8,PO10
CO3	PO2, PO3
CO4	PO2, PO3
CO5	PO6,PO10

Sub Title : NETWORK THEORY		
Sub Code: 18TE33	**No. of Credits: 4=4:0:0 (L:T:P)**	**No. of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours : 52**

1. http://elearning.vtu.ac.in/elcmys/CS33.html

Course Objectives :

1. To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
2. To understand the need of simplification techniques of complicated circuits using network theorems.
3. To learn about the comprehensive insight into the principle techniques available for characterizing Resonance circuits, networks and their evaluation of initial and final conditions and implementation in practice.
4. To learn applications of Laplace transforms in network applications
5. To gain knowledge of two-port network parameters modelling and their implementation.

UNIT No.	Syllabus Content	No. of Teaching Hours
1	**Basic Concepts:** Practical sources, Source transformations, Network reduction using Star – Delta transformation, Loop and Node analysis With linearly dependent and independent sources for DC and AC networks, Concepts of super Node and super Mesh, relevant problems.	12
2	**Network Theorems:** Superposition, Reciprocity and Millman's theorem, Thevinin's and Norton's theorems; Maximum Power transfer theorem, relevant problems.	10
3	**Resonant Circuits:** Series and parallel resonance, frequency response of series and parallel circuits, Q-factor, Bandwidth relevant problems.	10
4	**Transient behavior and initial conditions :** Behaviors of circuit elements under switching condition andtheir Representation, Evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DCexcitations, relevant problems.	10
5.	**Laplace Transformation :** Solution of networks, step, ramp and impulse responses, waveform Synthesis, definition of transfer function, relevant problems **Two port network parameters :** Definition of z, y, h and transmission parameters , modeling with these parameters, relationship between parameters sets, relevant problems .	10

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1:State and understand various Network theorems.
CO2: Understand basic concepts of Network Reduction techniques.
CO3: Apply knowledge of mathematics to solve and understand Network theorems related to network, initial conditions, Laplace Transformations, Two port network parameters
CO4: Analyse networks in terms of different two port network parameters.
CO5: Evaluate the transient behaviour of different networks, and quality factor of resonant circuits.

COs	Mapping with POs
CO1	PO1,PO2,PO4
CO2	PO2,PO4
CO3	PO1,PO2,PO3,PO4,PO5
CO4	PO1,PO4
CO5	PO1,PO4

TEXT BOOKS:

1. "**Network Analysis**", M. E. Van Valkenburg, PHI / Pearson Education, 3rd Edition. Reprint 2002.
2. "**Networks and systems**", Roy Choudhury,2nd edition,2009, New Academic Science Ltd.

REFERENCE BOOKS/WEBLINKS :

1."**Basic Circuit Analysis**" by John O'Maley, 2nd Edition, Schaum's Outlines,2011.
2."**Engineering Circuit Analysis**", Hayt, Kemmerly and Durbin, 8th Edition, TMH, 2013.
3. 3. elearning.vtu.ac.in/06ES34.html

Sub Title : LINEAR INTEGRATED CIRCUITS		
Sub Code: 18TE34	**No. of Credits : 3=3:0:0(L:T:P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives :

1. To Learn basic concepts of Op Amp, Parameters, Opamps as DC Amplifiers, Opamp asInverting, Non Inverting, Summing, Difference Circuits.
2. To design Op-Amps as AC Amplifiers, High Z_{in} Capacitor Coupled Voltage Follower, Inverting, Non Inverting Op Amp.
3. To understand Op-Amps frequency response and compensation**.**
4. To understand and design waveform generation circuits, and understand various linear applications of Op-amp.
5. To understand various Non-linear applications of Op-amp and 555 Timer.

UNIT No.	Syllabus Content	No. of Teaching Hours
1	**Operational Amplifier Fundamentals:** Basic Op-Amp circuit, Op-Amp parameters – Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedances, Slew rate and Frequency limitations; Op-Amps as DC Amplifiers- Biasing Op-Amps, Direct coupled - Voltage Followers, Non-inverting Amplifiers, Inverting amplifiers, Summing amplifiers, Difference amplifier. **(Text 1)**	**08**
2	**Op-Amps as AC Amplifiers:** Capacitor coupled Voltage Follower, High input impedance - Capacitor coupled Voltage Follower, Capacitor coupled Non-inverting Amplifiers, High input impedance - Capacitor coupled Non-inverting Amplifiers, Capacitor coupled Inverting amplifiers, setting the upper cut-off frequency. **(Text 1)**	**08**
3	**Op-Amps frequency response and compensation:** Circuit stability, Frequency and phase response, Frequency compensating methods, Band width, Slew rate effects, Z_{in} Mod compensation, and circuit stability precautions. **(Text 1)**	**07**
4	**Op-Amp Applications:** Voltage sources, current sources and current sinks, Current amplifiers, instrumentation amplifier, Integrator, Comparator, sample and hold circuits, V to I and I to V converters, phase shift oscillator, Wein bridge oscillator.**(Text 1)**	**08**
5.	**Non-linear circuit applications:** Crossing detectors, inverting Schmitt trigger circuits, Active Filters –First and second order Low pass and High pass filters. **Other Linear IC applications:** 555 timer - Basic timer circuit, 555 timer used as astable and monostable multivibrator, Schmitt trigger,Square Wave Generator, PLL-operating principles, VCO.**(Text 1)**	**08**

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2.

Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1: An ability to Remember Op-Amp basics and parameters like Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedances, Slew rate and Frequency limitations

CO2: To Understand Opamp Applications like Linear and Non Linear applications

CO3: Design all basic Opamp circuit like Inverting, Non Inverting, Summing, Difference Circuit, High capacitance Voltage Follower, Inverting, Non Inverting Circuits.

CO4: To analyze Op-Amps frequency response and different compensation techniques.

CO5: Implementation of various applications using Opamp and 555 timer.

Cos	Mapping with Pos
CO1	PO1,PO2,
CO2	PO1, PO3,
CO3	PO1,PO2
CO4	PO2, PO5,PO9
CO5	PO2

TEXT BOOKS:

1. **"Operational Amplifiers and Linear IC's"** , David A. Bell, 3rd edition. Oxford University Press, 2011.

2. **"Linear Integrated circuits"**, D. Roy Choudhary and Shail B. Jain, 3rd edition, New Academic Science Ltd. 2010.

REFERENCE BOOKS/WEBLINKS:

1. **"Op - Amps and Linear Integrated Circuits"**, James M. Fiore, Thomson Learning,2001.
2. **"Design with Operational Amplifiers and Analog Integrated Circuits"**, Sergio Franco,TMH, 3rd edition,2005.
3. **"Op Amps and Linear Integrated circuits"**, Ramakant .A. Gayakwad, 4th edition,PHI,2009.
4. http://www.electronics-tutorials.ws/opamp/opamp_1.html

Subject Title : FIELD THEORY		
Sub Code: 18TE35	**No. of Credits:3 = 2:2:0 (L:T:P)**	**No. of hours/week : 4**
Exam Duration : 3 hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours : 52**

Course objectives :

1. To introduce the fundamental principles of static electric fields.
2. To understand the concepts of energy and potential.
3. To study Laplace's equations and Poisson's equations and its applications.
4. To introduce the principles of time-varying magnetic field.
5. To learn the use of time-varying Maxwell's equations for analyzing wave propagation.

UNIT No.	Syllabus Content	No. of Hours	
		Teaching	Tutorials
1	**a. Coulomb's Law and electric field intensity**: Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge **,** relevant problems **b. Electric flux density, Gauss' law and divergence:** Electric flux density, Gauss' law, Application of Gauss' law,Divergence, Maxwell's First equation(Electrostatics), vector operator ∇ and divergence theorem, relevant problems	06	06
2	**Energy and potential and Conductors :** Energy expendedor work done in moving a point charge in an electric field, The line integral, Definition of potential diff erence and Potential, The potential field of a point charge and system of charges, Potential gradient , Current and current density, Continuity of current, relevant problems.	05	05
3	**Poisson's and Laplace's equations:** Derivations of Poisson's and Laplace's Equations, Uniqueness theorem, relevant problems **Boundary conditions :** metallic conductors, Conductor properties and boundary conditions between conductor and dielectric material ,boundary conditions for perfectDielectrics,	05	05
4	**The steady magnetic field:** Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and Vector magnetic potentials, Relevant problems**.** **Time Varying Maxwell's equations**: Faraday's Law, Displacement current, Equation of Continuity.	05	05
5	**Uniform Plane wave :** Wave equations**,** Wave Propagation in free space and dielectrics, Poynting's theorem and power, Propagation in good conductors – Skin Effect, Depthof penetration ,Normal incidence at dielectric-dielectric interface, Normal incidence at conductor-dielectric interface, relevant problems	05	05

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1: Understand the concepts of energy expended in moving a charge, potential gradient, vector magnetic potential, wave propagation in free space.
CO2: Remember Coulomb's law, Gauss's law, Ampere's law, Biot-Savart's law.
CO3: Evaluate Laplace's and Poisson's equations.
CO4: Apply knowledge of Maxwell's equations for interpretation of uniform plane wave.
CO5: Analyze the variations in EM waves at interface between two media.

COs	Mapping with Pos
CO1	PO1, PO2, PO10
CO2	PO1, PO2
CO3	PO1, PO2
CO4	PO1, PO2
CO5	PO1, PO2

TEXT BOOKS:

1. **"Engineering Electromagnetics",** William H Hayt Jr. and John A Buck**,** Tata McGraw- Hill, 8th edition, 2012
2. **"Electromagnetic Waves And Radiating Systems,"** Edward C. Jordan and Keith G Balmain, Prentice – Hall of India / Pearson Education, 2nd edition, 1968.Reprint 2002

REFERENCE BOOKS/WEBLINKS:

1. **"Electromagnetics",** Joseph A.Edminister, Mahmod Nahvi, Schaum Outline series,McGraw Hill,4th edition,2013
2. "**Fundamentals of Electromagnetics with MATLAB",** Karl Erik Lonngren,Sava Vasilev Savov, Randy J. Jost, SciTech Publication, 2nd edition,2007.
3. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013-electromagnetics-and-applications-spring-2009/lecture-notes/

Sub Title : MICROCONTROLLER USING ASSEMBLY AND C LANGUAGE		
Sub Code: 18TE41	**No. of Credits:4= 4:0:0 (L:T:P)**	**No. of lecture hours/week : 4**
Exam Duration : 3 hrs	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours : 52**

Course Objectives :

1. To understand the architecture of Microprocessor & Microcontroller and other related architectures.
2. To learn memory organization of 8051 architecture, basic programming for Intel 8051 Microcontroller using Assembly language.
3. To learn the basic embedded C language for Intel 8051microcontroller and study programming using Assembly & Embedded C language for timers/counters.
4. To study the serial communication & interrupts in 8051 microcontroller.
5. To study the on-chip peripherals and interfacing programs for Microcontroller in assembly and C language.

Unit No.	Syllabus Content	No. of Teaching Hours
1.	**Introduction:** A Historical background, the microprocessor based Personal Computer System. Architecture of 8086: Internal Microprocessor architecture, Real Mode Memory addressing. Introduction to 80386, 80486 & Pentium Processors. Microprocessors and microcontroller. Introduction, Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture, Computer software. (Text 1 & Reference 1)	**10**
2.	**The 8051 Architecture:** Introduction, Architecture of 8051, Pin diagram of 8051, Memory organization, External Memory interfacing, Stacks. **Instruction set:** Instruction timings, 8051 instructions: Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions,Bit manipulation instruction. Instruction syntax, **Addressing modes:** Immediate addressing, Register addressing, Direct addressing, Indirect addressing, relative	**10**

	addressing, Absolute addressing, Long addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. (Text 2)	
3.	**8051 programming in C:** Introduction to Embedded C**,** data types,Programming using Embedde C, logic operation, data conversion programs accessing code ROM space. Time delay calculations in 8051C. I/O programming. **Timers/counters:** Timers and Counters, 8051 timers/counters, programming 8051 timers in assembly and C . (Text 2)	**12**
4.	**8051 Serial Communication:** Data communication, Basics of Serial Data Communication, 8051 Serial Communication, connections to RS-232, Serial communication Programming in C. (Text 2) **Interrupts:** Basics of interrupts, 8051 interrupt structure (Text 2)	**11**
5.	**On-chip peripherals:** Watchdog Timer, Comparator, Real Time Clock (RTC), ADC, DAC, LCD, keyboard, stepper motor interfacing. (Text 2)	**09**

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course outcomes:

CO1: Learnt the architectures of Microprocessors and Microcontrollers.
CO2: Studied basic programming for Intel 8051 Microcontroller using assembly Language using its instruction sets and various addressing modes.
CO3: Learnt programming Intel 8051 Microcontroller using assembly and C language for Timers/counters.
CO4: Studied the concepts of 8051 serial communication & interrupts, using both assembly and C languages.
CO5: Studied and able to write interfacing programs for 8051 Microcontroller in assembly and C language.

COs	**Mapping with Pos**
CO1	PO1,PO 2,PO7, PO10
CO2	PO1,PO 2,PO3, PO4, PO8
CO3	PO1,PO2, PO3, PO4, PO7
CO4	PO1,PO2, PO3, PO4, PO9
CO5	PO1,PO 2, PO3, PO5,PO6, PO9

TEXT BOOKS:

1. **The Intel Microprocessors, Architecture, Programming and Interfacing –** Barry B. Brey, 8e, Pearson Education / Phi, 2009.
2. **"The 8051 Microcontroller and Embedded Systems – using assembly and C",** Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, Pearson, 2006.

REFERENCE BOOKS/WEBLINKS:

1. **"The 8051 Microcontroller Architecture, Programming and Applications",** 2e Kenneth J. Ayala, Thomson Learning 2005.
2. **Microcontrollers: Architecture, Programming, Interfacing and System Design",**Raj Kamal, " Pearson Education, 2005.
3. http://elearning.vtu.ac.in/elcmys/06ES42.html
4. "**The 8051 Microcontroller**", V.Udayashankar and MalikarjunaSwamy, TMH,2009.

Sub Title :FUNDAMENTALS OF TELECOMMUNICATIONS		
Sub Code: 18TE42	No of Credits: 3=3:0:0 (L-T-P)	No of lecture hours/week : 3
Exam Duration : 3 hours	CIE +Assignment + SEE = 45 + 5 + 50 =100	Total No of Contact Hours : 39

Course Objectives:

1. Understanding basic terms and principles of signal processing in telecommunication transmission.
2. Describing basic principles of the modern digital telecommunications.
3. Implementing acquired knowledge in professional specialist courses (theoretical and practical).
4. Understanding basic operation settings for telecommunication systems and equipment.

Unit No	Syllabus	No. of Teaching Hours
1	**Introductory Concepts:** What Is Telecommunication?, Introductory Topics in Telecommunications, End-Users, Nodes, and Connectivity, Telephone Numbering and Routing, The Use of Tandem Switches in a Local Area, Introduction to the Busy Hour and Grade of Service, Simplex, Half-Duplex, and Full Duplex, One-Way and Two-Way Circuits, Network Topologies, Variations in Traffic Flow, Quality of Service, Standardization in Telecommunications.	**8**
2	**Signals Convey Intelligence :** Basic Concepts of Electricity for Communications, Early Sources of Electrical Current, The Electrical Telegraph: An Early Form of Long-Distance Communications Electrical Signals, Introduction to Transmission, Modulation, Binary Digital Signals, Introduction to Transporting Electrical Signals, Wire Pair, Coaxial Cable Transmission, Fiber-Optic Cable, Radio Transmission	**7**
3	**Quality of Service and Telecommunication Impairments** Quality of Service: Voice, Data, and Image, Signal-to-Noise Ratio, Voice Transmission, Data Circuits, Video (Television), The Three Basic Impairments and How They Affect the End-User, Amplitude Distortion, Phase Distortion, Noise, Typical Levels, Echo and Singing.	**8**
4	**Transmission and Switching: Cornerstones of a Network:** Traffic Intensity Defines the Size of Switches and the Capacity of Transmission Links, Traffic Studies, Discussion of the Erlang and Poisson Traffic, Formulas, Waiting Systems (Queueing), Dimensioning and Efficiency,	**8**

	Quantifying Data Traffic, Introduction to Switching, Basic Switching, Concentration and Expansion, Local Switch, Early Automatic Switching Systems, Common Control (Hard-Wired), Stored Program Control, Concentrators and Remote Switching, Essential Concepts in Transmission, Two-Wire and Four-Wire Transmission, Multiplexing, Frequency Division Multiplex, Pilot Tones.	
5	**Voice Telephony & Television Transmission :** Definition of the Voice Channel, The Human Voice, Operation of the Telephone Subset, The Subset Mouthpiece or Transmitter, The Subset Earpiece or Receiver, Video Transmission, Composite Signal, Critical Video Parameters, Transmission Standard—Level, Video Transmission Standards (Criteria for Broadcasters), Color Transmission.	**8**

Note: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes:

1. Explain basic physical and technical principles of modern digital telecommunications,
2. Describe basic principles of operation in modern digital telecommunication equipment and systems,
3. Demonstrate measurements and experiments in laboratory on actual components, devices, equipment and systems in telecommunications,
4. Describe development and implementation methods of telecommunication systems,
5. Examine communication equipment for the technical functionality

Cos	Mapping with Pos
CO1	PO1,2,3,4,5,6,8,10
CO2	PO1,2,3,4,5,6,8,10
CO3	PO1,2,3,5,6,8
CO4	PO1,2,3,5,6,8
CO5	PO1,2,3,4,5,6,8,10

TEXT BOOKS:

1. "Fundamentals of Telecommunications" by Roger L. Freeman, Second Edition A JOHN WILEY & SONS, INC., PUBLICATION.

2. H. Taub, D.L. Schilling«Principles of Telecommunication Systems", 3rd edition 2006.

3. Tziolas , M. Salehi, "Communications Systems», 1st edition 2003, University of Athens Eds.

SUB TITLE : FUNDAMENTALS OF HARDWARE DESCRIPTION LANGUAGE		
Sub Code: 18TE44	**No. of Credits: 3= 3:0:0(L:T:P)**	**No. of lecture hours/week : = 3 hours**
Exam Duration : 3 hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours :39**

Course Objectives :

1. To understand the Description used in HDL languages.
2. To design simple logic circuits and also implementation of various digital logic designin various applications.
3. To understand the Structural type description used as pointers in C Language.
4. Basic concepts of synthesis are described.
5. To understand the mixed typed and mixed language description.

UNIT No	Syllabus Content	No. of Teaching Hours
1	**Introduction:** Why HDL? A Brief History of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Brief comparison of VHDL and Verilog, Introduction to XILINX , XILINX version of ModelSim, a Verilog Simulator.	07
2	**Data –Flow Descriptions**: Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type- Vectors, **Behavioral Descriptions (VHDL and Verilog)**: Behavioral Description highlights, Structure of HDL behavioral Description, The HDL Variable –Assignment Statement, Sequential statements	09
3	**Structural Descriptions**: Highlights of structural Description, Organization of the structural Descriptions. **Procedures and Tasks :** Highlights of Procedures and tasks Functions (HDL).	07
4	**Synthesis Basics:** Highlights of Synthesis, Synthesis information from Entity and Module, Mapping Process and Always in the Hardware Domain.	07
5	**Mixed –Type Descriptions**: Why Mixed-Type Description? HDL User-Defined Types, HDL Packages, Mixed-Type Description examples **Mixed –Language Descriptions (VHDL and Verilog):** Highlights of Mixed-Language Description, How to invoke One language from the Other, Mixed-language Description Examples, Limitations of Mixed-Language Description.	09

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1: Remember and define different types of Description of HDL.
CO2: Understand the basics of digital design and Invoking from Verilog to VHDL
CO3: Analyze the Structural, Behavioral and dataflow description.
CO4: Develop and execute algorithms for Mixed Type and Mixed Langauge descriptions
CO5: Design, apply and test combinational and sequential circuits, in HDL to verify the functionality.

Cos	Mapping with POs
CO1	PO1, PO2, PO3, PO4 , PO7
CO2	PO1, PO2, PO3, PO4, PO6
CO3	PO1, PO2, PO3, PO6, PO7
CO4	PO3, PO6, PO5, PO8, PO10
CO5	PO1,PO2, PO3, PO4

TEXT BOOKS:

1. **"HDL Programming (VHDL and Verilog)"-** Nazeih M.Botros- Dreamtech Press, Aug-2006.
2. "**A Verilog HDL Primer"**- J.Bhaskar – BS Publications, 2nd Edition, 2001.

REFERENCE BOOKS/WEBLINKS:

1. **"Verilog HDL"**–Samir Palnitkar -Pearson Education, 2nd Edition, Feb 21, 2003.
2. **VHDL -Douglas Perry**-Tata McGraw-Hill 3rd Edition, 2002.
3. https://electrobotss.files.wordpress.com/2014/01/ ece-iv-fundamentals-of-hdl-10ec45-notes.pdf

Sub Title : TRANSMISSION LINES AND WAVE GUIDES		
Sub Code: 18TE45	No. of Credits : 4=4:0:0(L:T:P)	No. of lecture hours/week : 4
Exam Duration :3 hours	CIE +Assignment + SEE =45 + 5 + 50 =100	Total No. of Contact Hours : 52

Course Objectives :

1. To introduce the types of Transmission Lines and analyze of their circuit equivalent.
2. To understand the concept of Standing waves.
3. To learn use of Smith chart.
4. To learn mathematical modeling of a system and finding the transfer function.
5. To learn block diagram reduction rules and finding transfer function using Signal flow graphs.

UNIT No.	Syllabus Content	No. of Teaching Hours
1	**Transmission – Line Theory** :The transmission Line general solution, Physical significance of the equations; the infinite line, The distortion less Line, The telephone cable, Reflection on a Line not terminated in Z_0, Open and short circuited Lines, Reflection loss, Insertion loss, T and PI sections equivalent to Lines, relevant problems .**(Text 1)**	12
2	**Impedance matching :** standing waves; nodes ; standing wave ratio. input impedance of dissipation less line, input impedance of open- and short-circuited lines, single-stub impedance matching, The quarter wave Line and its applications, relevant equations and problems. **(Text 1)**	10
3	**Smith Chart and its applications :** Smith Circle diagram, Applications of Smith chart, Single-stub impedance matching with Smith Chart.**(Text 1)**	08
4	**Guided waves :** Applications of restrictions to Maxwell's equation, types of propagation; TM, TE and TEM, Transmission of TM,TE and TEM waves in parallel planes.(Text 1 & 2)	10
5.	**Wave guides :** Application of Maxwell's equations to the rectangular wave guides, The $TM_{m,n}$ wave in the rectangular guide, The $TE_{m,n}$ wave in the rectangular guide, The TEM wave in the coaxial Line, Attenuation in the coaxial Line, Excitation of wave guides, Guide terminations, Resonant cavities (Text 1 & 2)	12

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcomes :

CO1: Understand the types and parameters of transmission line, various classifications of control systems, transfer function.

CO2: Remember general solution for transmission line, parameters of open-wire and co-axial line, Mason's gain formula.

CO3: Analyze different types of transmission lines.

CO4: Application of Smith chart to solve problems associated with transmission lines and impedance matching.

CO5: Evaluate transfer function using Block diagram reduction techniques and signal flow graph.

Cos	Mapping with Pos
CO1	PO1,PO2,PO8
CO2	PO1,PO2,PO3
CO3	PO1,PO2
CO4	PO1,PO2,PO10
CO5	PO1,PO2,PO3

TEXT BOOKS:

1."**Network Lines and Fields**" , John D Ryder, 2 edition, PHI, 2005.

REFERENCE BOOKS/WEBLINKS:

1. "**Transmission Lines and Networks**", Umesh Sinha, 8th edition, Satya Prakashana (TechIndia Publication), 2003.
2. "**Networks and systems**", Roy Choudhury,2nd edition,2009, New Academic Science Ltd.

Sub Title :ARM processor and Embedded System Design		
 **Sub Code: 18TE54**	**No. of Credits : 4=4:0:0 (L-T-P)**	**No. of lecture hours/week : 4**
Exam Duration : 3 hours	**CIE +Assignment + Activity +SEE = 40 + 5 + 5 + 50 =100**	**Total No. of Contact Hours : 52**

Course Objectives:

1. To learn system design for measurement of embedded system operating characteristicsand to determine system performance relative to functional requirements.
2. Studying complete design of an embedded system with functional requirements for hardware and software components including processor.
3. To learn design and implementation of software systems to provide an interface betweenhardware peripheral sensors and systems.
4. To learn designing of an embedded system with functional requirements for RTOSarchitecture.
5. To study design of an embedded system with functional requirements for RTOS

Unit No.	Syllabus	No. of Teaching Hours
1	**INTRODUCTION**: Overview of embedded systems, embedded system design challenges, common design metrics and optimizing. Survey of different embedded system design technologies, trade-offs.	10
2	**SINGLE-PURPOSE PROCESSORS**: Hardware, Combinational Logic, Sequential Logic, RT levelCombinational and Sequential Components, Optimizing single-purpose processors. Single-Purpose Processors:Software, Basic Architecture, Operation	10
3	**Standard Single-Purpose Peripherals**: Timers, Counters,UART, PWM, LCD Controllers, Keypad controllers, Stepper Motor Controller, A to D Converters, Examples. **MEMORY**:Introduction, Common memory Types, Compulsory memory, Memory Hierarchy and Cache, Advanced RAM. Interfacing, Communication Basics, Microprocessor Interfacing,	10
4	**INTERRUPTS** : Basics - Shared Data Problem - Interrupt latency. Survey Of Software Architecture, Round Robin, Round Robin with Interrupts - Function Queues - scheduling - RTOS architecture. **INTRODUCTION TO RTOS** : Tasks - states - Data - Semaphores and shared data.	10
5	**INTRODUCTION TO ARM PROCESSOR:** Acorn RISC Machine – Architecture Inheritance – ARM ProgrammingModel- ARM Development Tools – 3 and 5 Stage Pipeline ARM Organization - ARM Instruction Execution and Implementation – ARM Co-Processor Interface(Blendedlearning).	12

Note:

1. Unit 5 is identified for blended learning.
2. Students submit three assignments covering five units with higher level questions upto level 4.

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

1. Explain the design for measurement of embedded system operating characteristics and to determine system performance relative to functional requirements.
2. Apply the concepts related to design of an embedded system with functional requirements for hardware and software components including processor.
3. De sign and implement software systems to provide an interface between hardware peripheral sensors and systems.
4. Analyse the functional requirements for RTOS architecture for the efficient system design.
5. Demonstrate the functional requirements to solve system design problems.

COs	**Mapping with POs**
CO1	PO1,PO2,PO5,PO6
CO2	PO1,PO5, PO6, PO8,PO10
CO3	PO1, PO5,PO6
CO4	PO1,PO5,PO6,PO8
CO5	PO1, PO5,PO6

TEXT BOOKS:

1. Embedded System Design A unified hardware/software introduction– Frank Vahid,Tony Givargis, John Wiley & Sons, Inc.2002
2. An Embedded software Primer – David E. Simon, Pearson Education, 1999.

REFERENCE BOOKS:

1. "Introduction to Embedded systems", by SHIBU.K.V McGRaw Hill Education (India) Private limited.
2. Embedded Systems: Architecture and Programming – Raj Kamal, TMH.
3. Embedded Systems Architecture – Tammy Noergaard.
4. Comprehensive Guide for Engineer and Programmers –Elsevier Publication 2005
5. "ARM Processor on-chip" by Steve Furber.

Sub Title : COMPUTER COMMUNICATION NETWORKS		
Sub Code: 18TE61	No of Credits : 4=4:0:0(L-T-P)	No of lecture hours/week : 4
Exam Duration : 3 hours	CIE +Assignment +Activity+ SEE = 40 + 5 + 5+ 50 =100	Total No of Contact Hours :52

Course Objectives:

1. To define and understand the Layer functions of OSI model and TCP/IP Suite.
2. To study framing, flow control and error control.
3. To understand the different Multiple accesses techniques.
4. To study the standards and protocols of Wired and Wireless LANs.
5. To understand the different addressing modes, IPV4, IPV6 and to implement the different Routing algorithms.

UNIT No	Syllabus Content	No. of Teaching Hours
1	Layered tasks: OSI Model, Layers in OSI model, TCP/IP Suite, Addressing. Circuit switched Network , Data gram Networks, Virtual circuit Networks	10
2	Data Link Control: Framing, Flow and error control, Protocols, Noiseless channels and Noisy channels, HDLC. Multiple Access: Random access – CSMA, CSMA/CD, CSMA/CA, Controlled access – Reservation, Polling and Token Passing, Channelization – FDMA, TDMA, CDMA.	10
3	LANs: Ethernet: IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet. Wireless LANS: IEEE 802.11, Bluetooth, Connecting Devices: Passive Hubs, Repeaters, Active Hubs, Bridges and Routers.	10
4	Network Layer: Internetworking, IPV4, IPV6, Transition from IPV4 to IPV6, Delivery, Forwarding techniques and Process, Unicast Routing Protocols: Distance vector Routing, Link State Routing, Dijktras Algorithm, Unicast Routing Protocols.	12
5	Transport layer protocols: User Datagram protocol: User Datagram, UDP services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, windows in TCP, Flow control, Error control, TCP congestion control.	10

Note :

1. Unit 5 is identified as blended learning.
2. Students submit three assignments covering five units with higher level questions upto level 4.

Course Outcomes : At the end of the course, students will be able to:

1. Explain the architecture of OSI model and TCP/IP model and the switching techniques.
2. Implement Framing of the data, controlling the errors using DLL protocols in HDLCformats.
3. Analyze accessing of channels in a random and controlled manner using different techniques.
4. Analyze the Ethernet standards and wireless LANs.
5. Implement routing in network layer using different algorithms and analyze IPV4 andIPV6 address and their transitions.

COs	Mapping with POs
CO1	PO1, PO5, PO6,PO8
CO2	PO1, PO5, PO6,PO8
CO3	PO2, PO3, PO4
CO4	PO3, PO4, PO10
CO5	PO3, PO4, PO10

TEXT BOOK:

1. **Data Communication and Networking,** B Forouzan, 4th Ed, TMH , 2006.

REFERENCE BOOKS/WEBLINKS:

1. **Computer Networks**, Andrew Tanenbaum, Pearson Education 2008
2. **Computer Networks, James F. Kurose, Keith W. Ross**: Pearson education, 2nd Edition, 2003

3.Introduction to Data communication and Networking, Wayne Tomasi: Pearson education 2007

www.tutorialspoint.com/...communication_computer_network/data_communication

Sub Title : CRYPTOGRAPHY & NETWORK SECURITY

Sub Code:18TE641	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE +Assignment +Activity+ SEE = 40 + 5 + 5+ 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives:

1. To provide an introduction to the fundamental principles of cryptography and itsapplications on the network security domain.
2. To study various approaches to Encryption techniques, Design Principles and Modesof operation.
3. To study a given system with respect to security of the system.
4. To analyze the given system with respect to digital signature and intruders.
5. To analyze the given system with respect to malicious software and firewalls.

UNIT No	Syllabus Content	No of Teaching Hours
1	**Introduction:** Services, mechanisms and attacks, The OSI security architecture, A model for network security. **Symmetric Ciphers**: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Simplified DES, Data encryption standard (DES), The strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of Operation, Evaluation Criteria for Advanced Encryption Standard, The AES Cipher (In brief).	8
2	**Principles of Public-Key Cryptosystems**:Public-key cryptosystems, Applications for public-key cryptosystems, requirements for public-key cryptography,The RSA algorithm, Key Management, Diffie Hellman Key Exchange.	7
3	**Web Security Consideration**: Security socket layer (SSL), SSL architecture, Transport layer security, Secure Electronic Transaction.	7
4	**Digital signatures**: Requirements, direct digital signature, arbitrated digital signature,Digital Signature Standard , DSS approach, digital signature algorithm.**Intruders**:Intruders, Intrusion techniques, Intrusion Detection, distributed intrusion detection, honeypots, Intrusion detection exchange format.	9
5	**Malicious software**: Viruses and Related Threats, malicious programs, nature of viruses, virus structure, types, Virus Countermeasures, antivirus approaches, advanced antivirus techniques, . **Firewalls**:Firewalls Design Principles, firewall characteristics, types offirewalls, firewall configurations, Trusted Systems, data access control ,concept of trusted systems.	8

Note :

1. In Unit 5 is identified for blended learning.

2. Students submit three assignments covering five units with higher level questions.

Course Outcomes:

CO1: Apply the concepts of cryptographic techniques that provides information and network security.
CO2: Demonstrate the importance of SSL layer and Transport layer security.
CO3:Explain the concepts of public-key cryptosystems.
CO4:Illustrate the importance of Digital signature and Intruders.
CO5:Explain the concepts of malicious software and firewalls.

Cos	Mapping with POs
CO1	PO2,PO5, PO10
CO2	PO2,PO5, PO10
CO3	PO2,PO5, PO10
CO4	PO2,PO5, PO10
CO5	PO2,PO5, PO10

TEXT BOOK:

1. **Cryptography and Network Security**– William Stalling, Pearson Education, 2003.

REFERENCE BOOKS:

1. **Cryptography and Network Security** – Behrouz A. Forouzan, TMH, 2007.
2. **Cryptography and network security**– Atul Kahate, , TMH, 2003.
3. williamstallings.com/Extras/Security-Notes/

Sub Title: WIRELESS AND MOBILE NETWORKS

Sub Code: 18TE72	**No. of Credits: 4=3:2:0(L:T:P)**	**No of lecture hours per week: 4**
Exam Duration : 3 hours	**CIE +Assignment +Activity+ SEE =40 + 5 + 5+ 50 =100**	**Total No. of Contact Hours : 52**

Course Objectives :

1. To study fundamentals of Wireless communication networks, their issues and standards.
2. To study WBAN technology, its architecture, design issues, protocols and applications
3. To study WPAN technology, its architecture, design issues, protocols, components and applications.
4. To study WLAN components, design requirements, WMAN architecture, protocols and applications.
5. To study WWANs, cellular networks, Satellite Network, Applications, ad-hoc networks, Sensor network.

UNIT No.	Syllabus Content	No. of Hours Teaching
1	Review of fundamentals of wireless communication and Networks: Wireless communication channel specifications, Wireless communication systems, Wireless networks, Switching technology, Communication problems, Wireless network issues and standards.	10
2	Wireless body area networks: Properties, Network architectures, Components, Design issues, Network Protocols, WBAN technologies and WBAN applications.	10
3	Wireless personal area networks: Network Architectures, WPAN Components, Requirements of WPAN devices, WPAN Technologies and protocols, WPAN applications, Bluetooth and Zigbee.	8
4	Wireless LANs: Network components, design requirements, Architectures, IEEE-802.11x, WLAN protocols, 802.11p andapplications. WMANs, IEEE-802.16: Architectures, Components, WiMax mobility support, Protocols, Broadband networks and applications.	12
5	WWANs, cellular networks, Satellite Network, Applications. Wireless ad-hoc networks: Mobile ad-hoc networks, Sensor network, Mesh networks, VANETs, Research issues in Wireless networks.	12

Note 1: All Units will have internal choice.

Note 2: Two assignments are evaluated for 10 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3, 4 and 5.

Course Outcomes :

CO1: Have complete knowledge fundamentals of wireless communication and Networks and their applications.

CO2: Identify the different wireless networks like WBAN, WMAN, WLAN, WMAN, WMAN and understand their architecture and their components.

CO3: Understand and interpret the protocols and standards in different Wireless communication and networks.

CO4: Analyze the various design issues in WMAN, WLAN, WMAN, WMAN.

CO5: Determine the applications of Wireless communication networks, Adhoc networks and Sensor Networks.

COs	Mapping with POs
CO1	PO2, PO5
CO2	PO2, PO4,PO5
CO3	PO5
CO4	PO2,PO8
CO5	PO5

TEXT BOOK:

1. S S Manvi, and M. S. Kakkasageri, "Wireless and Mobile network concepts and Protocols", Wiley India Pvt Ltd, 2010.

REFERENCE BOOKS:

1. P Kaveh, Krishnamurthy, "Principles of Wireless network: A unified approach", PHI, 2006.
2. Iti Saha Mitra, "Wireless communication and network: 3G and Beyond", McGraw Hill, 2009.
3. Ivan Stojmenovic, "Handbook of Wireless networks and Mobile Computing", Wiley, 2009.
4. P Nicopolitidis, M. S. Obaidat, et al, "Wireless Networks", Wiley, 2009.
5. Yi-Bing Lin, Imrich Chlamtac, "Wireless and Mobile Network Architectures", Wiley, 2009.
6. Mullet, "Introduction to Wireless Telecommunication Systems and Networks", Cengage, 2009.

Sub Title : Optical Communication & Networks		
 **Sub Code: 18TE731**	**No of Credits : 3=3:0:0 (L-T-P)**	**No of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No of Contact Hours : 39**

Course Objectives:

1. To understand the environment of optical communication and networks.
2. To study the components ,both active and passive required in the optical domain.
3. To study the design concepts of optical networks.
4. To study the requirements of WDM networks.
5. To understand the functions required for maintenance and control of optical networks.

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Unit No	Syllabus	No. of Teaching hours
1	**OVERVIEW OF OPTICAL FIBER COMMUNICATION:** Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, Ray theory, step indexfibers, graded index fibers, single mode fiber, cutoff wave length, mode field diameter.	08
2	**TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS:** Introduction, Attenuation, material absorption characteristics in silica glass fibers ,linear scattering losses, non-linear scattering losses, fiber bend loss, dispersion, chromatic dispersion, Inter modal dispersion, overall fiber dispersion.	08
3	**OPTICAL SOURCES AND DETECTORS:** Introduction, LED's (4.2; 4.2.1;4.2.4), LASER diodes (4.3,4.3.4), Photo detectors (6.1-6.1.1,6.1.2), Photo detector noise (6.2-6.2.1,6.2.2) **ANALOG AND DIGITAL LINKS:** Analog Systems: – Introduction, Overview of analog links, CNR, RIN (9.2.3), Digital links – Introduction, point–to–point links, System considerations, link power budgets (8.1.2), rise-time budget (8.1.3)	08

4	**INTRODUCTION TO OPTICAL NETWORKS**: Telecommunication network architecture (1.1), Optical networks (1.3), Multiplexing techniques (1.3.1), Second-generation optical networks (1.3.2), The Optical Layer(1.4), Transperancy and All-optical networks (1.5), optical packet switching (1.6), Network Evolution (1.8 – 1.8.1 to 1.8.4), Non-linear effects (2.5) - SPM (2.5.5), CPM (2.5.7) , Four Wave Mixing (2.5.8)	08
5	**CONTROL AND MANAGEMENT :** Network management functions (8.1, - 8.1.1 to 8.1.3), Optical layer services and interfacing (8.2), Layers within the optical layer (8.3), Multivendor interoperability (8.4), Performance and fault management (8.5, - 8.5.1 to 8.5.4), Optical safety (8.7, - 8.7.1)	07

Note: Three assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Unit 3: Blended learning

Course Outcomes:

1. To analyse the need for optical communication and networking.
2. To analyse the working principle of various components of optical networks.
3. To analyse the impact of design considerationsof optical networks.
4. To analyse the components required for WDM networks.
5. To analyse the maintenance and control functions required for optical networks.

Cos	Mapping with PO s
CO1	PO1,PO2, PO5, PO10
CO2	PO1, PO2, PO5, PO10
CO3	PO1, PO2, PO5, PO10
CO4	PO1, PO2, PO10
CO5	PO1, PO2, PO5, PO10

TEXT BOOKS:

1. **Optical Fiber Communications**– – John M. Senior, Pearson Education. 3rd Edition, 2010.
2. **Optical Fiber Communication** – Gerd Keiser, 4th Ed., MGH, 2008.
3. **Optical networks: A practical perspective Third Edition** – Rajiv Ramaswamy, Kumar N Sivarajan, Galen H. Sasaki ,Morgan Kauffman 1998 & 2010.
4. **Optical Communication Networks–** Biswajit Mukherjee TMG 1998.

REFERENCE BOOK:

1. **Fiber Optic communication** – Joseph C Palais: 4th Edition, Pearson Education
2. Optical networks – Ulysees Black, Pearson education 2007.

Sub Title : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING		
Sub Code: 18TE733	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 39**

Course Objectives: The objectives are to

1. Understand concepts and techniques that are core to Machine Learning.
2. Apply learning techniques and decision trees.
3. Acquire knowledge of neural networks, Bayesian techniques and instant based learning..
4. Implement and work with state of the art tools in Machine Learning.

Unit No.	Syllabus	No. of Teaching hours
1	**Learning:** Designing Learning systems, Perspectives and Issues, Concept Learning, Version Spaces and Candidate Elimination Algorithm, Inductive bias.	8
2	**Decision Tree and ANN**: Decision Tree Representation, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree. Neural Network Representation, Perceptrons, Multilayer Networks and Back Propagation Algorithms.	8
3	**Bayesian and Computational Learning**: Bayes Theorem, Bayes Theorem Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier.	8
4	**Instant Based Learning and Learning set of rules**: K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning. Sequential Covering Algorithms, Learning Rule Sets, Learning First Order Rules, Learning Sets of First Order Rules, genetic algorithms.	8
5	**Analytical Learning and Reinforced Learning**: Perfect Domain Theories, Explanation Based Learning, Inductive-Analytical Approaches, FOCL Algorithm, Reinforcement Learning.	7

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

1. Explain different supervised and unsupervised machine learning algorithms.
2. Explore and apply the fundamentals of machine learning techniques.
3. Implement and apply different supervised and unsupervised machine learning algorithms.
4. Analyze the strength and weakness of different machine learning models to solve real world problems.
5. Carry out projects based on Machine Learning.

COs	**Mapping with Pos**
CO1	PO1, PO2, PO3, PO4, PO5, PO12
CO2	PO1, PO2, PO3, PO4, PO5, PO12
CO3	PO1, PO2, PO3, PO4, PO5, PO12
CO4	PO1, PO2, PO3, PO4, PO5, PO12
CO5	PO1, PO2, PO3, PO4, PO5, PO12

TEXT BOOKS:

1. Introduction to Machine Learning- Ethem Alpaydin, 2nd Ed., PHI Learning Pvt. Ltd.,2013.

REFERENCE BOOKS/WEBLINKS:

1. The Elements of Statistical Learning-T. Hastie, R. Tibshirani, J. H. Friedman, Springer;1st edition, 2001.
2. Machine Learning, Amit Kumar Das, SaikatDutt, Subramanian Chandramouli, Pearson Education India, April 2018.

Open Elective -C

Subject Title : Wireless Sensor Networks		
Sub Code : 18TE751	No. of credits : 3=3:0:0(L-T-P)	No. of hrs/week : 3
Exam duration : 3hrs	CIE + SEE = 50 + 50 =100	Total No. of ContactHours : 39

Course Objectives:

1. To learn the technologies and challenges of Wireless Sensor Networks.
2. To study the architecture of node and networks.
3. To understand various protocols of Wireless Sensor Networks.
4. To learn the topology control and positioning of nodes.
   To get familiarized with different platforms and tools needed for Wireless Sensor Networks.

Unit No.	Syllabus	No. of Teaching hours
1	**OVERVIEW OF WIRELESS SENSOR NETWORKS** Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks, Mobile Ad-Hoc Networks, 4G LTE and applications.	09
2	**ARCHITECTURES** Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.	09
3	**NETWORKING SENSORS** Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, B- MAC, IEEE 802.15.4 standard and Zigbee, Disseminationprotocol for large sensor network. The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.	09
4	**INFRASTRUCTURE ESTABLISHMENT** Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.	06
5	**SENSOR NETWORK PLATFORMS AND TOOLS** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	06

Note: (1) Five assignments are evaluated for 5 marks: Assignment – 1 from units 1 , Assignment 2 from Unit 2, Assignment - 3 from units 3, Assignment 4 from Unit 4 and Assignment – 5 from unit 5.

(2) Unit 3 is identified for Blended learning

Course Outcomes :

CO1. Learnt the technologies and challenges of Wireless Sensor Networks.
CO2. Understood the architecture of sensor node and networks.
CO3. Understood various protocols of Wireless Sensor Networks.
CO4. Learnt the topology control and positioning of nodes.
CO5. Studied the different platforms and tools for Wireless Sensor Networks.

COs	**Mapping with Pos**
CO1	PO1, PO2, PO5
CO2	PO1, PO2, PO4
CO3	PO1, PO2, PO5
CO4	PO1, PO2
CO5	PO1, PO2, PO6, PO7, PO8

TEXT BOOKS:

1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" John Wiley, 2005.
2. Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. Raghavendra, Cauligi S, Sivalingam, Krishna M, Zanti Taiev. "Wireless Sensor Networks", Spinger 1st Edition 2004.

REFERENCE BOOKS:

1. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "Wireless Sensor Networks Technology,Protocols and applications", Wiley Publications, 2013.
3. K Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks",Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349.
4. N P Mahalik, "Sensor Networks and Configuration- Fundamentals, standards, platforms and applications", Spinger verlag, 2007.

Title : VLSI IN TELECOMMUNICATIONS

Sub Code:18TE753	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE +Assignment +Activity+ SEE = 40 + 5 + 5+ 50 =100**	**Total No. of Contact Hours: 39**

Course objective

1. To teach various modeling & Fabrication Techniques.
2. To illustrate various MOS switches, design equation, resistivity of various layers .
3. To study various primitive logic gates.
4. To understand the different types of flipflops.
5. To understand non ideal effects, dynamic CMOS circuits.

Unit No	Syllabus	No of teaching hours
1	**Introduction to MOSFETs** : MOS Transistor Theory – Introduction MOS Device, Fabrication and Modeling , Body Effect, Noise Margin; Latch-up	08
2	**MOS Inverter** : MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, Design Equations, Static Load MOS Inverters, Resistivity of Various Layers.	09
3	**Combinational MOS Logic Circuits**: Pass Transistors/Transmission Gates; Designing with transmission gates, Primitive Logic Gates;	08
4	**Sequential MOS Logic Circuits**: SR Latch, clocked Latch and flip flop circuits, CMOS D latch and edge triggered flip flop.	06
5	**Dynamic Logic Circuits:** Basic principle, non ideal effects, domino CMOS Logic, high performance dynamic CMOS Circuits	08

Note:

1. Unit 4 Sequential MOS Logic Circuits is identified for blended learning.
2. Students submit three assignments covering five units with higher level questions uptolevel 4.

Course Outcomes

1. An ability to analyze fabrication and modeling.
2. An impact knowledge of logic gates, circuits and design equation.
3. To analyze primitive logic gates.
4. To create an understanding of various Flip flops.
5. An understanding of non ideal effects, dynamic CMOS Circuits.

Cos	Mapping with POs
CO1	PO1,PO2, PO4
CO2	PO1,PO2,PO3, PO4,PO8
CO3	PO1,PO2,PO3, PO4,PO7
CO4	PO1,PO2,PO3, PO4,PO9
CO5	PO1,PO2,PO3, PO5,PO6,PO9

TEXT BOOKS

1. D. A. Pucknell and K. Eshraghian, Basic VLSI Design : Systems and Circuits, Third EditionPHI,1994.
2. W. Wolf, Modern VLSI Design : System on Chip, Third Edition, PH/Pearson, 2002
3. N. Weste, K. Eshraghian and M. J. S. Smith, Principles of CMOS VLSI Design: A Systems

REFERENCES:

1. Leon-Garcia, Widjaja, "Communication networks", TMH seventh reprint 2002.
2. Aunurag Kumar, D. MAnjunath, Joy Kuri, "Communication Networking", MorganKaufmann Publishers, 1ed 2004.

Sub Title : ADHOC WIRELESS NETWORKS		
Sub Code: 18TE822	**No. of Credits : 3=3:0:0 (L-T-P)**	**No. of lecture hours/week : 3**
Exam Duration : 3 hours	**CIE +Assignment +Activity+ SEE =40 + 5 + 5+ 50 =100**	**Total No. of Contact Hours :39**

Course Objectives :

1. To understand Ad hoc Networks and their Issues.
2. To analyze the issues in designing MAC and Routing Protocols.
3. To know the challenges in providing QoS in Ad hoc Networks.
4. To study the Transport Layer Protocols.
5. To study the QoS in Adhoc Networks.

UNIT No	Syllabus Content	No of Hours
1	**AD HOC NETWORKS:** Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless Internet.	08
2	**MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS:** Introduction,Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols, Contention based protocols with reservation mechanisms. Contention- based MAC protocols with scheduling mechanism, MAC protocols that usedirectional antennas.	12
3	**ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS:** Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table drive routing protocol, On-demand routing protocol. Hybrid routing protocol, Routing protocols with effective flooding mechanisms, Hierarchical routing protocols	12
4	**TRANSPORT LAYER PROTOCOLS FOR AD HOC WIRELESS NETWORKS:** Introduction, Issues in designing , Design goals , Classification of transport layer solutions, TCP over Ad hoc wireless Networks, Other transport layer protocols for Ad hoc wireless Networks. Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning, Secure routing in Ad hoc wireless Networks.	12
5	**QUALITY OF SERVICE IN AD HOC WIRELESS NETWORKS:** Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks, Classification of QoS solutions, MAC layer solutions, network layer solutions	08

Note : Three assignments are evaluated for 5 marks: Assignment – 1 from units 1

and 2.

Assignment - 2 from units 3 and 4 , Assignment – 3 from unit 5.

Course Outcome :

1. Analyse users in adhoc networks.
2. To design MAC protocols and to meet design goals.
3. Analyze routing protocols and design different routing protocols.
4. Analyze and design transport layer protocols.
5. Solve the issues of QOS in adhoc networks.

Cos	Mapping with POs
CO1	PO1,PO5
CO2	PO2,PO5
CO3	PO2, PO5,PO10
CO4	PO1,PO2,PO10
CO5	PO2,PO10

TEXT BOOK:

1. **Ad hoc wireless Networks** – C. Siva Ram Murthy & B. S. Manoj, Pearson Education,2nd Edition, reprint 2005.

REFERENCE BOOKS/WEBLINKS:

1. **Ad hoc wireless Networks** – Ozan K. Tonguz and Gianguigi Ferrari, Wiley.
2. **Ad hoc wireless Networking**– Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du, KluwerAcademic publishers
3. http://www.alljntuworld.in/wp-content/uploads/2016/01/Adhoc-and-Sensor-Networks-