COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC201	NETWORK THEORY	3-1-0-4	2016

Prerequisite: Nil

Course objectives:

- To make the students capable of analyzing any linear time invariant electrical network.
- To study time domain, phasor and Laplace transform methods of linear circuit analysis.
- To study the transient response of networks subject to test signals.
- To develop understanding of the concept of resonance, coupled circuits and two port networks.

Syllabus:

Circuit variables and Circuit elements, Kirchhoff's laws, Network topology, Mesh and node analysis of network, Laplace transform, Inverse Laplace transform, Solution of differential equations by using Laplace transforms, Transient analysis of RL, RC, and RLC networks, Network functions for the single port and two ports, Parameters of two-port network, Resonance, Coupled circuits

Expected outcome:

At the end of the course students will be able to analyze the linear time invariant electrical circuits.

Text Books

1. Ravish R., Network Analysis and Synthesis, 2/e, McGraw-Hill, 2015.
2. Valkenburg V., Network Analysis, 3/e, PHI, 2011.

References:

1. Sudhakar A,S. P. Shyammohan, Circuits and Networks- Analysis and Synthesis, 5/e, McGraw-Hill, 2015.
2. Choudhary R., Networks and Systems, 2/e, New Age International, 2013.
3. Franklin F. Kuo, Network Analysis and Synthesis, 2/e, Wiley India, 2012.
4. Pandey S. K., Fundamentals of Network Analysis and Synthesis, 1/e, S. Chand, 2012.
5. Edminister, Electric Circuits – Schaum's Outline Series, McGraw-Hill,2009.

Course Plan

Module	Course content (48 hrs)	Hours	Sem. Exam Marks
I	Introduction to circuit variables and circuit elements, Review of Kirchhoff's Laws, Independent and dependent Sources, Source transformations	3	15
	Network topology, Network graphs, Trees, Incidence matrix, Tie-set matrix and Cut-set matrix	2	
	Solution methods applied to dc and phasor circuits: Mesh and node analysis of network containing independent and dependent sources	3	
II	Network theorems applied to dc and phasor circuits: Thevenin's theorem, Norton's theorem, Superposition theorem, Reciprocity theorem, Millman's theorem, Maximum power transfer theorem	6	15

	Laplace transform, properties Laplace Transforms and inverse Laplace transform of common functions, Important theorems: Time shifting theorem, Frequency shifting theorem, Time differentiation theorem, Time integration theorem, s domain differentiation theorem, s domain integration theorem, Initial value theorem, Final value theorem	4	
FIRST INTERNAL EXAM			
III	Partial Fraction expansions for inverse Laplace transforms, Solution of differential equations using Laplace transforms	3	**15**
	Transformation of basic signals and circuits into s-domain	2	
	Transient analysis of RL, RC, and RLC networks with impulse, step, pulse, exponential and sinusoidal inputs	3	
	Analysis of networks with transformed impedance and dependent sources.	3	
IV	Network functions for the single port and two ports, properties of driving point and transfer functions, Poles and Zeros of network functions, Significance of Poles and Zeros	3	**15**
	Time domain response from pole zero plot, Impulse Response	1	
	Network functions in the sinusoidal steady state, Magnitude and Phase response	3	
SECOND INTERNAL EXAM			
V	Parameters of two port network: impedance, admittance, transmission and hybrid parameters, Interrelationship among parameter sets	5	**20**
	Series and parallel connections of two port networks	2	
	Reciprocal and Symmetrical two port network	2	
	Characteristic impedance, Image impedance and propagation constant (derivation not required)	2	
VI	Resonance: Series resonance, bandwidth, Q factor and Selectivity, Parallel resonance	3	**20**
	Coupled circuits: single tuned and double tuned circuits, dot convention, coefficient of coupling, Analysis of coupled circuits	4	
END SEMESTER EXAM			

Question Paper Pattern

The question paper consists of three parts. Part A covers modules I and II, Part B covers modules III and IV and Part C covers modules V and VI. Each part has three questions. Each question can have a maximum of four subparts. Among the three questions one will be a compulsory question covering both the modules and the remaining two questions will be as one question from each module, of which one is to be answered. Mark pattern is according to the syllabus with maximum 30% for theory and 70% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC203	SOLID STATE DEVICES	3-1-0-4	2016

Prerequisite: Nil

Course objectives:

- To provide an insight into the basic semiconductor concepts
- To provide a sound understanding of current semiconductor devices and technology to appreciate its applications to electronics circuits and systems

Syllabus: Elemental and compound semiconductors, Fermi-Dirac distribution, Equilibrium and steady state conditions: Equilibrium concentration of electrons and holes, Temperature dependence of carrier concentration, Carrier transport in semiconductors, High field effects, Hall effect, Excess carriers in semiconductors , PN junctions ,contact potential, electrical field, potential and charge density at the junction, energy band diagram, minority carrier distribution, ideal diode equation, electron and hole component of current in forward biased pn junction, piecewise linear model of a diode , effect of temperature on VI characteristics, Diode capacitances, electrical breakdown in pn junctions, Tunnel Diode, Metal semiconductor contacts, bipolar junction transistor, metal insulator semiconductor devices, MOSFET, FinFET

Expected outcome:

The students should have a good knowledge in semiconductor theory and electronic devices.

Text Books:

1. Ben G. Streetman and Sanjay Kumar Banerjee, Solid State Electronic Devices, Pearson, 6/e, 2010
2. Achuthan, K N Bhat, Fundamentals of Semiconductor Devices, 1e, McGraw Hill,2015

References:

1. Tyagi M.S., Introduction to Semiconductor Materials and Devices, Wiley India, 5/e, 2008
2. Sze S.M., Physics of Semiconductor Devices, John Wiley, 3/e, 2005
3. Neamen, Semiconductor Physics and Devices, McGraw Hill, 4/e, 2012
4. Pierret, Semiconductor Devices Fundamentals, Pearson, 2006
5. Rita John, Solid State Devices, McGraw-Hill, 2014
6. Bhattacharya .Sharma, Solid State Electronic Devices, Oxford University Press, 2012
7. Dasgupta and Dasgupta , Semiconductor Devices : Modelling and Technology (PHI)

Course Plan

Module	Course content (48hrs)	Hours	Sem. Exam Marks
I	Elemental and compound semiconductors, Fermi-Dirac distribution, Equilibrium and steady state conditions, Equilibrium concentration of electrons and holes, Temperature dependence of carrier concentration	4	15
	Carrier transport in semiconductors, drift, conductivity and mobility, variation of mobility with temperature and doping, High Field Effects, Hall effect	5	
II	Excess carriers in semiconductors: Generation and recombination mechanisms of excess carriers, quasi Fermi levels, diffusion, Einstein relations, Continuity equations, Diffusion length, Gradient of quasi Fermi level	9	15
	FIRST INTERNAL EXAM		

III	PN junctions : Contact potential, Electrical Field, Potential and Charge density at the junction, Energy band diagram, Minority carrier distribution, Ideal diode equation, Electron and hole component of current in forward biased p-n junction, piecewise linear model of a diode effect of temperature on V-I characteristics	9	**15**
IV	Diode capacitances, switching transients, Electrical Breakdown in PN junctions, Zener and avalanche break down (abrupt PN junctions only), Tunnel Diode basics only, Metal Semiconductor contacts, Ohmic and Rectifying Contacts, current voltage characteristics	9	**15**
SECOND INTERNAL EXAM			
V	Bipolar junction transistor , current components, Minority carrier distributions, basic parameters, Evaluation of terminal currents (based on physical dimensions),Transistor action, Base width modulation	9	**20**
VI	Metal Insulator semiconductor devices: The ideal MOS capacitor, band diagrams at equilibrium, accumulation, depletion and inversion, surface potential, CV characteristics, effects of real surfaces, work function difference, interface charge, threshold voltage MOSFET: Output characteristics, transfer characteristics, sub threshold characteristics, MOSFET scaling (basic concepts)	9	**20**
	FinFET-structure and operation	1	
END SEMESTER EXAM			

Question Paper Pattern

The question paper consists of three parts. Part A covers modules I and II, Part B covers modules III and IV and Part C covers modules V and VI. Each part has three questions. Each question can have a maximum of four subparts. Among the three questions one will be a compulsory question covering both the modules and the remaining two questions will be as one question from each module, of which one is to be answered. Mark pattern is according to the syllabus with maximum 70 % for theory, derivation, proof and 30% for logical/numerical problems.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC205	ELECTRONIC CIRCUITS	3-1-0-4	2016

Prerequisite: Nil

Course objectives:

- To develop the skill of analysis and design of various analog circuits using discrete electronic devices as per the specifications.

Syllabus:

High pass and low pass RC circuits, Differentiator, Integrator, Analysis of BJT biasing circuits, small signal analysis of transistor configurations using small signal hybrid π model, low frequency and high frequency analysis of BJT amplifiers, Cascade amplifiers, Wide band amplifiers, Feedback amplifiers, Oscillators, Tuned amplifiers, Power amplifiers, Sweep circuits and multivibrators, transistor voltage regulator, DC analysis of MOSFET circuits, small signal equivalent circuit, Small signal analysis of MOSFET amplifier circuits, Analysis of multistage MOSFET amplifiers

Expected outcome:

- At the end of the course, students will be able to analyse and design the different electronic circuits using discrete electronic components.

Text Books:

- Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013
- Millman J. and C. Halkias, Integrated Electronics, 2/e, McGraw-Hill, 2010

References:

1. Neamen D., Electronic Circuits - Analysis and Design, 3/e, TMH, 2007
2. Rashid M. H., Microelectronic Circuits - Analysis and Design, Cengage Learning, 2/e, 2011
3. Spencer R. R. and M. S. Ghausi, Introduction to Electronic Circuit Design, Pearson, 2003
4. Razavi B., Fundamentals of Microelectronics, Wiley, 2015

Course Plan

Module	Course content (48 hrs)	Hours	Sem. Exam Marks
I	RC Circuits: Response of high pass and low pass RC circuits to sine, step, pulse and square wave inputs, Differentiator, Integrator	5	15
	BJT biasing circuits: Types, Q point, Bias stability, Stability factors, RC coupled amplifier and effect of various components, Concept of DC and AC load lines, Fixing of operating point, Classification of amplifiers	5	
II	Small signal analysis of CE, CB and CC configurations using small signal hybrid π model (gain, input and output impedance). Small signal analysis of BJT amplifier circuits, Cascade amplifier	7	15
	FIRST INTERNAL EXAM		
III	High frequency equivalent circuits of BJT, Short circuit current gain, cutoff frequency, Miller effect, Analysis of high frequency response of CE, CB and CC amplifiers	4	15
	Wide band amplifier: Broad banding techniques, low frequency and high frequency compensation, Cascode amplifier.	4	
IV	Feedback amplifiers: Effect of positive and negative feedback on gain, frequency response and distortion, Feedback topologies and	3	15

	its effect on input and output impedance, Feedback amplifier circuits in each feedback topologies (no analysis required)		
	Oscillators & Tuned Amplifiers: Classification of oscillators, Barkhausen criterion, Analysis of RC phase shift and Wien bridge oscillators, Working of Hartley, Colpitts and Crystal oscillators; Tuned amplifiers, synchronous and stagger tuning	6	
SECOND INTERNAL EXAM			
V	Power amplifiers: Classification, Transformer coupled class A power amplifier, push pull class B and class AB power amplifiers, efficiency and distortion, Transformer-less class B and Class AB power amplifiers, Class C power amplifier (no analysis required)	6	**20**
	Switching Circuits: Simple sweep circuit, Bootstrap sweep circuit, Astable, Bistable, and Monostable multivibrators, Schmitt Trigger	5	
VI	Transistor based voltage regulator: Design and analysis of shunt and series voltage regulator, load and line regulation, Short circuit protection	4	**20**
	MOSFET amplifiers: Biasing of MOSFET amplifier, DC analysis of single stage MOSFET amplifier, small signal equivalent circuit. Small signal voltage and current gain, input and output impedances of CS configuration, MOSFETCascade amplifier	5	
END SEMESTER EXAM			

Question Paper Pattern

The question paper consists of three parts. Part A covers modules I and II, Part B covers modules III and IV and Part C covers modules V and VI. Each part has three questions. Each question can have a maximum of four subparts. Among the three questions one will be a compulsory question covering both the modules and the remaining two questions will be as one question from each module, of which one is to be answered. Mark pattern is according to the syllabus with maximum 60 % for theory, derivation, proof and 40% for logical/numerical problems.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC207	LOGIC CIRCUIT DESIGN	3-0-0-3	2016

Prerequisite:Nil

Course objectives:

- To work with a positional number systems and numeric representations
- To introduce basic postulates of Boolean algebra and show the correlation between Boolean expression
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To study the fundamentals of HDL
- To design and implement combinational circuits using basic programmable blocks
- To design and implement synchronous sequential circuits

Syllabus:

Positional Number Systems, Boolean algebra, Combinational Logic, HDL concepts ,Digital ICs, Programmable Logic Devices, Sequential Logic, Sequential Circuits

Expected outcome:

The student should able to:

1. Compare various positional number systems and binary codes
2. Apply Boolean algebra in logic circuit design
3. Design combinational and sequential circuits
4. Design and implement digital systems using basic programmable blocks
5. Formulate various digital systems using HDL

Text Books:

1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003
2. John F Wakerly, Digital Design Principles and Practices, Pearson Prentice Hall, 2007

References:

1.Ronald J Tocci, Digital Systems, Pearson Education, 11th edition,2010
2.Thomas L Floyd, Digital Fundamentals, Pearson Education, 8th edition 2009
3.Moris Mano, Digital Design, Prentice Hall of India, 3rd edition, 2002
4.John M Yarbrough, Digital Logic Applications and Design, Cenage learning, 2009
5.David Money Harris, Sarah L Harris, Digital Design and Computer Architecture, Morgan Kaufmann – Elsevier, 2009

Course Plan

Module	Course content (42 hrs)	Hours	Sem. Exam Marks
I	Number systems- decimal, binary, octal, hexa decimal, base conversion	2	15
	1's and 2's complement, signed number representation Binary arithmetic, binary subtraction using 2's complement	2	
	Binary codes (grey, BCD and Excess-3), Error detection and correcting codes : Parity(odd, even), Hamming code (7,4), Alphanumeric codes : ASCII	2	
II	Logic expressions, Boolean laws, Duality, De Morgan's law, Logic functions and gates	2	15
	Canonical forms: SOP, POS, Realisation of logic expressions using K-	2	

	map (2,3,4 variables)		
	Design of combinational circuits – adder, subtractor, 4 bit adder/subtractor, BCD adder, MUX, DEMUX, Decoder,BCD to 7 segment decoder, Encoder, Priority encoder, Comparator (2/3 bits)	4	
FIRST INTERNAL EXAM			
III	Introduction to HDL : Logic descriptions using HDL, basics of modeling (only for assignments)	**2**	**0**
	Logic families and its characteristics: Logic levels, propagation delay, fan in, fan out, noise immunity , power dissipation, TTL subfamilies	1	**15**
	NAND in TTL (totem pole, open collector and tri-state), CMOS:NAND, NOR, and NOT in CMOS, Comparison of logic families (TTL,ECL,CMOS) in terms of fan-in, fan-out, supply voltage, propagation delay, logic voltage and current levels, power dissipation and noise margin	2	
	Programmable Logic devices - ROM, PLA, PAL, implementation of simple circuits using PLA	2	
IV	Sequential circuits - latch, flip flop (SR, JK, T, D), master slave JK FF, conversion of FFs, excitation table and characteristic equations	3	**15**
	Asynchronous and synchronous counter design, mod N counters, random sequence generator	5	
SECOND INTERNAL EXAM			
V	Shift Registers - SIPO, SISO, PISO, PIPO, Shift registers with parallel LOAD/SHIFT Shift register counter - Ring Counter and Johnson Counter	3	**20**
	Mealy and Moore models, state machine ,notations, state diagram, state table, transition table, excitation table, state equations	3	
VI	Construction of state diagram – up down counter, sequence detector	3	**20**
	Synchronous sequential circuit design - State equivalence	2	
	State reduction – equivalence classes, implication chart	2	
END SEMESTER EXAM			

Assignments:

1. Simple combinational circuit design using MUX,DEMUX, PLA & PAL
2. HDL simulation of circuits like simple ALU, up-down counter, linear feedback shift register, sequence generator

Question Paper Pattern

The question paper consists of three parts. Part A covers modules I and II, Part B covers modules III and IV and Part C covers modules V and VI. Each part has three questions. Each question have a maximum of four subparts. Among the three questions one will be a compulsory question covering both the modules and the remaining two questions will be as one question from each module, of which one is to be answered. Mark pattern is according to the syllabus with maximum 50 % for theory, derivation, proof and 50% for logical/numerical problems.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC231	Electronic Devices & Circuits Lab	0-0-3-1	2016

Prerequisite: Should have registered for EC205 Electronic circuits

Course objectives:

- To study the working of analog electronic circuits.
- To design and implement analog circuits as per the specifications using discrete electronic components.

List of Experiments: (12 Mandatory Experiments)

1. VI Characteristics of rectifier and zener diodes
2. RC integrating and differentiating circuits (Transient analysis with different inputs and frequency response)
3. Clipping and clamping circuits (Transients and transfer characteristics)
4. Fullwave Rectifier -with and without filter- ripple factor and regulation
5. Simple Zener voltage regulator (load and line regulation)
6. Characteristics of BJT in CE configuration and evaluation of parameters
7. Characteristics of MOSFET in CS configuration and evaluation of parameters
8. RC coupled CE amplifier - frequency response characteristics
9. MOSFET amplifier (CS) - frequency response characteristics
10. Cascade amplifier – gain and frequency response
11. Cascode amplifier -frequency response
12. Feedback amplifiers (current series, voltage series) - gain and frequency response
13. Low frequency oscillators –RC phaseshift, Wien bridge,
14. High frequency oscillators –Colpitt's and Hartley
15. Power amplifiers (transformer less) - Class B and Class AB
16. Transistor series voltage regulator (load and line regulation)
17. Tuned amplifier - frequency response
18. Bootstrap sweep circuit
19. Multivibrators -Astable, Monostable and Bistable
20. Schmitt trigger

Expected outcome:

The student should able to:

1. Design and demonstrate functioning of various discrete analog circuits.
2. Function effectively as an individual and in a team to accomplish the given task.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC233	ELECTRONICS DESIGN AUTOMATION LAB	0-0-3-1	2016

Prerequisite: Nil

Course Objectives :

The primary objective of this course is to familiarize the students, how to simulate the electronics/digital circuits, signals and systems using the soft-wares which are available for the modern design methodologies for the rapid design and verification of complex electronic systems.

List of Exercises / Experiments

1. **Introduction to SPICE**

[Institution can use any one circuit simulation package with schematic entry like EDWinXP, PSpice, Multisim, Proteus or CircuitLab.]

Introduction to SPICE software. Recognize various schematic symbols /model parameters of resistor, capacitor, inductor, energy sources (VCVS, CCVS, Sinusoidal source, pulse, etc), transformer, DIODE, BJT, FET, MOSFET, etc., units & values. Use SPICE Schematic Editor to draw and analyse (DC, AC, Transient) simple analog and digital electronic circuits.

List of Experiments using SPICE [Six experiments mandatory]

Simulation of following circuits using SPICE [Schematic entry of circuits using standard package, Analysis –Transient, AC, DC]

1. Potential divider network
2. RC integrating and differentiating circuits
3. Diode, BJT and MOSFET characteristics
4. Diode Circuits (Clipping, Clamping, Rectifiers)
5. RC coupled amplifier (Single & two stages)
6. RC oscillator (RC phase shift / Wien Bridge)
7. Astable multivibrator
8. Truth table verification of basic and universal gates
9. Half adder /full adder circuits using gates
10. 4 bit adder/BCD adder
11. Encoder/Multiplexers
12. Flipflops/Counters

2. **Introduction to MATLAB**

[Institution can use any one numerical computational package like SciLab, Octave, Spyder, Python (scipy) or Freemat instead of MATLAB]

Fundamentals, basic operations on array, matrix, complex numbers etc., Script and function files, plotting commands, control statements.

Writing simple programs for handling arrays and plotting of mathematical functions, plotting of analog, discrete and noise signals, analysing the simple electronic circuits/network using node and mesh equations.

List of Experiments [Four experiments mandatory]

Write program and obtain the solutions

1. Solve /plot the mathematical equations containing complex numbers, array, matrix multiplication and quadratic equations etc

	2. Obtain different types of plots (2D/3D, surface plot, polar plot) 3. Generate and plot various signals like sine square, pulse in same window. 4. Plot the diode/transistor characteristics. 5. Solve node, mesh and loop equations of simple electrical/network circuits. 6. Find the poles and zeros hence plot the transfer functions/polynomials 7. Sort numbers in ascending order and save to another text file using text read and sort function after reading n floating point numbers from a formatted text file stored in the system. 8. Plot a full wave rectified waveform using Fourier series
3	**Introduction to HDL** [Institution can choose VHDL or Verilog as language to describe the problem and any one simulation/synthesis tool like Xilinix ISE, Modelsim, QSim, verilog, VHDL, EDwinXP or ORCAD etc. for the simulation.] **List of Experiments using HDL** Write the HDL code to realise and simulate the following circuits: (at least 4 of the following) 1. Basic gates/universal gates 2. Combinational Circuits (Half adder/Half subtractor) 3. Full adder in 3 modelling styles (Dataflow/structural/Behavioural) 4. Multiplexer/De-multiplexer 5. Decoder/Encoder 6. 4 bit adder/BCD adder 7. Flipflops (SR,JK,T,D) 8. Binary Counters 9. Finite state machines
Expected outcomes: 1. An ability to apply knowledge of computer, science, and engineering to the analysis of electrical and electronic engineering problems. 2. An ability to design systems which include hardware and software components. 3. An ability to identify, formulate and solve engineering problems. 4. An ability to use modern engineering techniques	

Course code	Course Name	L-T-P - Credits	Year of Introduction
EC202	SIGNALS & SYSTEMS	3-1-0 -4	2016

Prerequisite: Nil

Course Objectives

1. To train students for an intermediate level of fluency with signals and systems in both continuous time and discrete time, in preparation for more advanced subjects in digital signal processing, image processing, communication theory and control systems.
2. To study continuous and discrete-time signals and systems, their properties and representations and methods those are necessary for the analysis of continuous and discrete-time signals and systems.
3. To familiarize with techniques suitable for analyzing and synthesizing both continuous-time and discrete time systems.
4. To gain knowledge of time-domain representation and analysis concepts as they relate to differential equations, difference equations, impulse response and convolution, etc.
5. To study frequency-domain representation and analysis concepts using Fourier analysis tools, Laplace Transform and Z-transform.

   To study concepts of the sampling process, reconstruction of signals and interpolation.

Syllabus

Elementary signals, Continuous time and Discrete time signals and systems, Signal operations, Differential equation representation, Difference equation representation, Continuous time LTI Systems, Discrete time LTI Systems, Correlation between signals, Orthogonality of signals, Frequency domain representation, Continuous time Fourier series, Continuous time Fourier transform, Laplace transform, Inverse Laplace transform, Unilateral Laplace transform, Transfer function, Frequency response, Sampling, Aliasing, Z transform, Inverse Z transform, Unilateral Z transform, Frequency domain representation of discrete time signals, Discrete time Fourier series and discrete time Fourier transform (DTFT), Analysis of discrete time LTI systems using the above transforms

Expected outcome .

The student will be able to:

i. Define, represent, classify and characterize basic properties of continuous and discrete time signals and systems.
ii. Represent the CT signals in Fourier series and interpret the properties of Fourier transform and Laplace transform
iii. Outline the relation between convolutions, correlation and to describe the orthoganality of signals.
iv. Illustrate the concept of transfer function and determine the magnitude and phase response of LTI systems.
v. Explain sampling theorem and techniques for sampling and reconstruction.
vi. Determine z transforms, inverse z transforms and analyze LTI systems using z transform.

Text Book:

1. Alan V. Oppenheim and Alan Willsky, Signals and Systems, PHI, 2/e, 2009
2. Simon Haykin, Signals & Systems, John Wiley, 2/e, 2003

References:

1. Anand Kumar, Signals and Systems, PHI, 3/e, 2013.
2. B P. Lathi, Priciples of Signal Processing & Linear systems, Oxford University Press.
3. Gurung, Signals and System, PHI.
4. Mahmood Nahvi, Signals and System, Mc Graw Hill (India), 2015.
5. P Ramakrishna Rao, Shankar Prakriya, Signals and System, MC Graw Hill Edn 2013.

6. Rodger E. Ziemer, Signals & Systems - Continuous and Discrete, Pearson, 4/e, 2013			
Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Elementary Signals, Classification and representation of continuous time and discrete time signals, Signal operations	4	15%
	Continuous time and discrete time systems - Classification, Properties.	3	
	Representation of systems: Differential equation representation of continuous time systems. Difference equation representation of discrete systems.	2	
II	Continuous time LTI systems and convolution integral.	3	15%
	Discrete time LTI systems and linear convolution.	2	
	Stability and causality of LTI systems.	2	
	Correlation between signals, Orthoganality of signals.	2	
FIRST INTERNAL EXAMINATION			
III	Frequency domain representation of continuous time signals- continuous time Fourier series and its properties.	4	15%
	Convergence, Continuous time fourier transform and its properties.	3	
	Laplace Transform, ROC, Inverse transform, properties, unilateral Laplace transform.	3	
	Relation between Fourier and Laplace transforms.	1	
IV	Analysis of LTI systems using Laplace and Fourier transforms. Concept of transfer function, Frequency response, Magnitude and phase response.	4	15%
	Sampling of continuous time signals, Sampling theorem for lowpass signals, aliasing.	3	
SECOND INTERNAL EXAMINATION			
V	Z transform, ROC , Inverse transform, properties, Unilateral Z transform.	4	20%
	Frequency domain representation of discrete time signals, Discrete time fourier series and its properties.	4	
	Discrete time fourier transform (DTFT) and its properties	4	
VI	Relation between DTFT and Z-Transform, Analysis of discrete time LTI systems using Z transforms and DTFT, Transfer function, Magnitude and phase response.	6	20%
END SEMESTER EXAM			

Assignment: Convolution by graphical methods, Solution of differential equations.
Project: Use of Matlab in finding various transforms: magnitude and phase responses.

Question Paper Pattern

The question paper shall consist of three parts. Part A covers I and II module, Part B covers III and IV module, Part C covers V and VI module. Each part shall have three questions which may have maximum four subdivisions. Among the three questions one will be a compulsory question covering both modules and the remaining from each module, of which one to be answered. Part A & Part B questions shall carry 15 marks each and Part C questions shall carry 20 marks each with maximum 30% for theory and 70% for logical/numerical problems, derivation and proof.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EC204	ANALOG INTEGRATED CIRCUITS	4-0-0-4	2016

Prerequisite: Nil

Course Objectives

- To equip the students with a sound understanding of fundamental concepts of operational amplifiers
- To understand the wide range of applications of operational amplifiers
- To introduce special function integrated circuits
  To introduce the basic concepts and types of data converters

Syllabus

Differential amplifier configurations, Operational amplifiers, Block diagram, Ideal op-amp parameters, Effect of finite open loop gain, bandwidth and slew rate on circuit performance, op-amp applications-linear and nonlinear, Active filters, Specialized ICs and their applications, Monolithic Voltage Regulators - types and its applications, Data converters - specifications and types.

Expected outcome .

The students will

i. have a thorough understanding of operational amplifiers
ii. be able to design circuits using operational amplifiers for various applications

Text Book:

1. Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata McGraw Hill, 2008
2. Salivahanan S. ,V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008

References:

1. Botkar K. R., Integrated Circuits, 10/e, Khanna Publishers, 2010
2. C.G. Clayton, Operational Amplifiers, Butterworth & Company Publ. Ltd. Elsevier, 1971
3. David A. Bell, Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition, 2010
4. Gayakwad R. A., Op-Amps and Linear Integrated Circuits, Prentice Hall, 4/e, 2010
5. R.F. Coughlin & Fredrick Driscoll, Operational Amplifiers & Linear Integrated Circuits, 6th Edition, PHI,2001
6. Roy D. C. and S. B. Jain, Linear Integrated Circuits, New Age International, 3/e, 2010
7. Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Differential amplifiers: Differential amplifier configurations using BJT, Large and small signal operations, Input resistance, Voltage gain, CMRR, Non-ideal characteristics of differential amplifier. Frequency response of differential amplifiers, Current sources, Active load, Concept of current mirror circuits, Wilson current mirror circuits (Analysis using hybrid 'pi' model only).	6	15%
	Operational amplifiers: Introduction, Block diagram, Ideal op-amp parameters, Equivalent circuit, Voltage transfer curve, Open loop op-amp configurations, Effect of finite open loop gain, Bandwidth and slew rate on circuit performance	5	
II	Op-amp with negative feedback: Introduction, Feedback	3	15%

	configurations, Voltage series feedback, Voltage shunt feedback, Properties of practical op-amp.		
	Op-amp applications: Inverting and non inverting amplifier, DC and AC amplifiers, Summing, Scaling and averaging amplifiers, Instrumentation amplifier.	4	
FIRST INTERNAL EXAMINATION			
III	Op-amp applications: Voltage to current converter, Current to voltage converter, Integrator, Differentiator, Precision rectifiers, Log and antilog amplifier, Phase shift and Wien bridge oscillators	7	15%
IV	Astable and monostable multivibrators, Triangular and saw tooth wave generators, Comparators, Zero crossing detector, Schmitt trigger	5	15%
	Active filters: Advantages, First and second order low pass, High pass, Band pass and band reject filters, Design of filters using Butterworth approximations	5	
SECOND INTERNAL EXAMINATION			
V	Specialized ICs and its applications: Timer IC 555 : Astable and monostable operations, applications. Analog Multipliers: Introduction, Gilbert multiplier cell. Voltage Controlled Oscillator IC AD633 and their applications.	3	20%
	Phase Locked Loop – Operation, Closed loop analysis, Lock and capture range, Basic building blocks, PLL IC 565, Applications of PLL for AM & FM detection and Frequency multiplication, Frequency division, Frequency synthesizing.	4	
	Monolithic Voltage Regulators - Fixed voltage regulators, 78XX and 79XX series, Adjustable voltage regulators, IC 723 – Low voltage and high voltage configurations, Current boosting, Current limiting, Short circuit and Fold-back protection.	4	
VI	Data Converters: D/A converter, Specifications, Weighted resistor type, R-2R Ladder type.	3	20%
	A/D Converters: Specifications, Classification, Flash type, Counter ramp type, Successive approximation type, Single slope type, Dual slope type, Sample-and-hold circuits.	5	
END SEMESTER EXAM			

Assignment

1. Explain the importance of frequency compensated networks in opamps and the commonly used compensation techniques.
2. Write short notes on commercially available integrated circuits (Opamp, ADC, DAC, VCO, Analog multiplier, PLL) with pin outs and their important features

Question Paper Pattern

The question paper shall consist of three parts. Part A covers I and II module, Part B covers III and IV module, Part C covers V and VI module. Each part has three questions, which may have maximum four subdivisions. Among the three questions, one will be a compulsory question covering both modules and the remaining from each module, of which, one to be answered. Part A & Part B questions shall carry 15 marks each and Part C questions shall carry 20 marks each with maximum 60% for theory and 40% for logical/numerical problems, derivation and proof.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EC206	COMPUTER ORGANISATION	3-0-0-3	2016

Prerequisite: EC207 Logic Circuit Design

Course Objectives

- To impart knowledge in computer architecture.
- To impart knowledge in machine language programming.
- To develop understanding on I/O accessing techniques and memory structures.

Syllabus

Functional units of a computer, Arithmetic circuits, Processor architecture, Instructions and addressing modes, Execution of program, Micro architecture design process, Design of data path and control units, I/O accessing techniques, Memory concepts, Memory interface, Cache and Virtual memory concepts.

Expected outcome .

The students will be able to:

i. Understand the functional units of a computer
ii. Identify the different types of instructions
iii. Understand the various addressing modes
iv. Understand the I/O addressing system
v. Categorize the different types of memories

Text Book:

1. David A. Patterson and John L. Hennessey, Computer Organisation and Design, Fourth Edition, Morgan Kaufmann
2. David Money Harris, Sarah L Harris, Digital Design and Computer Architecture,M Kaufmann – Elsevier, 2009

References:

1. Carl Hamacher : “Computer Organization ”, Fifth Edition, Mc Graw Hill
2. John P Hayes: “Computer Architecture and Organisation”, Mc Graw Hill
3. William Stallings: “Computer Organisation and Architecture”, Pearson Education
4. Andrew S Tanenbaum: “Structured Computer Organisation”, Pearson Education
5. Craig Zacker: “PC Hardware : The Complete Reference”, TMH

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Functional units of a computer Arithmetic Circuits: Adder-carry propagate adder, Ripple carry adder, Basics of carry look ahead and prefix adder, Subtractor, Comparator, ALU	4	15%
	Shifters and rotators, Multiplication, Division	3	
	Number System: Review of Fixed point & Floating point number system	1	
II	Architecture : Assembly Language, Instructions, Operands, Registers, Register set, Memory, Constants	2	15%
	Machine Language: R-Type, I-Type, J-Type Instructions, Interpreting machine language code	3	
FIRST INTERNAL EXAMINATION			
III	MIPS Addressing modes – Register only, Immediate, Base, PC-relative, Pseudo - direct	3	15%

	MIPS memory map, Steps for executing a program - Compilation, Assembling, Linking, Loading	3	
	Pseudoinstuctions, Exceptions, Signed and Unsigned instructions, Floating point instructions	3	
IV	MIPS Microarchitectures – State elements of MIPS processor	1	15%
	Design process and performance analysis of Single cycle processor, Single cycle data path, Single cycle control for R – type arithmetic/logical instructions.	3	
	Design process and performance analysis of multi cycle processor, Multi cycle data path, Multi cycle control for R – type arithmetic/logical instructions.	3	
SECOND INTERNAL EXAMINATION			
V	I/O system – Accessing I/O devices, Modes of data transfer, Programmed I/O, Interrupt driven I/O, Direct Memory Access, Standard I/O interfaces – Serial port, Parallel port, PCI, SCSI, and USB.	3	20%
	Memory system – Hierarchy, Characteristics and Performance analysis, Semiconductor memories (RAM, ROM, EPROM), Memory Cells – SRAM and DRAM, internal organization of a memory chip, Organization of a memory unit.	4	
VI	Cache Memory – Concept/principle of cache memory, Cache size, mapping methods – direct, associated, set associated, Replacement algorithms, Write policy- Write through, Write back.	3	20%
	Virtual Memory – Memory management, Segmentation, Paging, Address translation, Page table, Translation look aside buffer.	3	
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers I and II module, Part B covers III and IV module, Part C covers V and VI module. Each part has three questions, which may have maximum four subdivisions. Among the three questions, one will be a compulsory question covering both modules and the remaining from each module, of which one to be answered. Part A & Part B questions shall carry 15 marks each and Part C questions shall carry 20 marks each with maximum 80 % for theory and 20% for logical/numerical problems, derivation and proof.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EC208	ANALOG COMMUNICATION ENGINEERING	3-0-0-3	2016

Prerequisite: EC205 Electronic Circuits

Course Objectives

- To study the concepts and types of modulation schemes.
- To study different types of radio transmitters and receivers.
- To study the effects of noise in analog communication systems.
  To impart basic knowledge on public telephone systems.

Syllabus

Elements of communication system, Need for modulation, Noises, Amplitude Modulation, Amplitude modulator circuits, Demodulator circuits, AM transmitters, Types of AM, Angle modulation: principles of frequency modulation, phase modulation, AM and FM Receivers, Frequency modulator circuits, FM transmitters, FM receiver, Noise in AM and FM systems, Public telephone systems, standard telephone set, cordless telephones.

Expected outcome .

The students will be able to:

i. understand the different analog modulation schemes.
ii. understand the fundamental ideas of noises and its effect in communication systems.
iii. explain the principle and working of analog transmitters and receivers.
iv. know the basic idea of telephone systems.

Text Book:

1. Dennis Roody and John Coolen, Electronic Communication, Pearson, 4/e, 2011.
2. George Kennedy, Electronic Communication Systems, McGrawHill, 4/e, 2008.
3. Tomasi, Electronic Communications System, Pearson, 5/e, 2011.

References:

1. Blake, Electronic Communication system, Cengage, 2/e, 2012.
2. Simon Haykin, Communication Systems, Wiley 4/e, 2006.
3. Taub, Schilling, Saha, Principles of communication system, McGraw Hill, 2013.
4. Tomasi, Advanced Electronic Communications Systems, Pearson, 6/e, 2012.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction, Elements of communication systems, Need for modulation	2	15%
	Noise in communication system, Thermal noise (white noise), Shot noise, Partition noise, Flicker noise, Burst noise, Signal to noise ratio, Noise factor, Noise temperature, Narrow band noise.	3	
II	Amplitude modulation: Sinusoidal AM, Modulation index, Average power, Effective voltage and current, Nonsinusoidal modulation.	4	15%
	Amplitude modulator circuits, Amplitude demodulator circuits, AM transmitters, Noise in AM Systems.	5	
FIRST INTERNAL EXAMINATION			
III	Single Sideband Modulation: Principles, Balanced modulators, Singly & doubly balanced modulators, SSB generation, Filter method, Phasing method & Third method, SSB reception, Modified SSB systems, Pilot carrier SSB & ISB, Companded SSB.	6	15%

IV	Angle modulation: Frequency modulation, Sinusoidal FM, Frequency spectrum, Modulation index, Average power, Non-sinusoidal modulation, Deviation ratio, Comparison of AM and FM.	4	15%
	AM & FM Receivers: Super heterodyne receiver, Tuning range, Tracking, Sensitivity and gain, Image rejection, Double conversion, Adjacent channel selectivity, Automatic Gain Control (AGC).	4	
SECOND INTERNAL EXAMINATION			
V	Phase modulation, Equivalence between PM and FM, Sinusoidal phase modulation, Digital phase modulation.	3	20%
	Angle modulator Circuits: Varactor diode modulators, Transistor modulators. FM Transmitters: Direct and Indirect Methods.	3	
VI	Angle modulation detectors, Slope detector, Balanced slope detector, Foster-Seeley discriminator, PLL demodulator, Automatic Frequency Control (AFC), Amplitude limiters, Noise in FM systems, Pre-emphasis and De-emphasis.	4	20%
	Telephone systems, standard telephone set, basic call procedures and tones, DTMF, cordless telephones.	4	
END SEMESTER EXAM			

Assignment

Study of

1. The telephone circuit - Local subscriber loop, Private-line circuits, Voice-frequency circuit arrangements.
2. The public telephone network - Instruments, Local loops, Trunk circuits and exchanges, Local central exchanges, Automated central office switches and exchanges.

Question Paper

The question paper shall consist of three parts. Part A covers I and II module, Part B covers III and IV module, Part C covers V and VI module. Each part has three questions, which may have maximum four subdivisions. Among the three questions, one will be a compulsory question covering both modules and the remaining from each module, of which one to be answered. Part A & Part B questions shall carry 15 marks each and Part C questions shall carry 20 marks each with maximum 60 % for theory and 40% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC230	LOGIC CIRCUIT DESIGN LAB	0-0-3-1	2016

Prerequisite: EC207 Logic circuit design

Course objectives:

- To study the working of standard digital ICs and basic building blocks
- To design and implement combinational circuits
- To design and implement sequential circuits

List of Experiments: -(Minimum 12 experiments are to be done)

1. Realization of functions using basic and universal gates (SOP and POS forms).
2. Design and Realization of half /full adder and subtractor using basic gates and universal gates.
3. 4 bit adder/subtractor and BCD adder using 7483.
4. 2/3 bit binary comparator.
5. Binary to Gray and Gray to Binary converters.
6. Study of Flip Flops: S-R, D, T, JK and Master Slave JK FF using NAND gates
7. Asynchronous Counter: Realization of 4-bit counter
8. Asynchronous Counter: Realization of Mod-N counters.
9. Asynchronous Counter:3 bit up/down counter
10. Synchronous Counter: Realization of 4-bit up/down counter.
11. Synchronous Counter: Realization of Mod-N counters.
12. Synchronous Counter:3 bit up/down counter
13. Shift Register: Study of shift right, SIPO, SISO, PIPO, PISO (using FF & 7495)
14. Ring counter and Johnson Counter. (using FF & 7495)
15. Realization of counters using IC's (7490, 7492, 7493).
16. Multiplexers and De-multiplexers using gates and ICs. (74150, 74154),
17. Realization of combinational circuits using MUX & DEMUX.
18. Random sequence generator.
19. LED Display: Use of BCD to 7 Segment decoder / driver chip to drive LED display
20. Static and Dynamic Characteristic of NAND gate (MOS/TTL)

Expected outcome:

The student should able to:

1. Design and demonstrate functioning of various combination circuits
2. Design and demonstrate functioning of various sequential circuits
3. Function effectively as an individual and in a team to accomplish the given task

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC232	ANALOG INTEGRATED CIRCUITS LAB	0-0-3-1	2016

Prerequisite:.Should have registered for EC204 Analog Integrated Circuits

Course objectives:

- To acquire skills in designing and testing analog integrated circuits
- To expose the students to a variety of practical circuits using various analog ICs.

List of Experiments: (Minimum 12 experiments are to be done)

1. Familiarization of Operational amplifiers - Inverting and Non inverting amplifiers, frequency response, Adder, Integrator, comparators.
2. Measurement of Op-Amp parameters.
3. Difference Amplifier and Instrumentation amplifier.
4. Schmitt trigger circuit using Op –Amps.
5. Astable and Monostable multivibrator using Op -Amps.
6. Timer IC NE555
7. Triangular and square wave generators using Op- Amps.
8. Wien bridge oscillator using Op-Amp - without & with amplitude stabilization.
9. RC Phase shift Oscillator.
10. Precision rectifiers using Op-Amp.
11. Active second order filters using Op-Amp (LPF, HPF, BPF and BSF).
12. Notch filters to eliminate the 50Hz power line frequency.
13. IC voltage regulators.
14. A/D converters- counter ramp and flash type.
15. D/A Converters- ladder circuit.
16. Study of PLL IC: free running frequency lock range capture range

Expected outcome:

The student should able to:

1. Design and demonstrate functioning of various analog circuits
2. Students will be able to analyze and design various applications of analog circuits.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC301	**Digital Signal Processing**	**3-1-0-4**	**2016**

Prerequisite: EC 202 Signals & Systems

Course objectives:

1. To provide an understanding of the principles, algorithms and applications of DSP
2. To study the design techniques for digital filters
3. To give an understanding of Multi-rate Signal Processing and its applications
4. To introduce the architecture of DSP processors

Syllabus

Discrete Fourier Transform and its Properties, Linear Filtering methods based on the DFT, Frequency analysis of signals using the DFT, Computation of DFT, FFT Algorithms, IDFT computation using Radix-2 FFT Algorithms, Efficient computation of DFT of two real sequences and a 2N-Point real sequence, Design of FIR Filters, Design of linear phase FIR Filters using window methods and frequency sampling method, Design of IIR Digital Filters from Analog Filters, IIR Filter Design, Frequency Transformations, FIR Filter Structures, IIR Filter Structures, Introduction to TMS320C67xx digital signal processor, Multi-rate Digital Signal Processing, Finite word length effects in DSP systems, IIR digital filters, FFT algorithms.

Expected outcome:

The students will understand

(i) the principle of digital signal processing and applications.

(ii) the utilization of DSP to electronics engineering

Text Books:

1. Oppenheim A. V., Schafer R. W. and Buck J. R., Discrete Time Signal Processing, 3/e, Prentice Hall, 2007.
2. Proakis J. G. and Manolakis D. G., Digital Signal Processing, 4/e, Pearson Education, 2007.

References:

1. Chassaing, Rulph., DSP applications using C and the TMS320C6x DSK. Vol. 13. John Wiley & Sons, 2003.
2. Ifeachor E.C. and Jervis B. W., Digital Signal Processing: A Practical Approach, 2/e, Pearson Education, 2009.
3. Lyons, Richard G., Understanding Digital Signal Processing, 3/e. Pearson Education India, 2004.
4. Mitra S. K., Digital Signal Processing: A Computer Based Approach, 4/e McGraw Hill (India), 2014.
5. NagoorKani, Digital Signal Processing, 2e, Mc Graw –Hill Education New Delhi, 2013
6. Salivahanan, Digital Signal Processing,3e, Mc Graw –Hill Education New Delhi, 2014 (Smart book)
7. Singh A., Srinivasan S., Digital Signal Processing: Implementation Using DSP Microprocessors, Cenage Learning, 2012.

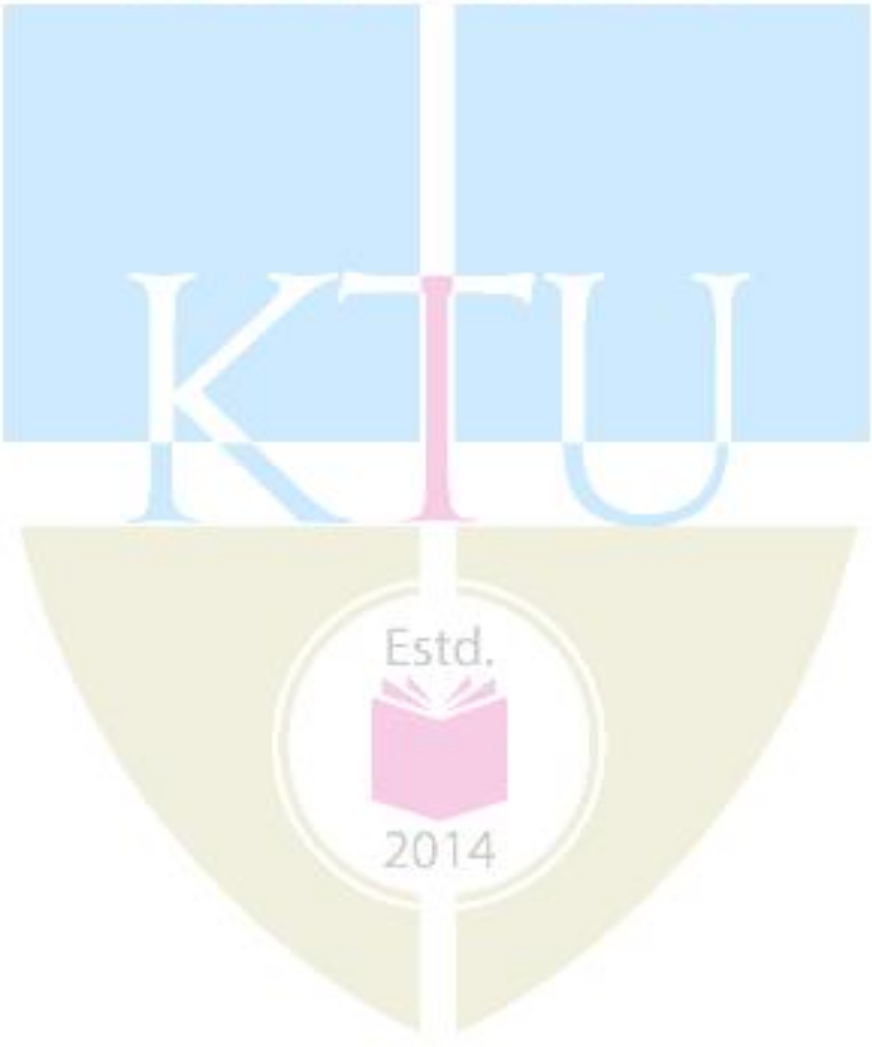
Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	The Discrete Fourier Transform: DFT as a linear transformation, Relationship of the DFT to other transforms, IDFT	2	**15**
	Properties of DFT and examples Circular convolution	4	
	Linear Filtering methods based on the DFT- linear convolution using circular convolution, overlap save and overlap add methods	3	
	Frequency Analysis of Signals using the DFT	2	
II	Computation of DFT: Radix-2 Decimation in Time and Decimation in Frequency FFT Algorithms	3	**15**
	IDFT computation using Radix-2 FFT Algorithms	2	
	Efficient computation of DFT of Two Real Sequences and a 2N-Point Real Sequence	2	
FIRST INTERNAL EXAM			
III	Design of FIR Filters- Symmetric and Anti-symmetric FIR Filters	2	**15**
	Design of linear phase FIR Filters using Window methods (rectangular, Hamming and Hanning) and frequency sampling Method	6	
	Comparison of Design Methods for Linear Phase FIR Filters	1	
IV	Design of IIR Digital Filters from Analog Filters (Butterworth)	4	**15**
	IIR Filter Design by Impulse Invariance, and Bilinear Transformation	3	
	Frequency Transformations in the Analog and Digital Domain	2	
SECOND INTERNAL EXAM			
V	Block diagram and signal flow graph representations of filters	1	**20**
	FIR Filter Structures: (Linear structures), Direct Form, Cascade Form and Lattice Structure	3	
	IIR Filter Structures: Direct Form, Transposed Form, Cascade Form and Parallel Form	2	
	Computational Complexity of Digital filter structures	1	
	Computer architecture for signal processing : Introduction to TMS320C67xx digital signal processor	2	
VI	Multi-rate Digital Signal Processing: Decimation and Interpolation (Time domain and Frequency Domain Interpretation without proof)	3	**20**
	Finite word length effects in DSP systems: Introduction (analysis not required), fixed-point and floating-point DSP arithmetic, ADC quantization noise	2	

	Finite word length effects in IIR digital filters: coefficient quantization errors	2	
	Finite word length effects in FFT algorithms: Round off errors	2	
END SEMESTER EXAM			

Question Paper Pattern (End Sem Exam)

Maximum Marks: 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 40 % for theory and 60% for logical/numerical problems, derivation and proof.



COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC303	Applied Electromagnetic Theory	3-0-0-3	2016

Prerequisite: Nil

Course objectives:

1. To introduce basic mathematical concepts related to electromagnetic vector fields.
2. To impart knowledge on the basic concepts of electric and magnetic fields
3. To develop a solid foundation in the analysis and application of electromagnetic fields, Maxwell's equations and Poynting theorem.
4. To become familiar with propagation of signal through transmission lines and waveguides.

Syllabus:

Co-ordinate transformation, vector algebra, vector calculus, electrostatics, magneto statics, Maxwell's equations, Boundary condition, Solution of wave equation, propagation of plane EM wave in different media, Poynting vector theorem, transmission lines, Smith chart, Waveguides.

Expected outcome:

At the end of the course, students will be able:

1. To develop a solid foundation and a fresh perspective in the analysis and application of electromagnetic fields.
2. To analyse the propagation of electromagnetic waves in different media.
3. To analyze the characteristics of transmission lines.
4. To solve the different transmission line problems using Smith chart
5. To understand the different modes of propagation in waveguides.

Text Books:

1. John D. Kraus, Electromagnetics, 5/e, TMH, 2010.
2. Mathew N O Sadiku, Elements of Electromagnetics, Oxford University Press, 6/e, 2014.
3. William, H., Jf Hayt, and John A. Buck. Engineering Electromagnetics. McGraw-Hill, 8/e McGraw-Hill, 2014.

References:

1. Jordan and Balmain , Electromagnetic waves and Radiating Systems, PHI, 2/e,2013
2. Joseph A Edminister , Electromagnetics, Schaum's Outline Series McGraw Hill, 4/e, 1995
3. Martin A Plonus , Applied Electromagnetics, McGraw Hill, 2/e,1978.
4. Matthew N.O. Sadiku & S.V. Kulkarni "'Principles of Electromagnetics', Oxford University Press Inc. Sixth Edition, Asian Edition,2015
5. Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, Pearson, 6/e, 2006.
6. Umran S. Inan and Aziz S. Inan, Engineering Electromagnetics, Pearson, 2010.

Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	Review of vector calculus, Spherical and Cylindrical coordinate system, Coordinate transformation	1	**0**
	Curl, Divergence, Gradient in spherical and cylindrical coordinate system.	1	
	Electric field – Application of Coulomb's law, Gauss law and Amperes current law (proof not required, simple problems only)	1	**15**
	Poisson and Laplace equations (proof not required, simple problems only), Determination of E and V using Laplace equation.	1	
	Derivation of capacitance and inductance of two wire transmission line and coaxial cable. Energy stored in Electric and Magnetic field.	2	
	Displacement current density, continuity equation. Magnetic vector potential. Relation between scalar potential and vector potential.	2	
II	Maxwell's equation from fundamental laws.	1	**15**
	Boundary condition of electric field and magnetic field from Maxwell's equations	1	
	Solution of wave equation	1	
	Propagation of plane EM wave in perfect dielectric, lossy medium, good conductor, media-attenuation, phase velocity, group velocity, skin depth.	3	
FIRST INTERNAL EXAM			
III	Reflection and refraction of plane electromagnetic waves at boundaries for normal & oblique incidence (parallel and perpendicular polarization), Snell's law of refraction, Brewster angle.	4	**15**
	Power density of EM wave, Poynting vector theorem, Complex Poynting vector.	3	
	Polarization of electromagnetic wave-linear, circular and elliptical polarisation.	2	
IV	Uniform lossless transmission line - line parameters	1	**15**
	Transmission line equations, Voltage and Current distribution of a line terminated with load	2	
	Reflection coefficient and VSWR. Derivation of input impedance of transmission line.	2	
SECOND INTERNAL EXAM			
V	Transmission line as circuit elements (L and C).	2	**20**
	Half wave and quarter wave transmission lines.	1	
	Development of Smith chart - calculation of line impedance and VSWR using smith chart.	2	

	Single stub matching (Smith chart and analytical method).	2	
VI	Parallel-Plate Waveguide - TE & TM waves.	1	**20**
	The hollow rectangular wave guide – modes of propagation of wave- dominant mode, group velocity and phase velocity - derivation and simple problems only.	3	
	Attenuation in wave guides, guide wavelength and impedance -derivation and simple problems only.	3	
END SEMESTER EXAM			

Question Paper (End semester exam)

Maximum marks : 100 **Time: 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50 % for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC305	**Microprocessor & Microcontroller**	**3-0-0-3**	**2016**

Prerequisite: EC207 Logic Circuit Design

Course objectives:

1. To understand fundamental operating concepts of microprocessors and microcontrollers.
2. To communicate with various devices using controller.
3. To design a microcontroller based system with the help of the interfacing devices.
4. To program the controller to make various peripherals work for specified application.

Syllabus:

Microprocessors: 8085 architecture and its operation, microprocessor initiated operations and bus organization, pin configuration and functions, generation of control signals for external operations- fetch, IO/M, read/write, machine cycles and bus timings. Addressing modes, instruction set, instruction classification. Overview/concept of peripheral IC interfacing with 8085 microprocessor (8251, 8253, 8255, 8279). Simple examples in assembly language programming for 8085 (only for internal examination). Introduction to development tools: IDE, cross assembler, builder, linker and debugger.(not required for exam). Introduction to 8086 and comparison between 8086, 80286, 80386, 80486 and Pentium.

Microcontrollers: 8051- features, architecture, memory organization, registers, I/O ports, pin configuration and functions. Addressing modes, instruction set, instruction classification. Assembly language programming. Interrupts in 8051. Timer/Counter programming: Operating modes, time delay generation, Waveform generation. Serial communication: RS 232 interface, registers in UART, modes of operation, programming examples for serial data transmission and reception. Interfacing of DIP switch, stepper motor, ADC, DAC, LEDs and seven segment displays, alphanumeric LCD module with 8051.

Expected outcome:

The students will be able to:

1. Distinguish various types of processor architectures.
2. Describe architectures, memory organization of 8085 microprocessor and 8051.
3. Develop programming skills in assembly for interfacing peripheral devices with 8051

Text Books:

1. Kenneth J. Ayala, The 8051 Microcontroller, Cengage learning, 3/e.
2. Lyla B.Das : Microprocessors and Microcontrollers, Pearson Education, India, 2011
3. Ramesh S. Goankar. 8085 Microprocessors Archiecture Application and Programming. Penram International, 5/e.

References:

1. Aditya P Mathur, Introduction to Microprocessor. Tata Mc Graw – Hill
2. Han Way Hung, "PIC Microcontroller, An introduction to software and hardware interfacing ", Cenage learning.
3. I.Scott Mackenzie, Raphel C.-W Phan, The 8051 microcontroller, 4th edition.
4. Muhammed Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, 2nd edition
5. Nagoorkani, Microprocessors and Microcontrollers 2e, McGraw Hill Education India, 2012.
6. Soumitra Kumar Mandal. Microprocessors and Microcontrollers Architecture, Programming & Interfacing Using 8085, 8086 and 8051, McGraw Hill Education (2011).
7.

Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	Microprocessors: Introduction, organization of a microprocessor based system, evolution of microprocessors, 8085 architecture and its operation, microprocessor initiated operations and bus organization, pin configuration and functions, generation of control signals for external operations-fetch, IO/M, read/write.	5	**15**
II	Machine cycles and bus timings, Addressing modes, instruction set instruction classification.	4	**15**
	Overview/concept of peripheral IC interfacing with 8085 microprocessor (8251, 8253, 8255, 8279).	3	
	Simple examples in assembly language programming for 8085 (only for internal examination)	2	**0**
	Introduction to development tools: IDE, cross assembler, builder, linker and debugger.(not required for exam)	3	
FIRST INTERNAL EXAM			
III	Introduction to 8086 and comparison between 8086,80286,80386,80486 and Pentium	2	**15**
	Microcontrollers: Introduction, comparison between microprocessors and microcontrollers, microcontroller families, 8051- features, architecture, memory organization, registers, I/O ports, pin configuration and functions.	6	
IV	Addressing modes, instruction set, instruction classification.	2	**15**
	Assembly language programming examples for 8051.	3	
SECOND INTERNAL EXAM			
V	Interrupts in 8051: Types, interrupt source, interrupt handling and programming	2	**20**
	Timer/Counter programming: Operating modes, time delay generation, Waveform generation.	2	
	Serial communication: RS 232 interface, registers in UART, modes of operation, programming examples for serial data transmission and reception	2	
VI	Interfacing: Interfacing (block schematic and assembly language programming) of DIP switch, stepper motor, ADC, DAC, LEDs and seven segment displays, alphanumeric LCD module with 8051.	6	**20**
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

Max. Marks: 100 **Time: 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 80 % for theory and 20% for logical/numerical problems and programming.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC307	Power Electronics & Instrumentation	3-0-0-3	2016

Prerequisite: EC205 Electronic Circuits

Course objectives:

1. To provide an insight on the concepts of Power Electronics and Electronic instruments.
2. To study the applications of Power electronics such as Switched mode regulators and inverters.
3. To develop understanding of the concept of Transducers and Digital instruments.

Syllabus:

Power semiconductor switches and its static and dynamic characteristics. Switched mode regulators, SMPS, Switched mode inverters, UPS.

Performance characteristics of instruments, Measurement of passive components, Different Transducers, Digital Instruments.

Expected outcome:

The students will be able:

1. To understand the concepts of Power Electronics and the various applications.
2. To get an insight on various electronic instruments, their configuration and measurements using them.
3. To understand the principle of operation of Transducers

Text Books:

1. Bell D. A., Electronic Instrumentation and Measurements, Oxford University Press, 2003.
2. Rashid M. H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi.
3. Umanand L., Power Electronics Essentials and Applications, Wiley India, 2015.

References:

1. Daniel W. Hart, Power Electronics, McGraw Hill, 2011.
2. Doeblin E., Measurement Systems, 5/e, McGraw Hill, 2003.
3. Helfrick A. D. and W. D. Cooper: Modern Electronic Instrumentation and Measurement Techniques, 5/e, PHI, 2003.
4. Mandal, Power Electronics 1e, McGraw Hill Education India, 2014
5. Mohan N. and T. M. Undeland, Power Electronics: Converters, Applications and Design, John Wiley, 2007.
6. Nakra, Instrumentation, Measurement and Analysis,4e, Mc Graw –Hill Education New Delhi,2016
7. Patranabis D., Principles of Electronic Instrumentation, PHI, 2008.

Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	Linear Electronics versus Power Electronics - Power semiconductor switches.	1	**15**
	Power diodes-structure, static and dynamic characteristics	2	
	Power transistors - Power BJT, Power MOSFET, GTO and IGBT	3	
	Steady state and switching characteristics of Power BJT, Power MOSFET and IGBT.	2	
II	Introduction to Switched mode regulators	1	**15**
	Buck, Boost and Buck-Boost DC-DC converters	2	
	Waveforms and expression of DC-DC converters for output voltage, voltage and current ripple under continuous conduction mode. (Derivation not required)	1	
	Isolated converters - Flyback, Forward, Push Pull, Half Bridge and Full Bridge Converters - waveforms and governing equations. (Derivation not required)	3	
FIRST INTERNAL EXAM			
III	Overview of SMPS, Switched mode inverters- Principles of PWM switching schemes.	2	**15**
	Single phase inverters - half bridge, full bridge and push pull.	2	
	UPS - on line and off line.	1	
	Three phase inverters - PWM and Space vector modulation in three phase inverters.	3	
IV	Generalized configurations of instruments - Functional elements. Classification of instruments	1	**15**
	Generalized performance characteristics of instruments - Static characteristics and Dynamic characteristics.	2	
	Measurement of: resistance using Wheastone's bridge, inductance using Maxwell-Wien bridge, and capacitance using Schering's bridge.	2	
SECOND INTERNAL EXAM			
V	Transducers - Classification, Selection of transducers.	1	**20**
	Resistance transducers - Principle of operation, strain gauge.	2	
	Inductive Transducers: LVDT.	2	
	Capacitive transducers - different types, capacitor microphone, Hall Effect transducer, proximity transducers.	2	
VI	Electronic Multimeter, Audio Power Meter, RF power meter	2	**20**
	Digital Instruments - Basics, digital measurement of time, phase, frequency and digital voltmeter.	2	
	Frequency synthesizer, Spectrum analyzers, Logic State analyzers (block diagram only).	1	

	Digital storage oscilloscope – Working Principle, controls and applications.	2	
END SEMESTER EXAM			

Question Paper Pattern (End Sem Exam)

Max. Marks: 100 **Time: 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 100 % for theory.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC360	Soft Computing	3-0-0 -3	2016

Prerequisite: NIL

Course objectives:

1. To familiarize various components of soft computing like fuzzy logic, neural networks and genetic algorithm.
2. To give an overview of fuzzy Logic and to understand the concepts and terminologies of fuzzy systems
3. To give a description on artificial neural networks with its advantages and application.
4. To study the fundamentals of Genetic Algorithm (GA).
5. To understand the concepts of hybrid systems.

Syllabus:

Fuzzy sets and systems. Neural Networks - Applications - typical architecture, pattern Classification and pattern Association. Fundamentals of Genetic Algorithm, AI search algorithm and hybrid structure.

Expected outcome:

The students will be able to:

1. Identify and describe soft computing techniques and their roles in building intelligent Machines.
2. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
3. Recognize the feasibility of applying a soft computing methodology for a particular Problem.
4. Apply neural networks to pattern classification and regression problems.
5. Apply genetic algorithms to combinatorial optimization problems

Text Books:

1. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley,N.Y, 1989.
2. Laurene V. Fausett, (1993) “Fundamentals of Neural Networks: Architecture, Algorithms and Applications", Prentice Hall.
3. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India.

References:

1. Ibrahim A. M., Introduction to Applied Fuzzy Electronics, PHI, 2013.
2. J. Yen and R. Langari, Fuzzy Logic, Intelligence, Control and Information, Pearson Education.
3. K.H.Lee, First Course on Fuzzy Theory and Applications, Springer-Verlag.
4. Lin C. T. and C.S. G. Lee, Neural Fuzzy Systems, Prentice Hall, 1996.
5. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications” Prentice Hall of India.
6. S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007. ISBN: 10: 81-265-1075-7.

Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	Soft computing: Introduction, soft computing vs hard computing, Fuzzy Computing, Neural Computing, Genetic Algorithms. applications of soft computing	2	**15**
	Introduction to fuzzy sets and systems-crispness, vagueness, uncertainty and fuzziness. Basics of fuzzy sets, membership functions, support of a fuzzy set height, normalized fuzzy set, alpha cuts.	3	
II	Type- 2 fuzzy sets. Operation on fuzzy set-complement, intersection, union, Demorgan's Law Equality & subset hood.	4	**15**
	Extension Principle and its application, Fuzzy relation-operations, projection, max-min, min-max composition, cylindrical extension.	3	
FIRST INTERNAL EXAM			
III	Reflexivity, symmetry and transitivity of fuzzy relations. Fuzzy prepositions, fuzzy connectives, linguistic variables, hedges.	4	**15**
	Approximate reasoning or fuzzy inference, Fuzzy rule based system. Fuzzification and defuzzification using centroid, centre of sums.	4	
IV	Introduction to Neural Networks - Applications –Biological neuron- Typical architecture of Artificial Neural Networks - Common activation function.	4	**15**
	McCulloh Pitts Neuron – Architecture, logic implementatons. Supervised and Unsupervised learning	4	
SECOND INTERNAL EXAM			
V	Linear Separability, Pattern Classification: Perceptrons	2	**20**
	Back propagation network and its architecture, Back propagation learning, back propagation algorithm	4	
VI	Genetic Algorithm Basic concepts, Initialization and selection, Survival of the Fittest - Fitness Computations.	5	**20**
	Operators - Cross over, Mutation.	3	
END SEMESTER EXAM			

Question Paper (End semester exam)

Max. Marks: 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50 % for theory, derivation, proof and 50% for logical/numerical problems.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC365	Biomedical Engineering	3-0-0-3	2016

Prerequisite: Nil

Course objectives:

1. To introduce student to basic biomedical engineering technology
2. To understand the anatomy & physiology of major systems of the body in designing equipment for medical treatments.
3. To impart knowledge about the principle and working of different types of bio-medical electronic equipment/devices.

Syllabus:

Human body-overview, Physiological systems of body, Measurement of physiological parameters, Assisting and therapeutic devices, Medical laboratory equipments, Telemetry in patient care, Patient safety, Medical imaging system

Expected outcome:

The students will be able:

1. To understand diagnosis and therapy related equipments.
2. To understand the problem and identify the necessity of equipment for diagnosis and therapy.
3. To understand the importance of electronics engineering in medical field.
4. To understand the importance of telemetry in patient care

Text Books:

1. K S Kandpur, "Hand book of Biomedical instrumentation", Tata McGraw Hill 2nd e/d.
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, PHI, 2nd Edition, 2004

References:

1. Barbara Christe, Introduction to Biomedical Instrumentation, Cambridge University Press, 2008.
2. J. J. Carr, "Introduction to Biomedical Equipment Technology", Pearson Education 4th e/d.
3. John G Webster, "Medical Instrumentation application and design", John Wiley 3rd e/d.
4. Richard Aston, "Principle of Biomedical Instrumentation and Measurement". Merrill Education/Prentice Hall.

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	Introduction to bio-medical instrumentation system, overview of anatomy and physiological systems of the body.	1	15
	Sources of bio-electric potential: Resting and action potential, propagation of action potentials. Bioelectric potentials examples (ECG, EEG, EMG, ERG, EOG, EGG, etc introduction only.)	2	
	Electrode theory: Nernst relation Bio potential electrodes: Microelectrodes, skin surface electrodes, needle electrodes.	1	

	Instrumentation for clinical laboratory: Bio potential amplifiers- instrumentation amplifiers, carrier amplifiers, isolation amplifiers, chopper amplifiers	2	
II	Heart and cardiovascular system (brief discussion), electro conduction system of the heart. Electrocardiography, ECG machine block diagram, ECG lead configurations, ECG recording system, Einthoven triangle, analysis of ECG signals.	3	**15**
	Measurement of blood pressure: Direct, indirect and relative methods of blood pressure measurement, auscultatory method, oscillometric and ultrasonic non-invasive pressure measurements.	2	
	Measurement of blood flow: Electromagnetic blood flow meters and ultrasonic blood flow meters.	2	
FIRST INTERNAL EXAM			
III	The human nervous system. Neuron, action potential of brain, brain waves, types of electrodes, placement of electrodes, evoked potential, EEG recording, analysis of EEG.	2	**15**
	Electromyography: Nerve conduction velocity, instrumentation system for EMG.	1	
	Physiology of respiratory system (brief discussion), Respiratory parameters, spirometer, body plethysmographs, gas exchange and distribution.	2	
	Instruments for clinical laboratory: Oxymeters, pH meter, blood cell counter, flame photometer, spectrophotometer	3	
IV	Therapeutic Equipments: Principle, block schematic diagram, working and applications of : pacemakers, cardiac defibrillators, heart–lung machine, dialyzers, surgical diathermy equipment, ventilators	6	**15**
SECOND INTERNAL EXAM			
V	Medical Imaging systems (Basic Principle only): X-ray imaging - Properties and production of X-rays, X-ray machine, applications of X-rays in medicine.	2	**20**
	Computed Tomograpy: Principle, image reconstruction, scanning system and applications.	2	
	Ultrasonic imaging systems: Basic pulse echo system, propagation of ultrasonic through tissues and reflections, display types, A-Scan, B-Scan, M-Scan, applications, real-time ultrasonic imaging systems and probes.	3	
VI	Magnetic Resonance Imaging – Basic NMR components, Biological effects and advantages of NMR imaging	3	**20**
	Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG and temperature	2	
	Patient Safety: Electric shock hazards, leakage current, safety codes for electro medical equipments	1	
END SEMESTER EXAM			

Question Paper Pattern (End Sem. Exam)

Maximum Marks: 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 100 % for theory.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC333	Digital Signal Processing Lab	0-0-3-1	2016

Prerequisite:
EC 213 Electronics Design Automation Lab, EC 202 Signals & Systems

Course objectives:

- To enable the students to explore the concepts of design, simulation and implementation of various systems using MATLAB/SciLab/OCTAVE and DSP kit.

List of Experiments:

Part A: Experiments on Digital Signal Processor/ DSP kits: (All experiments are mandatory)

1. Generation of sine wave and standard test signals.
2. Convolution : Linear and Circular
3. Real Time FIR Filter implementation (Low-pass, High-pass and Band-pass) by inputting a signal from the signal generator
4. Real Time IIR Filter implementation (Low-pass, High-pass and Band-pass) by inputting a signal from the signal generator
5. Sampling of analog signal and study of aliasing.

Part B: Experiments based on MATLAB/SciLab/OCTAVE (7 experiments are mandatory)

1. Generation of Waveforms (Continuous and Discrete)
2. Verification of Sampling Theorem.
3. Time and Frequency Response of LTI systems (First and second order).
4. Linear Convolution, Circular Convolution and Linear Convolution using Circular Convolution.
5. To find the DFT and IDFT for the given input sequence.
6. Linear convolution using DFT (Overlap-add and Overlap-Save methods).
7. To find the DCT and IDCT for the given input sequence.
8. To find FFT and IFFT for the given input sequence.
9. FIR and IIR filter design using Filter Design Toolbox.
10. FIR Filter (Low-pass, High-pass and Band-pass)design (Window method).
11. IIR Filter (Low-pass, High-pass and Band-pass)design (Butterworth and Chebychev).
12. Generation of AM, FM & PWM waveforms and their spectrum.
13. Generation of DTMF signal.
14. Study of sampling rate conversion (Decimation, Interpolation, Rational factor).
15. Filtering of noisy signals
16. Implementation of simple algorithms in audio processing (delay, reverb, flange etc.).
17. Implementation of simple algorithms in image processing (detection, de-noising, filtering etc.)

Expected outcome:
The students will be able to:
Design, simulate and realize various systems related to DSP.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC335	Power Electronics & Instrumentation Lab	0-0-3-1	2016

Prerequisite: NIL

Course objectives:

- To design and implement basic power electronic circuits
- To study the working of transducers
- To train the usage of Digital Instruments

List of Experiments (8 experiments mandatory):

Cycle I (Four mandatory)

1. Design and Set up DC-DC converter
2. Design and Set up Push pull DC- DC Converter
3. Design and Set up Buck DC-DC Converters
4. Design and Set up Simple SMPS
5. Design and Set up Half bridge and full bridge converters
6. Design and Set up basic Inverter Circuits

Cycle II (Four mandatory)

7. Transducer measurements using diode thermometer
8. Transducer measurements using LVDT
9. Transducer measurements using Strain gauge.
10. Transducer measurements using Pressure transducer.
11. Transducer measurements using Thermocouple & RTDS
12. Transducer measurements using Photocells

Desired Experiment

13. Study of Digital LCR meter, Frequency synthesizer, Spectrum analyzer and Logic State analyzer application.

Expected outcome:

The students will be able to:

1. Design and demonstrate basic power electronic circuits.
2. Use transducers for application.
3. Function effectively as an individual and in a team to accomplish the given task.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC302	Digital Communication	4-0-0-4	2016

Prerequisite: EC204 Signals and Systems, EC208 Analog Communication

Course Objectives:

- To understand the concept of Digital representation of analog source
- To understand the Performance comparison various pulse modulation schemes
- To discuss Inter Symbol Interference (ISI) problem in digital communication and to derive the Nyquist Criteria for zero ISI in data Transmission
- To analyse the need for introducing ISI in controlled manner
- To understand signal space representation of signal using Gram Schmidt orthonormalisation procedure
- To analyse the error probability for different modulation schemes like BPSK, BFSK, QPSK etc.
- To understand the principle of spread spectrum communication and to illustrate the concept of FHSS and DSSS
- To understand various Multiple Access Techniques

Syllabus: Overview of Random variables and Random process, Overall picture and relevance of digital communication, Digital Pulse modulation, Signal space concepts, Matched filter receiver, Review of Gaussian random process, Digital band pass modulation schemes, Detection of signals in Gaussian noise, Pseudo–noise sequences, Importance of synchronization, Spread spectrum communication, Diversity techniques, Multiple Access Techniques.

Expected Outcome

The students will be able to

i. Illustrate the Digital representation of analog source
ii. Compare the performance of various Digital Pulse Modulation Schemes
iii. Apply the knowledge of ISI problems in Digital communication to derive Nyquist criteria for zero ISI
iv. Analyse the need for introducing ISI in Digital Communication in a controlled manner
v. Construct signal space representation of signal using Gram Schmidt orthonormalisation procedure
vi. Compare the error probability for different digital modulation schemes like BPSK, BFSK, QPSK etc.
vii. Describe the principle of spread spectrum communication and to illustrate the concept of FHSS and DSSS
viii. Understand various Diversity Techniques

Text Books:

1. John G. Proakis, Masoud Salehi, Digital Communication, McGraw Hill Education Edition, 2014
2. Nishanth N, Digital Communication, Cengage Learning India , 2017
3. Ramakrishna Rao, Digital communication, Tata McGraw Hill Education Pvt. Limited.
4. Simon Haykin, Communication Systems, 4/e Wiley India, 2012.

References:
1. Couch: Analog and Digital Communication. 8e, Pearson Education India, 2013.
2. H.Taub and Schilling Principles of Communication Systems, , TMH, 2007
3. K.Sam Shanmugham, Digital and Analog Communication Systems, John Wiley & Sons
4. Pierre Lafrance ,Fundamental Concepts in Communication, Prentice Hall India.
5. Sheldon.M.Ross, "Introduction to Probability Models", Academic Press, 7th edition.
6. Sklar: Digital Communication, 2E, Pearson Education.
7. T L Singal, Digital Communication, McGraw Hill Education (India) Pvt Ltd, 2015

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	**Overview of Random variables and Random process:** Random variables–continuous and Discrete, random process-Stationarity, Autocorrelation and power spectral density, Transmission of Random Process through LTI systems, PSD, AWGN	3	**15**
	Pulse Code Modulation (PCM): Pulse Modulation, Sampling process, Performance comparison of various sampling techniques Aliasing, Reconstruction, PAM, Quantization, Noise in PCM system	3	
	Modifications of PCM: Delta modulation, DPCM, ADPCM, ADM, Performance comparison of various pulse modulation schemes, Line codes, PSD of various Line codes	4	
II	**Transmission over baseband channel:** Matched filter, Inter Symbol Interference (ISI), Nyquist Criteria for zero ISI, Ideal solution, Raised cosine spectrum, Eye Pattern	4	**15**
	Correlative Level Coding - Duobinary coding, precoding, Modified duobinary coding, Generalized Partial response signalling.	3	
FIRST INTERNAL EXAM			
III	**Signal Space Analysis:** Geometric representation of signals, Gram Schmidt orthogonization procedure.	3	**15**
	Transmission Over AWGN Channel: Conversion of the continuous AWGN channel into a vector channel, Likelihood function, Maximum Likelihood Decoding, Correlation Receiver	4	
IV	**Digital Modulation Schemes:** Pass band transmission model**,** Coherent Modulation Schemes- BPSK, QPSK, BFSK**.** Non-Coherent orthogonal modulation schemes**,** Differential Phase Shift Keying (DPSK)	4	**15**
	Detection of Binary modulation schemes in the presence of noise**,** BER for BPSK, QPSK, BFSK	5	
SECOND INTERNAL EXAM			
V	**Pseudo–noise sequences**: Properties of PN sequences. Generation of PN Sequences, generator polynomials, Maximal length codes and Gold Codes.	3	**20**

	Importance of synchronization: Carrier, frame and symbol/chip synchronization techniques.	2	
	Spread spectrum communication: Direct sequence spread spectrum with coherent binary phase shift keying, Processing gain, Probability of error, Anti-jam Characteristics, Frequency Hop spread spectrum with MFSK, Slow and Fast frequency hopping.	4	
VI	**Multipath channels:** classification, Coherence time, Coherence bandwidth, Statistical characterization of multi path channels, Binary signalling over a Rayleigh fading channel.	3	**20**
	Diversity techniques: Diversity in time, frequency and space.	2	
	Multiple Access Techniques: TDMA, FDMA, CDMA and SDMA – RAKE receiver, Introduction to Multicarrier communication- OFDM	5	
END SEMESTER EXAM			

Question Paper Pattern (End Semester Exam)

Maximum Marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 30% for theory and 70% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC304	VLSI	3-0-0-3	2016

Prerequisite: EC203 Solid State Devices, EC204 Analog Integrated Circuit.

Course objectives:

- To give the knowledge about IC Fabrication Techniques
- To impart the skill of analysis and design of MOSFET and CMOS logic circuits.

Syllabus:

IC Fabrication Technology**,** CMOS IC Fabrication Sequence, CMOS inverters, Design rules, Static CMOS Design, Dynamic CMOS circuits, Pass transistor, Read Only Memory, Random Access Memory, Sense amplifiers, Adders, multipliers, Testing of VLSI circuits.

Expected outcome:

The students will be able to design and analyse various MOSFET and CMOS logic circuits.

Text Books:

1. John P Uyemura, Introduction to VLSI Circuits and Systems, Wiley India, 2006
2. S.M. SZE, VLSI Technology, 2/e, Indian Edition, McGraw-Hill,2003

References:

1. Jan M.Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005.
2. Neil H.E. Weste, Kamran Eshraghian, Principles of CMOS VLSI Design- A Systems Perspective, Second Edition. Pearson Publication, 2005
3. Razavi - Design of Analog CMOS Integrated Circuits,1e, McGraw Hill Education India Education, New Delhi, 2003.
4. Sung –Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Design, McGraw-Hill, Third Ed., 2003.
5. Yuan Taur & Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2008

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	**Material Preparation**- Purification, Crystal growth (CZ and FZ process), wafer preparation **Thermal Oxidation-** Growth mechanisms, Dry and Wet oxidation, Deal Grove model.	4	**15**
	Diffusion- Fick's Laws, Diffusion with constant surface concentration and from a constant source, diffusion techniques. **Ion implantation**-Technique, Range Theory, annealing.	3	
II	**Epitaxy :** Vapour phase epitaxy and molecular beam epitaxy **Lithography**- Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition	4	**15**
	Methods of isolation Circuit component fabrication: transistor, diodes, resistors, capacitors, N-well CMOS IC Fabrication Sequence	3	
	FIRST INTERNAL EXAM		
III	**CMOS inverters**- DC characteristics, switching characteristics, power dissipation	4	**15**

	Layout Design rules, Stick Diagram and layout of CMOS Inverter, two input NAND and NOR gates	4	
IV	**MOSFET Logic Design** -Pass transistor logic, Complementary pass transistor logic and transmission gate logic , realization of functions	6	**15**
SECOND INTERNAL EXAM			
V	**Read Only Memory**-4x4 MOS ROM Cell Arrays(OR,NOR,NAND) **Random Access Memory** –SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and One transistor Dynamic Memory Cell	4	**20**
	Sense amplifiers –Differential Voltage Sensing Amplifiers Introduction to PLDs and FPGAs, Design of PLAs.	3	
VI	**Adders**- Static adder, Carry-By pass adder, Linear Carry-Select adder, Square- root carry- select adder **Multipliers**-Array multiplier	4	**20**
END SEMESTER EXAM			

Question Paper Pattern (End Semester Exam)

Maximum Marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 70% for theory and 30% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC306	Antenna & Wave Propagation	3-0-0-3	2016

Prerequisite: EC303 Applied Electromagnetic Theory

Course objectives:

- To learn the basic working of antennas.
- To study various antennas, arrays and radiation patterns of antennas.
- To understand various techniques involved in various antenna parameter measurements.
- To understand the propagation of radio waves in the atmosphere.

Syllabus:

Antenna and antenna parameters, Duality of antennas, Derivation of electromagnetic fields and directivity of short dipole and half wave dipole, Measurement of antenna parameters. Antenna arrays and design of Endfire, broadside, binomial and Dolphchebyshev arrays, Principles of practical antennas. Traveling wave antennas, principle and applications of V and rhombic antennas Principles of Horn, Parabolic dish antenna and Cassegrain antenna, Log periodic antenna array and Helical antenna. Design of rectangular Patch antennas. Principle of smart antenna, Radio wave propagation, Different modes, effect of earth's magnetic field. Fading and diversity techniques.

Expected outcome:

The student will be able to know:

i. The basic working of antennas.
ii. Various antennas, arrays and radiation patterns of antennas
iii. Various techniques involved in various antenna parameter measurements.
iv. The propagation of radio waves in the atmosphere.

Text Books:

1. Balanis, Antenna Theory and Design, 3/e, Wiley Publications.
2. John D. Krauss, Antennas for all Applications, 3/e, TMH.

References:

1. Collin R.E, Antennas & Radio Wave Propagation, McGraw Hill. 1985.
2. Jordan E.C. & K. G. Balmain, Electromagnetic Waves & Radiating Systems, 2/e, PHI.
3. Raju G.S.N., Antenna and Wave Propagation, Pearson, 2013.
4. Sisir K.Das & Annapurna Das, Antenna and Wave Propagation, McGraw Hill,2012
5. Terman, Electronics & Radio Engineering, 4/e, McGraw Hill.
6. Thomas A. Milligan, Modern Antenna Design, IEEE PRESS, 2/e, Wiley Inter science.

Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	Basic antenna parameters - gain, directivity, beam solid angle, beam width and effective aperture calculations. Effective height - wave polarization - antenna temperature - radiation resistance - radiation efficiency - antenna field zones - principles of reciprocity. Duality of antennas.	7	**15**
II	Concept of retarded potential. Field, directivity and radiation resistance of a short dipole and half wave dipole. Measurement of radiation pattern, gain, directivity and impedance of antenna	7	**15**
FIRST INTERNAL EXAM			
III	Arrays of point sources - field of two isotropic point sources - principle of pattern multiplication - linear arrays of 'n' isotropic point sources. Grating lobes.	4	**15**
	Design of Broadside, Endfire & Binomial arrays. Design of DolphChebyshev arrays.	4	
IV	Basic principle of beam steering. Travelling wave antennas. Principle and applications of V and rhombic antennas. Principles of Horn, Parabolic dish antenna, Cassegrain antenna (expression for E, H andGain without derivation).	6	**15**
SECOND INTERNAL EXAM			
V	Principle of Log periodic antenna array and Helical antenna. Antennas for mobile base station and handsets.	3	**20**
	Design of rectangular Patch antennas. Principle of smart antenna.	3	
VI	Radio wave propagation , Modes , structure of atmosphere, sky wave propagation , effect of earth's magnetic field, Ionospheric abnormalities and absorption, space wave propagation, LOS distance	4	**20**
	Field strength of space wave, duct propagation, VHF and UHF Mobile radio propagation, tropospheric scatter propagation, fading and diversity techniques.	4	
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

Max. Marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC308	**Embedded Systems**	**3-0-0 -3**	**2016**

Prerequisite: EC206 Computer Organization, EC305 Microprocessors & Microcontrollers

Course objectives:

- To have a thorough understanding of the basic structure and design of an Embedded System
- To study the different ways of communicating with I/O devices and standard I/O interfaces.
- To study the basics of RTOS for Embedded systems.
- To study the programming concepts of Embedded Systems
- To study the architecture of System-on-Chip and some design examples.

Syllabus: Introduction to Embedded Systems, Embedded system design process, Serial and parallel communication standards and devices, Memory devices and device drivers, Programming concepts of embedded programming - Embedded C++ and embedded java, Real Time Operating Systems Micro C/OS-II.

Expected outcome:

The students will be able to:

i. Understand the basics of an embedded system
ii. Develop program for an embedded system.
iii. Design, implement and test an embedded system.

Text Books:

1. David E. Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.
2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers - Elsevier 3ed, 2008

References:

1. Frank Vahid and Tony Givargis, Embedded Systems Design – A Unified Hardware / Software Introduction, John Wiley, 2002
2. Iyer - Embedded Real time Systems, 1e, McGraw Hill Education New Delhi, 2003
3. K.V. Shibu, Introduction to Embedded Systems, 2e, McGraw Hill Education India, 2016.
3. Lyla B. Das, Embedded Systems: An Integrated Approach, 1/e , Lyla B. Das, Embedded Systems, 2012
4. Rajkamal, Embedded Systems Architecture, Programming and Design, TMH, 2003
5. Steve Heath, Embedded Systems Design, Newnes – Elsevier 2ed, 2002
6. Tammy Noergaard, Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers, Newnes – Elsevier 2ed, 2012

Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	Introduction to Embedded Systems– Components of embedded system hardware–Software embedded into the system – Embedded Processors - CPU architecture of ARM processor (ARM9) – CPU Bus Organization and Protocol.	4	**15**
	Design and Development life cycle model - Embedded system design process – Challenges in Embedded system design	3	
II	Serial Communication Standards and Devices - UART, HDLC, SCI and SPI.	3	**15**
	Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus. Parallel communication standards ISA, PCI and PCI-X Bus.	3	
FIRST INTERNAL EXAM			
III	Memory devices and systems - memory map – DMA - I/O Devices – Interrupts - ISR – Device drivers for handling ISR – Memory Device Drivers – Device Drivers for on-board bus.	6	**15**
IV	Programming concepts of Embedded programming – Features of Embedded C++ and Embedded Java (basics only). Software Implementation, Testing, Validation and debugging, system-on-chip.	6	**15**
	Design Examples: Mobile phones, ATM machine, Set top box	1	**0**
SECOND INTERNAL EXAM			
V	Inter Process Communication and Synchronization -Process, tasks and threads –Shared data– Inter process communication - Signals – Semaphore – Message Queues – Mailboxes – Pipes – Sockets – Remote Procedure Calls (RPCs).	8	**20**
VI	Real time operating systems - Services- Goals – Structures - Kernel - Process Management – Memory Management – Device Management – File System Organization. Micro C/OS-II RTOS - System Level Functions – Task Service Functions – Memory Allocation Related Functions – Semaphore Related Functions. Study of other popular Real Time Operating Systems.	8	**20**
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

Maximum Marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 100 % for theory.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC312	Object Oriented Programming	3-0-0-3	2016

Prerequisite: NIL

Course objectives:

- To introduce the Object Oriented Programming paradigm using C++ and Java as the languages.
- To learn simple Android application development from the fundamentals.

Syllabus:

Object Oriented Programming and basics of C++, Advanced features of C++ programming such as exception handling and templates. Object oriented features of Java and their implementation. Advanced features of Java including packages, multithreading and error management. Introduction to Android application development with a case study.

Expected outcome:

Tthe students will have:

i. A thorough understanding of the features of OOP like class construction, polymorphism and inheritance of C++ and Java.
ii. An understanding of advanced features of C++ such as templates, abstract classes and virtual functions.
iii. Knowledge of advanced features of Java such as multithreading, packages and error management.
iv. Skills in designing android application development.
v. Skills in debugging, deploying and testing mobile applications.

Text Books:

1. E. Balagurusamy, Object Oriented Programming with C++ and JAVA, McGrawHill, 2015
2. Hardy, Brian, and Bill Phillips, Android Programming: The Big Nerd Ranch Guide. Addison-Wesley Professional, 2013.
3. Yashwant P. Kanetkar, Let us C++, 2/e, BPB Publications, 2003

References:

1. Deitel, Harvey M., and Paul J. Deitel., Java how to program.,7th International edition." (2007): 390-420.
2. G. Booch, R. A. Maksimchuk, M. W. Engel, and B J. Young, Object-oriented Analysis and Design with Applications, Addison-Wesley, 3rd Edition, 2007.
3. Horstmann, Cay S., and Gary Cornell., Core Java 2: Volume I, Fundamentals, Pearson Education, 2002.
4. Samanta, Debasis, Object-Oriented programming with C++ and Java, PHI Learning Pvt. Ltd., 2006.
5. Stroustrup, Bjarne. The C++ programming language, Pearson Education India, 1986.
6. www.tutorialspoint.com/android/android_tutorial.pdf

Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	Concepts of OOP – Introduction to OOP, Procedural Vs. Object Oriented Programming, Principles of OOP, Benefits and applications of OOP.	2	**15**
	Beginning with C++: Overview and Structure of C++ Program, Classes and Objects, Constructors and Destructors.	4	
II	Operator Overloading and Inheritance – Overloading Unary Operators, Overloading Binary Operators, Overloading Binary Operators using Friends, Manipulation of Strings Using Operators.	4	**15**
	Inheritance – Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance. Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Member Classes: Nesting of Classes	5	
FIRST INTERNAL EXAM			
III	Virtual Functions and Polymorphism – Pointers to objects, this pointer, Pointers to derived classes, Virtual functions, Virtual Constructors and Destructors.	6	**15**
IV	Programming with JAVA – Overview of Java Language, Classes Objects and Methods, Method Overloading and Inheritance, Overriding Methods, Final Variables and Methods. Interfaces, Packages, Multithreaded programming, Managing Errors and Exceptions.	8	**15**
SECOND INTERNAL EXAM			
V	Introduction to Android : Setting up Development Environment, Basic Building blocks – Activities, Services, Broadcast Receivers & Content providers, UI Components – Views & notifications, Components for communication – Intents & Intent Filters,	6	**20**
VI	Application Structure-Android Manifest.xml, uses-permission & uses-sdk, Layouts & Drawable Resources, First sample Application, Emulator-Android Virtual Device, Basic UI design, Styles & Themes, Content Providers-SQLite Programming, Case study –Develop an App to demonstrate database usage.	7	**20**
END SEMESTER EXAM			

Assignment:

1. Assignment for implementing virtual base class in C++ related to some application.
2. Assignment for implementing a simple interactive applet in Java (eg: calculator)
3. A group assignment on simple android mobile app (eg: managing students' details and rank calculation of a class).

Question Paper Pattern (End semester exam)

Maximum marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 60 % for theory and 40% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC366	**Real Time Operating Systems**	**3-0-0-3**	**2016**

Prerequisite: EC206 Computer Organization

Course objectives:

- To understand the basics of operating systems tasks and basic OS architectures and develop these to RTOS
- To understand concepts of task scheduling
- To understand problems and issues related with multitasking
- To learn strategies to interface memory and I/O with RTOS kernels
- To impart skills necessary to develop software for embedded computer systems using a real-time operating system.

Syllabus:

Introduction to OS and RTOS, Process management of OS/RTOS, Process Synchronization, Memory and I/O management, Applications of RTOS

Expected outcome:

At the end of the course the students will be familiar with operating systems. They will have an in depth knowledge about the real time operating systems and its applications.

Text Books:

1. C.M. Krishna and G.Shin, Real Time Systems, McGraw-Hill International Edition, 1997.
2. Jean J Labrosse, Embedded Systems Building Blocks Complete and Ready-to-use Modules in C, CMP books, 2/e, 1999.

References:

1. Jean J Labrosse , Micro C/OS-II, The Real Time Kernel, CMP Books, 2011
2. Sam Siewert, V, Real-Time Embedded Components and Systems: With Linux and RTOS (Engineering), 2015
3. Tanenbaum, Modern Operating Systems, 3/e, Pearson Edition, 2007.
4. VxWorks: Programmer's Guide 5.4, Windriver, 1999
5. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, 2/e, Kindle Publishers, 2005.

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	Operating system objectives and functions, Virtual Computers, Interaction of O. S. & hardware architecture, Evolution of operating systems	2	**15**
	Architecture of OS (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures)	3	
	Batch, Multi programming, Multitasking, Multiuser, parallel, distributed & real –time O.S.	3	
II	Uniprocessor Scheduling: Types of scheduling	2	**15**
	Scheduling algorithms: FCFS, SJF, Priority, Round Robin	3	
	UNIX Multi-level feedback queue scheduling, Thread Scheduling, Multiprocessor Scheduling concept	3	
FIRST INTERNAL EXAM			

III	Concurrency: Principles of Concurrency, Mutual Exclusion H/W Support, software approaches, Semaphores and Mutex, Message Passing techniques	2	**15**
	Classical Problems of Synchronization: Readers-Writers Problem, Producer Consumer Problem, Dining Philosopher problem.	3	
	Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategies.	3	
IV	Memory Management requirements, Memory partitioning: Fixed, dynamic, partitioning	3	**15**
	Memory allocation Strategies (First Fit, Best Fit, Worst Fit, Next Fit), Fragmentation, Swapping, Segmentation, Paging, Virtual Memory, Demand paging	2	
	Page Replacement Policies (FIFO, LRU, Optimal, clock), Thrashing, Working Set Model	3	
SECOND INTERNAL EXAM			
V	I/O Management and Disk Scheduling: I/O Devices, Organization of I/O functions	2	**20**
	Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), Disk Caches	3	
VI	Comparison and study of RTOS: Vxworks and µCOS	3	**20**
	Case studies: RTOS for Control Systems.	3	
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

Maximum marks: 100 **Time: 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50 % for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC368	**Robotics**	**3-0-0-3**	**2016**

Prerequisite: EC 307 Power Electronics & Instrumentation, EC 305 Microprocessors & Microcontrollers

Course objectives:

- To impart knowledge about the engineering aspects of Robots and their applications.

Syllabus:

Robots: Introduction, anatomy, Robot specifications, Robot characteristics, Areas of application, classification of robots. Robotic arm, Sensors, Encoders, Tachometers, Robotic drive systems and actuators, Specification, principle of operation and areas of application of: DC motor, Stepper motor, Servo motor and brushless DC motor, Microprocessor control of electric motors, speed control using PWM and direction control using H- Bridge, Robotic vision systems, Image processing techniques, kinematics, inverse kinematics, Velocity kinematics, Application of velocity kinematics for all serial manipulators, Digital and Programmable Logic (PLC) controllers. Robot Programming, Industrial applications of Robots, Mobile robots, Micro robots, Recent developments in Robotics.

Expected outcome:

i. The students will have a thorough understanding about Robots and their applications
ii. The students will be able to analyse and design robotic structures.

Text Books:

1. Mikell and Groover, Industrial Robotics – Technology, Programming and Applications, McGraw Hill, 2/e, 2012
2. Saeed B. Niku Introduction to Robotics. Analysis and control, applications- Wiley student edition, 2010
3. Spong and Vidyasagar, Robot Dynamics and Control, John Wiley & Sons, 1990.

References:

1. Ashitava Ghosal, Robotics, Fundamental concepts and analysis, OXFORD University Press, 2006
2. Fu, K.S,Gonzalez,R.C,Lee, C.S.G.,Robotics, Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
3. John. J.Craig, Introduction to Robotics: Mechanics and Control, PHI, 2005.
4. Klafter, R.D., Chmielewski, T.A, Negin, M, Robotic Engineering An Integrated Approach, PHI, 2007
5. Robert J. Schilling, Fundamentals of Robotics: Analysis & Control, Pearson Education, 2000
6. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi, 1994.

Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	Introduction – Definition and origin of robotics, Robot Anatomy, Robot specifications, Robot characteristics – accuracy, precision, and repeatability, Areas of application, classification of robots. Robotic arm – Components and structure, Types of joints and workspace, Common kinematic arrangements, Wrists, End effectors.	7	**15**
II	Sensors: Types and applications of sensors in Robotics, position and displacement sensors, Strain gauge based force-torque sensors, Tachometers. Robotic drive systems and actuators: Hydraulic, Pneumatic and Electric drives. Specification, principle of operation and areas of application of: Stepper motor, Servo motor and brushless DC motor. Microprocessor control of electric motors, speed control using PWM and direction control using H- Bridge	6	**15**
FIRST INTERNAL EXAM			
III	Robotic vision systems: Imaging, Sensing and Digitization, Image processing techniques, Areas of application in robotics. Introduction to kinematics: Position and orientation of objects, Rotation, Euler angles, Rigid motion representation using Homogenous Transformation matrix.	7	**15**
IV	Forward kinematics: Link coordinates, Denavit-Hartenberg Representation, Application of DH convention to different serial kinematic arrangements fitted with spherical wrist. Inverse kinematics – General properties of solutions, Kinematic Decoupling, Inverse kinematic solutions for all basic types of three-link robotic arms fitted with a spherical wrist.	9	**15**
SECOND INTERNAL EXAM			
V	Velocity kinematics – Derivation of the Jacobian, Application of velocity kinematics for serial manipulators, importance of Singularities. Manipulator Dynamics. Introduction to Legrangian mechanics and Dynamic equation for 2 DOF robots, Introduction to position control and force control of robotic manipulators, Robot actuation and control using PID controllers.	6	**20**
VI	Robot Programming – Programming methods, Robot language classification, Robot language structure, elements and its functions. Motion, End-effecter and Sensor commands in VAL programming language. Simple programs. Industrial applications of Robots in material handling and assembly. Mobile robots, Recent developments in Robotics.	7	**20**
END SEMESTER EXAM			

Question Paper Pattern (End Semester Examk Pattern)

Max. Marks : 100 **Time : 3 Hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 70 % for theory and 30% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC332	Communication Engineering Lab (Analog & Digital)	0-0-3-1	2016

Prerequisite: EC204 Analog Integrated Circuit, EC208 Analog Communication Engineering.

Course objectives:

- To provide experience on design, testing and analysis of few electronic circuits used in communication engineering.

List of Experiments:

Cycle I (Six experiments are mandatory)

1. AM generation using discrete components.
2. AM using multiplier IC AD534 or AD633.
3. AM detection using envelope detector.
4. IF tuned amplifier.
5. FM using 555 IC.
6. FM generation and demodulation using PLL.
7. Frequency multiplier using PLL
8. Pre-emphasis and de-emphasis circuits
9. Analog signal sampling & Reconstruction

Cycle II (Six mandatory)

10. Generation of Pseudo Noise Binary sequence using Shift registers
11. Time Division Multiplexing and Demultiplexing
12. Generation & Detection of DM/SIGMA DELTA/ ADM
13. Generation & Detection of PAM/PWM/PPM
14. Generation & Detection of BPSK/DPSK/DEPSK
15. Generation & Detection of PCM
16. 16 QPSK Modulation and Demodulation

Expected outcome:

The students will be able to understand the basic concepts of circuits used in communication systems.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC334	Microcontroller Lab	0-0-3-1	2016

Prerequisite: EC305 Microprocessors & Microcontrollers

Course objectives:

1. To understand Assembly Language/embedded C programming of Microcontroller.
2. To interface simple peripheral devices to a Microcontroller.
3. To equip student groups to design and implement simple embedded systems.

List of Experiments:

PART –A (At least 6 experiments are mandatory)

Assembly Language Programming experiments using 8051 Trainer kit.

1. Data transfer/exchange between specified memory locations.
2. Largest/smallest from a series.
3. Sorting (Ascending/Descending) of data.
4. Addition / subtraction / multiplication / division of 8/16 bit data.
5. Sum of a series of 8 bit data.
6. Multiplication by shift and add method.
7. Square / cube / square root of 8 bit data.
8. Matrix addition.
9. LCM and HCF of two 8 bit numbers.
10. Code conversion – Hex to Decimal/ASCII to Decimal and vice versa.

PART –B (At least 4 experiments are mandatory)

Interfacing experiments using 8051 Trainer kit and interfacing modules.

1. Time delay generation and relay interface.
2. Display (LED/Seven segments/LCD) and keyboard interface.
3. ADC interface.
4. DAC interface with wave form generation.
5. Stepper motor and DC motor interface.
6. Realization of Boolean expression through port.
7. Elevator interfacing.

PART -C(At least 2 experiments are mandatory)

Programming / interfacing experiments with IDE for 8051/PIC/MSP/Arduino/Raspberry Pi based interfacing boards/sensor modules (Direct downloading of the pre-written ALP/'C'/Python programs can be used).

1. Relay control
2. Distance measurement.
3. Temperature measurement / Digital Thermometer
4. Txr-Rxr interface.
5. Alphanumeric LCD display interface.
6. Simple project work including multiple interfaces.

Expected outcome:

The students will be able to:

1. Program Micro controllers.
2. Interface various peripheral devices to Micro controller.
3. Function effectively as an individual and in a team to accomplish the given task.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC401	INFORMATION THEORY & CODING	4-0-0-4	2016

Prerequisite: EC302 Digital Communication

Course objectives:

- To introduce the concept of information
- To understand the limits of error free representation of information signals and the transmission of such signals over a noisy channel
- To design and analyze data compression techniques with varying efficiencies as per requirements
- To understand the concept of various theorems proposed by Shannon for efficient data compression and reliable transmission
- To give idea on different coding techniques for reliable data transmission
- To design an optimum decoder for various coding schemes used.

Syllabus: Concept of amount of information, Entropy, Source coding, Channel Capacity, Shannon's Limit, Rate Distortion Theory, Channel Coding, Linear Block Codes, Cyclic codes, Cryptography, Convolutional Codes, Viterbi Algorithm

Expected outcome:

The students will be able to

i. Apply the knowledge of Shannon's source coding theorem and Channel coding theorem for designing an efficient and error free communication link.
ii. Analyze various coding schemes
iii. Design an optimum decoder for various coding schemes used.

Text Books:

1. P S Sathya Narayana, Concepts of Information Theory & Coding, Dynaram Publications, 2005
2. Simon Haykin: Digital Communication Systems, Wiley India, 2013.

References:

1. Bose, Information theory coding and cryptography, 3/e McGraw Hill Education India , 2016
2. D.E.R. Denning, Cryptography and Data Security, Addison Wesley, 1983.
3. J S Chitode, Information Theory and Coding, Technical Publications, Pune, 2009
4. Kelbert & Suhov, Information theory and coding by examples, Cambridge University Press, 2013
5. Shu Lin & Daniel J. Costello. Jr., Error Control Coding : Fundamentals and Applications, 2/e, Prentice Hall Inc., Englewood Cliffs, NJ,2004

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	Introduction to Information Theory. Concept of information, units, entropy, marginal, conditional and joint entropies, relation among entropies, mutual information, information rate. Source coding: Instantaneous codes, construction of instantaneous codes, Kraft's inequality, coding efficiency and redundancy	9	15%
II	Noiseless coding theorem , construction of basic source codes, Shannon – Fano Algorithm, Huffman coding, Channel capacity – redundancy and efficiency of a channel, binary	9	15%

	symmetric channel (BSC), Binary erasure channel (BEC) – capacity of band limited Gaussian channels		
FIRST INTERNAL EXAM			
III	Continuous Sources and Channels: Differential Entropy, Mutual information, Waveform channels, Gaussian channels, Shannon – Hartley theorem, bandwidth, SNR trade off, capacity of a channel of infinite bandwidth, Shannon's limit	9	**15%**
IV	Introduction to rings, fields, and Galois fields. Codes for error detection and correction – parity check coding – linear block codes – error detecting and correcting capabilities – generator and parity check matrices – Standard array and syndrome decoding	9	**15%**
SECOND INTERNAL EXAM			
V	Perfect codes, Hamming codes, encoding and decoding Cyclic codes, polynomial and matrix descriptions, generation of cyclic codes, decoding of cyclic codes BCH codes, Construction and decoding, Reed Solomon codes	9	**20%**
VI	Convolutional Codes – encoding – time and frequency domain approaches, State Tree & Trellis diagrams – transfer function and minimum free distance – Maximum likelihood decoding of convolutional codes – The Viterbi Algorithm. Sequential decoding.	9	**20%**
END SEMESTER EXAM			

Question Paper

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC403	MICROWAVE & RADAR ENGINEERING	3-0-0-3	2016

Prerequisite: EC303 Applied Electromagnetic Theory, EC306 Antenna & Wave Propagation

Course objectives:

- To introduce the various microwave sources, their principle of operation and measurement of various parameters
- To study the various microwave hybrid circuits and formulate their S matrices.
- To understand the basic concepts, types, working of radar and introduce to radar transmitters and receivers.

Syllabus:

Microwaves: introduction, advantages, Cavity Resonators, Microwave vacuum type amplifiers and sources, Klystron Amplifiers, Reflex Klystron Oscillators, Magnetron oscillators, Travelling Wave Tube, Microwave measurements, Microwave hybrid circuits, Directional couplers, Solid state microwave devices, Gunn diodes, Radar, MTI Radar, Radar Transmitters, Radar receivers.

Expected outcome:

The students will be able to understand the basics of microwave engineering and radar systems.

Text Books:

1. Merrill I. Skolnik, Introduction to Radar Systems, 3/e, Tata McGraw Hill, 2008.
2. Samuel Y. Liao, Microwave Devices and Circuits, 3/e, Pearson Education, 2003.

References:

1. Das, Microwave Engineering, 3/e, McGraw Hill Education India Education , 2014
2. David M. Pozar, Microwave Engineering,4/e, Wiley India, 2012.
3. Kulkarni M, Microwave and Radar Engineering, 4/e, Umesh Publications, 2012.
4. Rao, Microwave Engineering, 2/e, PHI, 2012.
5. Robert E. Collin, Foundation of Microwave Engineering, 2/e, Wiley India, 2012.

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	**Microwaves:** introduction, advantages, Cavity Resonators - Rectangular and Circular wave guide resonators- Derivation of resonance frequency of Rectangular cavity.	4	15%
	Microwave vacuum type amplifiers and sources: Klystron Amplifiers - Re-entrant cavities, Velocity modulation, Bunching (including analysis), Output power and beam	4	
II	**Reflex Klystron Oscillators**: Derivation of Power output, efficiency and admittance	2	15%
	Magnetron oscillators: Cylindrical magnetron, Cyclotron angular frequency, Power output and efficiency.	3	
	FIRST INTERNAL EXAM		
III	**Travelling Wave Tube**: Slow wave structures, Helix TWT, Amplification process, Derivation of convection current, axial electric field, wave modes and gain.	4	15%
	Microwave measurements: Measurement of impedance, frequency and power	2	

IV	**Microwave hybrid circuits**: Scattering parameters, Waveguide tees- Magic tees, Hybrid rings, Corners, Bends, and Twists. Formulation of S-matrix.	5	**15%**
	Directional couplers: Two hole directional couplers, S-matrix of a directional coupler. Circulators and isolators.	4	
SECOND INTERNAL EXAM			
V	**Solid state microwave devices**: Microwave bipolar transistors, Physical structures, Power frequency limitations equivalent circuit. Principle of **Tunnel diodes** and tunnel	4	**20%**
	Gunn diodes: Different modes, Principle of operation Gunn Diode Oscillators.	2	
VI	**Radar**: The simple Radar equation. Pulse Radar, CW Radar, CW Radar with non zero IF, Equation for doppler frequency FM-CW Radar using sideband super heterodyne receiver. **MTI Radar**-Delay line canceller, MTI Radar with power amplifier & power oscillator, Non coherent MTI Radar, Pulse	5	**20%**
	Radar Transmitters: Radar Modulator-Block diagram, **Radar receivers**- noise figure, low noise front ends, Mixers, Radar Displays	3	
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 60% for theory and 40% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC405	OPTICAL COMMUNICATION	3-0-0-3	2016

Prerequisite: EC203 Solid State Devices, EC205 Electronic Circuits

Course objectives:

- To introduce the concepts of light transmission through optical fibers, optical sources and detectors.
- To compare the performance of various optical transmission schemes.
- To impart the working of optical components and the principle of operation of optical amplifiers.
- To give idea on WDM technique.

Syllabus: General light wave system, advantages, classification of light wave systems, fibre types, linear and non linear effects in fibres, Fibre materials, fabrication of fibres, Optical sources, LEDs and LDs Optical detectors, Optical receivers, Digital transmission systems, Optical Amplifiers, WDM concept, Introduction to free space optics, Optical Time Domain Reflectometer (OTDR).

Expected outcome:

The students will be able to:-

i. Know the working of optical source and detectors.
ii. Compare the performance of various optical modulation schemes.
iii. Apply the knowledge of optical amplifiers in the design of optical link.
iv. Analyse the performance of optical amplifiers.
v. Know the concept of WDM
vi. Describe the principle of FSO and LiFi.

Text Books:

1. Gerd Keiser, Optical Fiber Communications, 5/e, McGraw Hill, 2013.
2. Mishra and Ugale, Fibre optic Communication, Wiley, 2013.

References:

1. Chakrabarthi, Optical Fibre Communication, McGraw Hill, 2015.
2. Hebbar, Optical fibre communication, Elsevier, 2014
3. John M Senior- Optical communications, **3/e**, Pearson, 2009.
4. Joseph C. Palais, Fibre Optic Communications, 5/e Pearson, 2013.
5. Keiser, Optical Communication Essentials (SIE), 1/e McGraw Hill Education New Delhi, 2008.

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	General light wave system, advantages, classification of light wave systems. Fibres: types and refractive index profiles, mode theory of fibres: modes in SI and GI fibres, linear and non linear effects in fibres, dispersion, Group Velocity Dispersion, modal, wave guide and Polarization, Modes, Dispersion, attenuation- absorption, bending and scattering losses.	8	**15%**
II	Fibre materials, fabrication of fibres, photonic crystal fibre, index guiding PCF, photonic bandgap fibre, fibre cables. Optical sources, LEDs and LDs, structures, characteristics,	7	**15%**

	modulators using LEDs and LDs. coupling with fibres, noise in Laser diodes, Amplified Spontaneous Emission noise, effects of Laser diode noise in fibre communications		
FIRST INTERNAL EXAM			
III	Optical detectors, types and characteristics, structure and working of PIN and AP, noise in detectors, comparison of performance. Optical receivers, Ideal photo receiver and quantum limit of detection.	6	**15%**
IV	Digital transmission systems, design of IMDD links- power and rise time budgets, coherent Systems, sensitivity of a coherent receiver, comparison with IMDD systems. Introduction to soliton transmission, soliton links using optical amplifiers, GH effect, soliton-soliton interaction, amplifier gain fluctuations, and design guide lines of soliton based links.	8	**15%**
SECOND INTERNAL EXAM			
V	Optical Amplifiers ,basic concept, applications, types, doped fibre amplifiers, EDFA, basic theory, structure and working, Semiconductor laser amplifier, Raman amplifiers, TDFA, amplifier configurations, performance comparison.	6	**20%**
VI	The WDM concept, WDM standards, WDM components, couplers, splitters, Add/ Drop multiplexers, gratings, tunable filters, system performance parameters. Introduction to optical networks. Introduction to free space optics, LiFi technology and VLC. Optical Time Domain Reflectometer (OTDR) – fault detection, length and refractive index measurements.	7	**20%**
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC407	COMPUTER COMMUNICATION	3-0-0-3	2016

Prerequisite: NIL

Course objectives:

- To give the basic concepts of computer network and working of layers, protocols and interfaces in a computer network.
- To introduce the fundamental techniques used in implementing secure network communications and give them an understanding of common threats and its defences.

Syllabus: Introduction to computer communication, Transmission modes, Networks, Interconnection of Networks: Internetwork, Network models: OSI model, TCP/IP protocol suite. Physical Layer, Data Link Layer, Media access control, Ethernet(802.3), Logical link control, Logical addressing: IPV4, IPV6, Subnetting, CIDR, ICMP, IGMP, DHCP, Routing, Transport Layer, Congestion Control & Quality of Service, Application Layer, Introduction to system and network security, security attacks, Firewalls, Intrusion detection systems.

Expected outcome:

The students will have a thorough understanding of:

i. Different types of network topologies and protocols.
ii. The layers of the OSI model and TCP/IP with their functions.
iii. The concept of subnetting and routing mechanisms.
iv. The basic protocols of computer networks, and how they can be used to assist in network design and implementation.
v. Security aspects in designing a trusted computer communication system.

Text Books:

1. Behrouz A. Forouzan, Cryptography & Network Security , , IV Edition, Tata McGraw-Hill, 2008
2. J F Kurose and K W Ross, Computer Network A Top-down Approach Featuring the Internet, 3/e, Pearson Education, 2010

References:

1. Behrouz A Forouzan, Data Communications and Networking, 4/e, Tata McGraw-Hill, 2006.
2. Larry Peterson and Bruce S Davie: Computer Network- A System Approach, 4/e, Elsevier India, 2011.
3. S. Keshav, An Engineering Approach to Computer Networking, Pearson Education, 2005.
4. Achyut S.Godbole, Data Communication and Networking, 2e, McGraw Hill Education New Delhi, 2011

Course Plan

Module	Course content (42 hrs)	Hours	End Sem. Exam Marks
I	Introduction to computer communication: Transmission modes - serial and parallel transmission, asynchronous, synchronous, simplex, half duplex, full duplex communication. Switching: circuit switching and packet switching	2	15%

	Networks: Network criteria, physical structures, network models, categories of networks, Interconnection of Networks: Internetwork	2	
	Network models: Layered tasks, OSI model, Layers in OSI model, TCP/IP protocol suite.	2	
II	Physical Layer: Guided and unguided transmission media (Co-axial cable, UTP,STP, Fiber optic cable)	2	15%
	Data Link Layer: Framing, Flow control (stop and wait , sliding window flow control)	2	
	Error control, Error detection(check sum, CRC), Bit stuffing, HDLC	2	
	Media access control: Ethernet (802.3), CSMA/CD, Logical link control, Wireless LAN (802.11), CSMA/CA	2	
FIRST INTERNAL EXAM			
III	Network Layer Logical addressing : IPv4 & IPV6	2	15%
	Address Resolution protocols (ARP, RARP)	2	
	Subnetting, Classless Routing(CIDR), ICMP, IGMP, DHCP	3	
	Virtual LAN, Networking devices (Hubs, Bridges & Switches)	1	
IV	Routing: Routing and Forwarding, Static routing and Dynamic routing	1	15%
	Routing Algorithms: Distance vector routing algorithm, Link state routing (Dijkstra's algorithm)	2	
	Routing Protocols: Routing Information protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), MPLS	3	
SECOND INTERNAL EXAM			
V	Transport Layer –UDP, TCP	1	20%
	Congestion Control & Quality of Service – Data traffic, Congestion, Congestion Control, QoS and Flow Characteristics	4	
	Application Layer – DNS, Remote Logging (Telnet), SMTP, FTP, WWW, HTTP, POP3, MIME, SNMP	3	
VI	Introduction to information system security, common attacks	1	20%
	Security at Application Layer (E-MAIL, PGP and S/MIME). Security at Transport Layer (SSL and TLS). Security at Network Layer (IPSec).	3	
	Defence and counter measures: Firewalls and their types. DMZ, Limitations of firewalls, Intrusion Detection Systems -Host based, Network based, and Hybrid IDSs	2	
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 90% for theory and 10% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC409	CONTROL SYSTEMS	3-0-0-3	2016

Prerequisite: EC202 Signals & Systems

Course objectives:

- To introduce the elements of control system and its modelling
- To introduce methods for analyzing the time response, the frequency response and the stability of systems.
- To design control systems with compensating techniques.
- To introduce the state variable analysis method.
- To introduce basic concepts of digital control systems.

Syllabus:

Control system, types and application, feedback system, mathematically modelling of control systems, block diagram representation, signal flow graph, Mason's formula, test signals, time response analysis, frequency analysis, stability concepts and analysis, state variable analysis, Observability and controllability, digital control systems , state space analysis, Jury's test

Expected outcome:

The Students will be able to

i. Represent mathematically a systems and deriving their transfer function model.
ii. Analyse the time response and frequency response of the systems for any input
iii. Find the stability of system
iv. Design a control system with suitable compensation techniques
v. Analyse a digital control system.

Text Books

1. Farid Golnaraghi, Benjamin C. Kuo, Automatic Control Systems, 9/e, Wiley India.
2. Gopal, Control Systems, 4/e, McGraw Hill Education India Education , 2012.
3. Ogata K., Discrete-time Control Systems, 2/e, Pearson Education.

References

1. Gopal, Digital Control and State Variable Method, 4/e, McGraw Hill Education India 2012.
2. Norman S. Nise, Control System Engineering, 5/e, Wiley India
3. Ogata K., Modern Control Engineering, Prentice Hall of India, 4/e, Pearson Education, 2002.
4. Richard C Dorf and Robert H. Bishop, Modern Control Systems, 9/e, Pearson Education, 2001.

Course Plan

Module	Course contents	Hours	End Sem Exam Marks
I	Basic Components of a Control System, Applications, Open-Loop Control Systems and Closed-Loop Control Systems, Examples of control system	1	15%
	Effects of Feedback on Overall Gain, Stability, External, disturbance or Noise	1	

	Types of Feedback Control Systems, Linear versus Nonlinear Control Systems, Time-Invariant versus Time-Varying Systems.	1	
	Overview of solving differential equations using Laplace transforms	1	
	Mathematical modelling of control systems - Electrical Systems and Mechanical systems.	2	
	Block diagram representation and reduction methods	2	
	Signal flow graph and Mason's rule formula.	2	
II	Standard test signals. Time response specifications.	1	15%
	Time response of first and second order systems to unit step input, ramp inputs, time domain specifications	2	
	Steady state error and static error coefficients.	1	
	Dynamic error coefficient.	1	
FIRST INTERNAL EXAM			
III	Stability of linear control systems: methods of determining stability, Routh's Hurwitz Criterion.	2	15%
	Root Locus Technique: Introduction, properties and its construction.	2	
	Frequency domain analysis: Frequency domain specifications, correlation between time and frequency responses.	1	
IV	Nyquist stability criterion: fundamentals and analysis	2	
	Relative stability: gain margin and phase margin. Stability analysis with Bode plot.	2	15%
	Design of Control Systems: PI,PD and PID controllers	2	
	Design with phase-lead and phase-lag controllers (frequency domain approach), Lag-lead	2	
SECOND INTERNAL EXAM			
V	State variable analysis: state equation, state space representation of Continuous Time systems	2	20%
	Transfer function from State Variable Representation, Solutions of the state equations, state transition matrix	2	
	Concepts of Controllability and Observability, Kalman's Test, Gilbert's test	2	
VI	Discrete Control systems fundamentals: Overview of Z transforms. State space representation for Discrete time systems.	2	20%
	Sampled Data control systems, Sampling Theorem, Sample & Hold, Open loop & Closed loop sampled data systems.	2	
	State space analysis : Solving discrete time state space equations, pulse transfer function, Discretization of continuous time state space equations	3	
	Stability analysis of discrete time systems Jury's test	1	
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 30% for theory and 70% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC465	MEMS	3-0-0 -3	2016

Prerequisite : NIL

Course objectives:

- To understand the operation of major classes of MEMS devices/systems
- To give the fundamentals of standard micro fabrication techniques and processes
- To understand the unique demands, environments and applications of MEMS devices

Syllabus:

MEMS and Microsystems applications, Review of Mechanical concepts, Actuation and Sensing techniques, Scaling laws in miniaturization, Materials for MEMS, Micro System fabrication techniques, Micro manufacturing, Micro system Packaging, Bonding techniques for MEMS, Overview of MEMS areas.

Expected outcome:

The student will be able to:

i. Understand the working principles of micro sensors and actuators
ii. Understand the application of scaling laws in the design of micro systems
iii. Understand the typical materials used for fabrication of micro systems
iv. Understand the principles of standard micro fabrication techniques
v. Appreciate the challenges in the design and fabrication of Micro systems

Text Books:

1. Chang Liu, Foundations of MEMS, Pearson 2012
2. Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, TMH, 2002

References:

1. Chang C Y and Sze S. M., VLSI Technology, McGraw-Hill, New York, 2000
2. Julian W Gardner, Microsensors: Principles and Applications, John Wiley & Sons, 1994
3. Mark Madou, Fundamentals of Micro fabrication, CRC Press, New York, 1997
4. Stephen D. Senturia, Microsystem design, Springer (India), 2006.
5. Thomas B. Jones, Electromechanics and MEMS, Cambridge University Press, 2001

Course Plan

Module	Course content (42hrs)	Hours	End Sem. Exam Marks
I	MEMS and Microsystems: Applications – Multidisciplinary nature of MEMS – principles and examples of Micro sensors and micro actuators – micro accelerometer –comb drives - Micro grippers – micro motors, micro valves, micro pumps, Shape Memory Alloys.	4	15%
	Review of Mechanical concepts: Stress, Strain, Modulus of Elasticity, yield strength, ultimate strength – General stress strain relations – compliance matrix. Overview of commonly used mechanical structures in MEMS - Beams, Cantilevers, Plates, Diaphragms – Typical applications	3	

II	Flexural beams: Types of Beams, longitudinal strain under pure bending – Deflection of beams – Spring constant of cantilever – Intrinsic stresses	3	**15%**
	Actuation and Sensing techniques : Thermal sensors and actuators, Electrostatic sensors and actuators , Piezoelectric sensors and actuators, magnetic actuators	4	
FIRST INTERNAL EXAM			
III	Scaling laws in miniaturization - scaling in geometry, scaling in rigid body dynamics, Trimmer force scaling vector, scaling in electrostatic and electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection.	5	**15%**
IV	Materials for MEMS – Silicon – Silicon compounds – Silicon Nitride, Silicon Dioxide, Silicon carbide, Poly Silicon, GaAs , Silicon Piezo resistors,	4	
	Polymers in MEMS – SU-8, PMMA, PDMS, Langmuir – Blodgett Films, Micro System fabrication – Photolithography – Ion implantation- Diffusion – Oxidation – Chemicalvapour deposition – Etching	5	**15%**
SECOND INTERNAL EXAM			
V	Overview of Micro manufacturing – Bulk micro manufacturing, Surface micro machining , LIGA process –Microstereo lithography	6	**20%**
	Micro system Packaging: general considerations in packaging design – Levels of Micro system packaging	3	
VI	Bonding techniques for MEMS : Surface bonding , Anodic bonding , Silicon - on - Insulator , wire bonding , Sealing – Assembly of micro systems	3	**20%**
	Overview of MEMS areas : RF MEMS, BioMEMS, MOEMS, NEMS	2	
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 70% for theory and 30% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC469	OPTO ELECTRONIC DEVICES	3-0-0-3	2016

Prerequisite: NIL

Course objectives:

- To know the physics of absorption, recombination and photoemission from semiconductors.
- To analyse different types of photo detectors based on their performance parameters.
- To discuss different LED structures with material properties and reliability aspects.
- To explain optical modulators and optical components
- To illustrate different types of lasers with distinct properties.

Syllabus:

Optical processes in semiconductors – LASERS- Nitride light emitters- White-light LEDs- Optical modulators - optical switching and logic devices, optical memory- Optical detection - Optoelectronic ICs - Introduction to optical components

Expected outcome:

The students will be able to:

i. Explain the property of absorption, recombination and photoemission in semiconductors.
ii. Illustrate different types of lasers with distinct properties.
iii. Explain different LED structures with material properties.
iv. Analyse different types of photo detectors.
v. Explain optical modulators and optical components.

Text Books:

1. Pallab Bhattacharya: Semiconductor Optoelectronic Devices, Pearson, 2009
2. Yariv, Photonics Optical Electronics in modern communication, 6/e ,Oxford Univ Press,2006.

References:

1. Alastair Buckley, Organic Light-Emitting Diodes, Woodhead, 2013.
2. B E Saleh and M C Teich, Fundamentals of Photonics:, Wiley-Interscience, 1991
3. Bandyopadhay, Optical communicatoion and networks, PHI, 2014.
4. Mynbaev, Scheiner, Fiberoptic Communication Technology, Pearson, 2001.
5. Piprek, Semiconductor Optoelectronic Devices, Elsevier, 2008.
6. Xun Li, Optoelectronic Devices Design Modelling and Simulation, Cambridge University Press, 2009

Course Plan

Module	Course content (42hrs)	Hours	End Sem. Exam Marks
I	Optical processes in semiconductors – electron hole recombination, absorption, Franz-Keldysh effect, Stark effect, quantum confined Stark effect, deep level transitions, Auger recombination heat generation and dissipation, heat sources.	7	15%
II	Lasers – threshold condition for lasing, line broadening mechanisms, axial and transverse laser modes, heterojunction lasers, distributed feedback lasers, DBR lasers, quantum well lasers, tunneling based lasers, modulation of lasers.	7	15%

FIRST INTERNAL EXAM			
III	Nitride light emitters, nitride material properties, InGaN/GaN LED, structure and working, performance parameters, InGaN/GaN Laser Diode, structure and working, performance parameters. White-light LEDs, generation of white light with LEDs**,** generation of white light by dichromatic sources, **,**generation of white light by trichromatic sources**,** temperature dependence of trichromatic, 7generation of white light by tetrachromatic and pentachromatic sources, white-light sources based on wavelength converters.	9	**15%**
IV	Optical modulators using pn junction, electro-optical modulators, acousto-optical modulators, Raman-Nath modulators, Franz-Keldysh and Stark effect modulators, quantum well electro-absorption modulators, optical switching and logic devices, optical memory.	5	**15%**
SECOND INTERNAL EXAM			
V	Optical detection – PIN, APD, modulated barrier photodiode, Schottky barrier photodiode, wavelength selective detection, micro cavity photodiodes. Optoelectronic ICs, advantages, integrated transmitters and receivers, guided wave devices. Working of LDR, liquid crystal display, structure, TFT display, structure, polymer LED, organic LED.	7	**20%**
VI	Introduction to optical components, directional couplers, multiplexers, attenuators, isolators, circulators, tunable filters, fixed filters, add drop multiplexers, optical cross connects, wavelength convertors, optical bistable devices.	7	**20%**
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC431	COMMUNICATION SYSTEMS LAB (OPTICAL & MICROWAVE)	0-0-3-1	2016

Prerequisite: EC403 Microwave & Radar Engineering, EC405 Optical Communication

Course objectives:

- To provide practical experience in design, testing, and analysis of few electronic devices and circuits used for microwave and optical communication engineering.

List of Experiments

Microwave Experiments: (Minimum Six experiments are mandatory)

1. GUNN diode characteristics.
2. Reflex Klystron Mode Characteristics.
3. VSWR and Frequency measurement.
4. Verify the relation between Guide wave length, free space wave length and cut off wave length for rectangular wave guide.
5. Measurement of E-plane and H-plane characteristics.
6. Directional Coupler Characteristics.
7. Unknown load impedance measurement using smith chart and verification using transmission line equation.
8. Measurement of dielectric constant for given solid dielectric cell.
9. Antenna Pattern Measurement.
10. Study of Vector Network Analyser

Optical Experiments: (Minimum Six Experiments are mandatory)

1. Measurement of Numerical Aperture of a fiber, after preparing the fiber ends.
2. Study of losses in Optical fiber
3. Setting up of Fiber optic Digital link.
4. Preparation of a Splice joint and measurement of the splice loss.
5. Power vs Current (P-I) characteristics and measure slope efficiency of Laser Diode.
6. Voltage vs Current (V-I) characteristics of Laser Diode.
7. Power vs Current (P-I) characteristics and measure slope efficiency of LED.
8. Voltage vs Current (V-I) characteristics of LED.
9. Characteristics of Photodiode and measure the responsivity.
10. Characteristics of Avalanche Photo Diode (APD) and measure the responsivity.
11. Measurement of fiber characteristics, fiber damage and splice loss/connector loss by OTDR.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC402	NANOELECTRONICS	3-0-0 -3	2016

Prerequisite: EC203 Solid State Devices, EC304 VLSI

Course objectives:

- To introduce the concepts of nanoelectronics.

Syllabus:

Introduction to nanotechnology, Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence, Schrodinger's Equation, wave function, Low dimensional structures Quantum wells, Basic properties of two dimensional semiconductor nanostructures, Quantum wires and quantum dots, carbon nano tube, grapheme, Introduction to methods of fabrication of nano-layers, Introduction to characterization of nanostructures, Principle of operation of Scanning Tunnelling Microscope, X-Ray Diffraction analysis, MOSFET structures, Quantum wells, modulation doped quantum wells, multiple quantum wells, The concept of super lattices, Transport of charge in Nanostructures under Electric field, Transport of charge in magnetic field, Nanoelectonic devices, principle of NEMS

Expected outcome:

- The students will be able to understand basic concepts of nanoelectronic devices and nano technology.

Text Books:

1. J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006
2. W.R. Fahrner, Nanotechnology and Nanoelctronics, Springer, 2005

References:

1. Chattopadhyay, Banerjee, Introduction to Nanoscience & Technology, PHI, 2012
2. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.
3. K. Goser, P. Glosekotter, J. Dienstuhl, Nanoelectronics and nanosystems, Springer 2004.
4. Murty, Shankar, Text book of Nanoscience and Nanotechnology, Universities Press, 2012.
5. Poole, Introduction to Nanotechnology, John Wiley, 2006.
6. Supriyo Dutta, Quantum Transport- Atom to transistor, Cambridge, 2013.

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	Introduction to nanotechnology, Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics	1	15%
	Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence	2	
	Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality	1	

	Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells,	2	
	Quantum wires and quantum dots, carbon nano tube, graphene	1	
II	Introduction to methods of fabrication of nano-layers, different approaches, physical vapour deposition, chemical vapour deposition	2	**15%**
	Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods.	2	
	Fabrication of nano particle- grinding with iron balls, laser ablation, reduction methods, sol gel, self assembly, precipitation of quantum dots.	2	
FIRST INTERNAL EXAM			
III	Introduction to characterization of nanostructures, tools used for of nano materials characterization, microscope-optical, electron, and electron microscope.	2	**15%**
	Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope	2	
	X-Ray Diffraction analysis, PL & UV Spectroscopy, Particle size analyser.	2	
IV	Two dimensional electronic system, two dimensional behaviour, MOSFET structures, Heterojunctions	2	**15%**
	Quantum wells, modulation doped quantum wells, multiple quantum wells	2	
	The concept of super lattices Kronig - Penney model of super lattice.	2	
V	Transport of charge in Nanostructures under Electric field - parallel transport, hot electrons, perpendicular transport.	2	**20%**
	Quantum transport in nanostructures, Coulomb blockade	2	
	Transport of charge in magnetic field - Effect of magnetic field on a crystal. Aharonov-Bohm effect, the Shubnikov-de Hass effect, the quantum Hall effect.	3	
VI	Nanoelectonic devices- MODFETS, heterojunction bipolar transistors	1	**20%**
	Resonant tunnel effect, RTD, RTT, Hot electron transistors	2	
	Coulomb blockade effect and single electron transistor, CNT transistors	2	
	Heterostructure semiconductor laser	1	
	Quantum well laser, quantum dot LED, quantum dot laser	2	
	Quantum well optical modulator, quantum well sub band photo detectors, principle of NEMS.	2	
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 70% for theory and 30% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC404	ADVANCED COMMUNICATION SYSTEMS	3-0-0 -3	2016

Prerequisite: EC302 Digital Communication, EC403 Microwave & Radar Engineering

Course objectives:

- To impart the basic concepts of various communication system.

Syllabus:

Microwave Radio Communications, Diversity, protection switching arrangements, Digital TV, Satellite communication systems, Satellite sub systems, Evolution of mobile radio communications, Introduction to Modern Wireless Communication Systems, wireless networks, Over view of WIMAX technologies, Cellular concept, Wireless propagation mechanism, Introduction to Multiple Access GSM system architecture, Introduction to new data services

Expected outcome:

- The students will be able to understand the basics and technology of advanced communication system

Text Books:

1. Dennis Roody, Satellite communication, 4/e, McGraw Hill, 2006.
2. Herve Benoit, Digital Television Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework, 3/e, Focal Press, Elsevier, 2008
3. Simon Haykin, Michael Mohar, Modern wireless communication, Pearson Education, 2008
4. Theodore S. Rappaport: Wireless communication principles and practice,2/e, Pearson Education, 1990

References:

1. Jochen Schiller, Mobile Communications, Pearson, 2008.
2. Mishra, Wireless communications and Networks, McGraw Hill, 2/e, 2013.
3. Nathan, Wirelesscommunications,PHI, 2012.
4. Singal, Wireless communications, Mc Graw Hill, 2010.
5. Tomasi, Advanced Electronic Communication Systems, 6/e, Pearson, 2015.
6. W.C.Y.Lee, Mobile Cellular Telecommunication, McGraw Hill, 2010.

Course Plan

Module	Course content (42hrs)	Hours	End Sem. Exam Marks
I	Microwave Radio Communications : Introduction, Advantages and Disadvantages, Analog vs digital microwave, frequency vs amplitude modulation	1	15%
	Frequency modulated microwave radio system, FM microwave radio repeaters	1	
	Diversity, protection switching arrangements, FM microwave radio stations, microwave repeater station, line of sight path characteristics	2	
II	Digital TV: Digitized Video, Source coding of Digitized Video, Compression of Frames, DCT based (JPED), Compression of Moving Pictures (MPEG). Basic blocks of MPEG2 and MPE4,Digital Video Broadcasting (DVB)	4	15%
	Modulation: QAM (DVB-S, DVB-C), OFDM for Terrestrial Digital TV (DVB –T). Reception of Digital TV Signals (Cable, Satellite and	4	

	terrestrial). Digital TV over IP, Digital terrestrial TV for mobile		
	Display Technologies: basic working of Plasma, LCD and LED Displays	2	
FIRST INTERNAL EXAM			
III	Satellite Communication systems, introduction, Kepler's laws, orbits, orbital effects, orbital perturbations	2	**15%**
	Satellite sub systems, Antennas, Transponders, earth station technology, Link calculation,	2	
	Satellite systems- GEO systems, non-GEO communication systems, Satellite Applications- Global Positioning System, Very Small Aperture Terminal system, Direct to Home Satellite Systems	3	
IV	Evolution of mobile radio communications, paging systems, Cordless telephone systems, comparison of various wireless systems	2	**15%**
	Introduction to Modern Wireless Communication Systems, Second generation cellular networks, third generation wireless networks, fourth generation wireless technologies	1	
	Wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks, Over view of WIMAX Technologies, architecture, spectrum allocation	2	
SECOND INTERNAL EXAM			
V	Cellular concept, hand off strategies, Interference and system capacity: Cell splitting, Sectoring, Repeaters, and Microcells. Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity	3	**20%**
	Wireless propagation mechanism, free space propagation model, ground reflection model, knife edge diffraction model, path loss prediction in hilly terrain, introduction to fading and diversity techniques, Introduction to MIMO system	3	
VI	Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, CDMA, OFDM	2	**20%**
	Wireless Networking, Difference between wireless and fixed telephone networks, development of wireless networks, fixed network transmission hierarchy, traffic routing in wireless networks, wireless data services, Wireless standards,	2	
	GSM system architecture, radio link aspects, network aspects	1	
	Introduction to new data services like High Speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), Digital Enhanced Cordless Telecommunications (DECT) , Enhanced Data Rate for Global Evolution (EDGE), Ultra wideband systems (UWB), Push To Talk (PTT) technology, Mobile IP	5	
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 60% for theory and 40% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC466	CYBER SECURITY	3-0-0 -3	2016

Prerequisite: EC407 Computer Communication

Course objectives:

- To familiarize various types of cyber-attacks and cyber-crimes.
- To give an overview of the cyber laws
- To study the defensive techniques against these attacks

Syllabus:

Vulnerability scanning, tools for scanning, Network defense tools, Firewalls and Intrusion Detection Systems, Virtual Private Networks, Scanning for web vulnerabilities tools, Cyber crimes and law, cyber crime investigation

Expected outcome:

The students will be able to understand cyber-attacks, types of cybercrimes, cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks

Text Books:

1. Mike Shema , Anti-Hacker Tool Kit, Mc Graw Hill
2. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley

References:

1. Achyut S.Godbole Data Communication and Networking,2e, McGraw –Hill Education New Delhi,2011
2. Forouzan, Data Communication and Networking (Global Edition) 5/e, McGraw Hill Education India, 2013.
3. Forouzan,TCP/IP Protocol Suite 4e, McGraw Hill Education India, 2010

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	**Introduction to Vulnerability Scanning** Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit.	7	15%
II	**Network Vulnerability Scanning** Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools, Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping, Kismet	7	15%
	FIRST INTERNAL EXAM		
III	**Network Defense tools** Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection	8	15%

IV	**Web Application Tools** Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra	6	**15%**
SECOND INTERNAL EXAM			
V	**Introduction to Cyber Crime and law** Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.	8	**20%**
VI	**Introduction to Cyber Crime Investigation** Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks	6	**20%**
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 100% for theory.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC468	SECURE COMMUNICATION	3-0-0 -3	2016

Prerequisite: EC407 COMPUTER COMMUNICATION

Course objectives:

•To impart the students about the theory and technology behind the secure communication.

Syllabus:

Introduction on Security, Security Goals, Types of Attacks, Modular arithmetic: Groups, Ring, Fields. The Euclidean algorithm, Finite fields of the form GF(p), Polynomial arithmetic, Symmetric Ciphers, Symmetric Cipher Model, Substitution Techniques, Transposition techniques, Block Ciphers, Data encryption Standards, Differential and Linear Crypt analysis Advanced Encryption standard, The AES Cipher, Public key cryptosystem, RSA algorithm, Intruders, Password management

Expected outcome:

The student will be

i. Exposed to the different approaches that handle security and the algorithms in use for maintaining data integrity and authenticity.

ii. Enabled student to appreciate the practical aspects of security features design and their implementation

Text Books:

1. Behrouz A. Forouzan , Cryptography and Network security Tata McGraw-Hill, 2008
2. William Stallings, Cryptography and Network security: principles and practice", 2nd Edition, Prentice Hall of India, New Delhi, 2002

References:

1. David S. Dummit & Richard M Foote, Abstract Algebra, 2nd Edition, Wiley India Pvt. Ltd., 2008.
2. Douglas A. Stinson, Cryptography, Theory and Practice, 2/e, Chapman & Hall, CRC Press Company, Washington, 2005.
3. Lawrence C. Washington, Elliptic Curves: Theory and Cryptography, Chapman & Hall, CRC Press Company, Washington, 2008.
4. N. Koeblitz: A course in Number theory and Cryptography, 2008
5. Thomas Koshy: Elementary Number Theory with Applications, 2/e, Academic Press, 2007
6. Tyagi and Yadav , Cryptography and network security, Dhanpatrai, 2012

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	Introduction on security, security goals and types of attacks: Passive attack, active attack, attacks on confidentiality, attacks on integrity and availability, Security services and mechanisms.	5	15%
II	Modular arithmetic: Groups, Ring, Fields. The Euclidean algorithm, Finite fields of the form GF(p)	4	15%
	Polynomial arithmetic: Finite fields of the form GF (2n).	4	
	FIRST INTERNAL EXAM		
III	Symmetric Ciphers, Symmetric Cipher Model	3	15%

	Substitution Techniques, Caesar Cipher, Mono alphabetic Cipher, Play fair cipher, Hill cipher, Poly alphabetic Cipher, one time pad	4	
IV	Transposition techniques ,Block Ciphers, Data encryption Standards, DES Encryption, DES decryption	3	**15%**
	Differential and Linear Crypt analysis Advanced Encryption standard	2	
	The AES Cipher, substitute bytes transformation, Shift row transformation, Mix Column transformation.	2	
SECOND INTERNAL EXAM			
V	Public key cryptosystem, Application for Public key cryptosystem requirements	2	**20%**
	RSA algorithm, Key management, Distribution of public key, public key certificates, Distribution of secret keys.	5	
VI	Intruders: Intrusion techniques, Intrusion detection, Statistical anomaly detection, Rule based intrusion detection, Distributed intrusion detection, Honey pot, Intrusion detection exchange format.	5	**20%**
	Password management: Password protection, password selection strategies.	2	
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.

Course code	Course Name	Credits	Year of Introduction
*492	PROJECT	6	2016

Prerequisite : Nil

Course Objectives

- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

Course Plan

In depth study of the topic assigned in the light of the preliminary report prepared in the seventh semester
Review and finalization of the approach to the problem relating to the assigned topic
Preparing a detailed action plan for conducting the investigation, including team work
Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed
Final development of product/process, testing, results, conclusions and future directions
Preparing a paper for Conference presentation/Publication in Journals, if possible
Preparing a report in the standard format for being evaluated by the dept. assessment board
Final project presentation and viva voce by the assessment board including external expert

Expected outcome

The students will be able to

iii. Think innovatively on the development of components, products, processes or technologies in the engineering field
iv. Apply knowledge gained in solving real life engineering problems

Evaluation

Maximum Marks : 100

(i) Two progress assessments	20% by the faculty supervisor(s)
(ii) Final project report	30% by the assessment board
(iii) Project presentation and viva voce	50% by the assessment board

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.