Course No.	Course Name	L-T-P - Credits	Year of Introduction
MA201	LINEAR ALGEBRA AND COMPLEX ANALYSIS	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

COURSE OBJECTIVES

- To equip the students with methods of solving a general system of linear equations.
- To familiarize them with the concept of Eigen values and diagonalization of a matrix which have many applications in Engineering.
- To understand the basic theory of functions of a complex variable and conformal Transformations**.**

Syllabus

Analyticity of complex functions-Complex differentiation-Conformal mappings-Complex integration-System of linear equations-Eigen value problem

Expected outcome .

At the end of the course students will be able to
(i) solve any given system of linear equations
(ii) find the Eigen values of a matrix and how to diagonalize a matrix
(iii) identify analytic functions and Harmonic functions.
(iv)evaluate real definite Integrals as application of Residue Theorem
(v) identify conformal mappings(vi) find regions that are mapped under certain Transformations

Text Book:

Erwin Kreyszig: Advanced Engineering Mathematics, 10th ed. Wiley

References:

1.Dennis g Zill&Patric D Shanahan-A first Course in Complex Analysis with Applications-Jones&Bartlet Publishers
2.B. S. Grewal. Higher Engineering Mathematics, Khanna Publishers, New Delhi.
3.Lipschutz, Linear Algebra,3e **(** Schaums **Series)**McGraw Hill Education India 2005
4.Complex variables introduction and applications-second edition-Mark.J.Owitz-Cambridge Publication

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Complex differentiation Text 1[13.3,13.4] Limit, continuity and derivative of complex functions	3	
	Analytic Functions	2	
	Cauchy–Riemann Equation(Proof of sufficient condition of analyticity & C R Equations in polar form not required)-Laplace's Equation	2	
	Harmonic functions, Harmonic Conjugate	2	15%
II	Conformal mapping: Text 1[17.1-17.4] Geometry of Analytic functions Conformal Mapping,	1	
	Mapping $w = z^2$ conformality of $w = e^z$.	2	15%

	The mapping $w = z + \frac{1}{z}$ Properties of $w = \frac{1}{z}$ Circles and straight lines, extended complex plane, fixed points Special linear fractional Transformations, Cross Ratio, Cross Ratio property-Mapping of disks and half planes Conformal mapping by $w = \sin z$ & $w = \cos z$ (Assignment: Application of analytic functions in Engineering)	1 3 3	
FIRST INTERNAL EXAMINATION			
III	Complex Integration. Text 1[14.1-14.4] [15.4&16.1] Definition Complex Line Integrals, First Evaluation Method, Second Evaluation Method Cauchy's Integral Theorem(without proof), Independence of path(without proof), Cauchy's Integral Theorem for Multiply Connected Domains (without proof) Cauchy's Integral Formula- Derivatives of Analytic Functions(without proof)Application of derivative of Analytical Functions Taylor and Maclaurin series(without proof), Power series as Taylor series, Practical methods(without proof) Laurent's series (without proof)	2 2 2 2 2	15%
IV	Residue Integration Text 1 [16.2-16.4] Singularities, Zeros, Poles, Essential singularity, Zeros of analytic functions Residue Integration Method, Formulas for Residues, Several singularities inside the contour Residue Theorem. Evaluation of Real Integrals (i) Integrals of rational functions of $\sin\theta$ and $\cos\theta$ (ii)Integrals of the type $\int_{-\infty}^{\infty} f(x)dx$ (Type I, Integrals from 0 to ∞) (Assignment : Application of Complex integration in Engineering)	2 4 3	15%
SECOND INTERNAL EXAMINATION			
V	Linear system of Equations Text 1(7.3-7.5) Linear systems of Equations, Coefficient Matrix, Augmented Matrix Gauss Elimination and back substitution, Elementary row operations, Row equivalent systems, Gauss elimination-Three possible cases, Row Echelon form and Information from it.	1 5	20%

	Linear independence-rank of a matrix Vector Space-Dimension-basis-vector space$\mathbf{R}^3$ Solution of linear systems, Fundamental theorem of non-homogeneous linear systems(Without proof)-Homogeneous linear systems (Theory only	2 1	
VI	Matrix Eigen value Problem Text 1.(8.1,8.3 &8.4) Determination of Eigen values and Eigen vectors-Eigen space Symmetric, Skew Symmetric and Orthogonal matrices –simple properties (without proof) Basis of Eigen vectors- Similar matrices Diagonalization of a matrix-Quadratic forms- Principal axis theorem(without proof) (Assignment-Some applications of Eigen values(8.2))	3 2 4	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks : 100 Exam Duration: 3 hours

The question paper will consist of 3 parts.

Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.

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 - Credits	Year of Introduction
HS200	Business Economics	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To familiarize the prospective engineers with elementary Principles of Economics and Business Economics.
- To acquaint the students with tools and techniques that are useful in their profession in Business Decision Making which will enhance their employability;
- To apply business analysis to the "firm" under different market conditions;
- To apply economic models to examine current economic scenario and evaluate policy options for addressing economic issues
- To gain understanding of some Macroeconomic concepts to improve their ability to understand the business climate;
- To prepare and analyse various business tools like balance sheet, cost benefit analysis and rate of returns at an elementary level

Syllabus

Business Economics - basic concepts, tools and analysis, scarcity and choices , resource allocation, marginal analysis, opportunity costs and production possibility curve. Fundamentals of microeconomics - Demand and Supply Analysis, equilibrium, elasticity, production and production function, cost analysis, break-even analysis and markets. Basics of macroeconomics - the circular flow models, national income analysis, inflation, trade cycles, money and credit, and monetary policy. Business decisions - investment analysis, Capital Budgeting decisions, forecasting techniques and elementary Balance Sheet and taxation, business financing, international investments

Expected outcome .

A student who has undergone this course would be able to

i. make investment decisions based on capital budgeting methods in alignment with microeconomic and macroeconomic theories.
ii. able to analyse the profitability of the firm, economy of operation, determination of price under various market situations with good grasp on the effect of trade cycles in business.
iii. gain knowledge on Monetary theory, measures by RBI in controlling interest rate and emerging concepts like Bit Coin.
iv. gain knowledge of elementary accounting concepts used for preparing balance sheet and interpretation of balance sheet

Text Books

1. Geetika, Piyali Ghosh and Chodhury, *Managerial Economics*, Tata McGraw Hill, 2015
2. Gregory Mankiw, *Principles of Macroeconomics*, Cengage Learning, 2006.
3. M.Kasi Reddy and S.Saraswathi, *Economics and Financial Accounting*. Prentice Hall of India. New Delhi.

References:

1. Dornbusch, Fischer and Startz, *Macroeconomics*, McGraw Hill, 11th edition, 2010.
2. Khan M Y, *Indian Financial System*, Tata McGraw Hill, 7th edition, 2011.
3. Samuelson, *Managerial Economics*, 6th edition, Wiley
4. Snyder C and Nicholson W, *Fundamentals of Microeconomics*, Cengage Learning (India), 2010.
5. Truett, Managerial Economics: Analysis, Problems, Cases, 8th Edition, Wiley
6. Welch, *Economics: Theory and Practice* 7th Edition, Wiley
7. Uma Kapila, *Indian Economy Since Independence, 26th Edition: A Comprehensive and Critical Analysis of India's Economy*, 1947-2015
8. C Rangarajan, *Indian Economy, Essays on monetary and finance*, UBS Publishers'Distributors, 1998
9. A.Ramachandra Aryasri, *Managerial Economics and Financial Analysis*, Tata McGraw-Hill, New Delhi.
10. Dominick Salvatore, *Managerial Economics in Global Economy*, Thomas Western College Publishing, Singapore.
11. I.M .Pandey, *Financial Management*, Vikas Publishing House. New Delhi.
12. Dominick Salvatore, *Theory and Problems of Micro Economic Theory.* Tata Mac Graw-Hill, New Delhi.
13. T.N.Hajela.*Money, Banking and Public Finance.* Anne Books. New Delhi.
14. G.S.Gupta. *Macro Economics-Theory and Applications.* Tata Mac Graw- Hill, New Delhi.
15. Yogesh, Maheswari, *Management Economics* , PHI learning, NewDelhi, 2012
16. Timothy Taylor , *Principles of Economics*, 3rd edition, TEXTBOOK MEDIA.
17. Varshney and Maheshwari. *Managerial Economics*. Sultan Chand. New Delhi

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Business Economics** and its role in managerial decision making-meaning-scope-relevance-economic problems-scarcity Vs choice (2 Hrs)-Basic concepts in economics-scarcity, choice, resource allocation- Trade-off-opportunity cost-marginal analysis- marginal utility theory, Law of diminishing marginal utility -production possibility curve (2 Hrs)	4	15%
II	**Basics of Micro Economics I** Demand and Supply analysis-equillibrium-elasticity (demand and supply) (3 Hrs.) -Production concepts-average product-marginal product-law of variable proportions- Production function-Cobb Douglas function-problems (3 Hrs.)	6	15%
FIRST INTERNAL EXAMINATION			
III	**Basics of Micro Economics II** Concept of costs-marginal, average, fixed, variable costs-cost curves-shut down point-long run and short run (3 Hrs.)- Break Even Analysis-Problem-Markets-Perfect Competition, Monopoly and Monopolistic Competition, Oligopoly-Cartel and collusion (3 Hrs.).	6	15%
IV	**Basics of Macro Economics** - Circular flow of income-two sector and multi-sector models- National Income Concepts-Measurement methods-problems-Inflation, deflation (4 Hrs.)-Trade cycles-Money-stock and flow concept-Quantity theory of money-Fischer's Equation and Cambridge Equation -velocity of circulation of money-credit control methods-SLR, CRR, Open Market Operations-Repo and Reverse Repo rate-emerging concepts in money-bit coin (4 Hrs.).	8	15%

SECOND INTERNAL EXAMINATION			
V	**Business Decisions I**-Investment analysis-Capital Budgeting-NPV, IRR, Profitability Index, ARR, Payback Period (5 Hrs.)- Business decisions under certainty-uncertainty-selection of alternatives-risk and sensitivity- cost benefit analysis-resource management (4 Hrs.).	9	20%
VI	**Business Decisions II** Balance sheet preparation-principles and interpretation-forecasting techniques (7 Hrs.)-business financing-sources of capital- Capital and money markets-international financing-FDI, FPI, FII-Basic Principles of taxation-direct tax, indirect tax-GST (2 hrs.).	9	20%
END SEMESTER EXAM			

Question Paper Pattern

Max. marks: 100, Time: 3 hours

The question paper shall consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

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 No.	Course Name	L-T-P - Credits	Year of Introduction
MA204	Probability distributions, Random Processes and Numerical Methods	3-1-0-4	2016

Prerequisite: Nil

Course Objectives

- To introduces the modern theory of probability and its applications to modelling and analysis and processing of random processes and signals.
- To learn most of the important models of discrete and continuous probability distributions and widely used models of random processes such as Poisson processes and Markov chains.
- To understand some basic numerical methods for interpolation and integration and also for finding roots of equations and solutions of ODEs.

Syllabus

Discrete random variables- Continuous Random variables-Multiple Random variables.
Random Processes- Autocorrelation, Power spectrum-Special Random Processes.
Numerical Methods.

Expected outcome .

At the end of the course students would have become familiar with quantifying and analysing random phenomena using various models of probability distributions and random processes. They would also have learned the concepts of autocorrelation and power spectral density which are useful in the analysis of random signals. Some of the fundamental numerical methods learned in the course would help them to solve a variety of mathematical problems by the use of computers when analytical methods fail or are difficult.

Text Book:

1. V.Sundarapandian, "Probability, Statistics and Queueing theory", PHI Learning, 2009
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.

References:

1. Hossein Pishro-Nik, "Introduction to Probability, Statistics and Random Processes", Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. OliverC.Ibe,FundamentalsofAppliedProbabilityandRandomProcesses"Elsevier,2005.
3. T Veerarajan "Probability Statistics and Random Process" Third edition-Mc Graw Hill.
4. Numerical Mathematical and computing –Ward-Cheney-Cengage Learning-7th Edition

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Discrete random variables [Text 1: Relevant portions of sections 2.1, 2.2,2.3, 2.5, 3.3 and 3.4]** Discrete random variables, probability mass function, cumulative distribution function, expected value, mean and variance. Binomial random variable-, mean, variance.	3 2	15%

	Poisson random variable, mean, variance, approximation of binomial by Poisson. Distribution fitting-binomial and Poisson.	2 2	
II	**Continuous random variables [Text 1: Relevant portions of sections 2.4, 2.5, 3.7, 3.8 and 3.11]** Continuous random variables, Probability density function, expected value, mean and variance. Uniform random variable-, mean, variance. Exponential random variable-mean, variance, memoryless property. Normal random variable-Properties of Normal curve mean, variance (without proof), Use of Normal tables.	 2 2 2 3	15%
FIRST INTERNAL EXAMINATION			
III	**Joint distributions [Text 1: Relevant portions of sections 4.1, 4.2, 4.4 4.7and 4.10]** Joint probability distributions- discrete and continuous, marginal distributions, independent random variables. Expectation involving two or more random variables, covariance of pairs of random variables. Central limit theorem (without proof).	 4 3 2	15%
IV	**Random processes [Text 1: Relevant portions of sections 5.1, 5.2, 5.3 and 6.2]** Random processes, types of random processes, Mean, correlation and covariance functions of random processes, Wide Sense Stationary (WSS) process, Properties of autocorrelationand auto covariance functions of WSS processes. Power spectral density and its properties.	 2 4 2	15%
SECOND INTERNAL EXAMINATION			
V	**Special random processes [Text 1: Relevant portions of sections 5.5, 5.5.1, 5.5.2, 5.5.3,5.5.4) and 5.6]** Poisson process-properties, probability distribution of inter arrival times. Discrete time Markov chain- **T**ransition probability matrix, Chapman Kolmogorov theorem (without proof), computation of probability distribution and higher order transition probabilities, stationary distribution.	 4 5	20%
VI	**Numerical Methods [Text 2: Relevant portions of sections 19.2, 19.3, 19.5 and 21.1]** (Derivation of formulae not required in this module) Finding roots of equations-Newton-Raphson method. Interpolation-Newton's forward and backward difference formula, Lagrange's interpolation method. Numerical Integration-trapezoidal rule, Simpson's 1/3rd rule. Numerical solution of first order ODE-Euler method, Runge-Kutta fourth order (classical method).	 3 3 3 3	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks : 100 Exam Duration: 3 hours

The question paper will consist of 3 parts.

Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.

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-Credits	Year of Introduction
HS210	LIFE SKILLS	2-0-2	2016

Prerequisite : Nil

Course Objectives

- To develop communication competence in prospective engineers.
- To enable them to convey thoughts and ideas with clarity and focus.
- To develop report writing skills.
- To equip them to face interview & Group Discussion.
- To inculcate critical thinking process.
- To prepare them on problem solving skills.
- To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
- To understand team dynamics & effectiveness.
- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
- To learn leadership qualities and practice them.

Syllabus

Communication Skill: Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

Critical Thinking & Problem Solving: Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats, Mind Mapping & Analytical Thinking.

Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

Ethics, Moral & Professional Values: Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

Leadership Skills: Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation.

Expected outcome

The students will be able to

- Communicate effectively.
- Make effective presentations.
- Write different types of reports.
- Face interview & group discussion.
- Critically think on a particular problem.
- Solve problems.
- Work in Group & Teams
- Handle Engineering Ethics and Human Values.
- Become an effective leader.

Resource Book:

Life Skills for Engineers, Complied by ICT Academy of Kerala, McGraw Hill Education (India) Private Ltd., 2016

References:

- Barun K. Mitra; (2011), *"Personality Development & Soft Skills*", First Edition; Oxford Publishers.
- Kalyana; (2015) "*Soft Skill for Managers*"; First Edition; Wiley Publishing Ltd.
- Larry James (2016); "*The First Book of Life Skills*"; First Edition; Embassy Books.
- Shalini Verma (2014); *"Development of Life Skills and Professional Practice"*; First Edition; Sultan Chand (G/L) & Company
- John C. Maxwell (2014); "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc.

Course Plan

Module	Contents	Hours L-T-P L	P	Sem. Exam Marks
I	Need for Effective Communication, Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication, Types of barriers; Miscommunication; Noise; Overcoming measures, Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills. **Technical Writing:** Differences between technical and literary style, Elements of style; Common Errors, **Letter Writing:** Formal, informal and demi-official letters; business letters, **Job Application**: Cover letter, Differences between bio-data, CV and Resume, **Report Writing:** Basics of Report Writing; Structure of a report; Types of reports. **Non-verbal Communication and Body Language:** Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language **Interview Skills**: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication, **Group Discussion**: Differences between group discussion and debate; Ensuring success in group discussions, **Presentation Skills**: Oral presentation and public speaking skills; business presentations, **Technology-based Communication:** Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.	2 3	2 4 4	See evaluation scheme

II	Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity	2		
	Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.		2	
	Steps in problem solving, Problem Solving Techniques, Problem Solving through Six Thinking Hats, Mind Mapping, Forced Connections.	2		
	Problem Solving strategies, Analytical Thinking and quantitative reasoning expressed in written form, Numeric, symbolic, and graphic reasoning, Solving application problems.		2	
III	Introduction to Groups and Teams, Team Composition, Managing Team Performance, Importance of Group, Stages of Group, Group Cycle, Group thinking, getting acquainted, Clarifying expectations.	3		
	Group Problem Solving, Achieving Group Consensus.		2	
	Group Dynamics techniques, Group vs Team, Team Dynamics, Teams for enhancing productivity, Building & Managing Successful Virtual Teams. Managing Team Performance & Managing Conflict in Teams.	3		
	Working Together in Teams, Team Decision-Making, Team Culture & Power, Team Leader Development.		2	
IV	Morals, Values and Ethics, Integrity, Work Ethic, Service Learning, Civic Virtue, Respect for Others, Living Peacefully.	3		
	Caring, Sharing, Honesty, Courage, Valuing Time, Cooperation, Commitment, Empathy, Self-Confidence, Character		2	
	Spirituality, Senses of 'Engineering Ethics', variety of moral issued, Types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Consensus and controversy, Models of Professional Roles, Theories about right action, Self-interest, customs and religion, application of ethical theories.	3		
	Engineering as experimentation, engineers as responsible experimenters, Codes of ethics, Balanced outlook on.	3		
	The challenger case study, Multinational corporations, Environmental ethics, computer ethics,		2	

	Weapons development, engineers as managers, consulting engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE), India, etc.	3		
V	Introduction, a framework for considering leadership, entrepreneurial and moral leadership, vision, people selection and development, cultural dimensions of leadership, style, followers, crises. Growing as a leader, turnaround leadership, gaining control, trust, managing diverse stakeholders, crisis management Implications of national culture and multicultural leadership Types of Leadership, Leadership Traits. Leadership Styles, VUCA Leadership, DART Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders, making of a Leader, Formulate Leadership	4 2 2	 2 2	
END SEMESTER EXAM				

EVALUATION SCHEME

Internal Evaluation

(Conducted by the College)

Total Marks: 100

Part – A

(To be started after completion of Module 1 and to be completed by 30th working day of the semester)

1. Group Discussion – Create groups of about 10 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation is as follows;

(i) Communication Skills – 10 marks
(ii) Subject Clarity – 10 marks
(iii) Group Dynamics - 10 marks
(iv) Behaviors & Mannerisms - 10 marks

(Marks: 40)

Part – B

(To be started from 31st working day and to be completed before 60th working day of the semester)

2. Presentation Skills – Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation is as follows;

(i)	Communication Skills*	-	10 marks
(ii)	Platform Skills**	-	10 marks
(iii)	Subject Clarity/Knowledge	-	10 marks

(Marks: 30)

* Language fluency, auditability, voice modulation, rate of speech, listening, summarizes key learnings etc.

** Postures/Gestures, Smiles/Expressions, Movements, usage of floor area etc.

Part – C

(To be conducted before the termination of semester)

3. Sample Letter writing or report writing following the guidelines and procedures. Parameters to be used for evaluation is as follows;

(i)	Usage of English & Grammar	-	10 marks
(ii)	Following the format	-	10 marks
(iii)	Content clarity	-	10 marks

(Marks: 30)

External Evaluation

(Conducted by the University)

Total Marks: 50 Time: 2 hrs.

Part – A

Short Answer questions

There will be one question from each area (five questions in total). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows;

(i) Content Clarity/Subject Knowledge
(ii) Presentation style
(iii) Organization of content

(Marks: 5 x 6 = 30)

Part – B

Case Study

The students will be given a case study with questions at the end the students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows;

(i) Analyze the case situation
(ii) Key players/characters of the case
(iii) Identification of the problem (both major & minor if exists)
(iv) Bring out alternatives
(v) Analyze each alternative against the problem
(vi) Choose the best alternative
(vii) Implement as solution
(viii) Conclusion
(ix) Answer the question at the end of the case

(Marks: 1 x 20 = 20)

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
EC 301	Digital Signal Processing	3-1-0-4	2015

Prerequisite: EC 202 Signals & Systems,

Course objectives:

The course shall provide:

1. Concepts of Discrete Fourier Transform, Fast Fourier Transform & Discrete Cosine Transforms
2. Understanding about the development of algorithms for efficient computation of DFT
3. Details about the concepts of design of IIR and FIR filters.
4. Understanding of the realization of various structures for IIR and FIR Filters.
5. Practical consideration about sampling, multirate conversion and its applications
6. Concepts of quantisation effects in digital implementation of IIR and FIR systems.
7. Introduction of the architecture of DSP processors

Syllabus:

DFT, DCT, FFT algorithm, Design of FIR and IIR filters, Realization structures for FIR and IIR filters, Introduction to digital signal processors, Multirate signal processing, Finite word length effects in DSP systems

Expected outcome:

After the course, the student will understand the principle of digital signal processing and applications. The utilization of DSP to electronics engineering will also studied.

Text Books:

1. Proakis J. G. and Manolakis D. G., Digital Signal Processing, 4/e, Pearson Education, 2007.
2. Mitra S. K., Digital Signal Processing: A Computer Based Approach, 4/e McGraw Hill(India), 2013.
3. Ifeachor E.C. and Jervis B. W., Digital Signal Processing: A Practical Approach, 2/e, Pearson Education, 2009.

References

1. Oppenheim A. V., Schafer R. W. and Buck J. R., Discrete Time Signal Processing, 3/e, Prentice Hall, 2007.
2. Singh A., and Srinivasan S., Digital Signal Processing: Imlementation Using DSP Microprocessors, Cenage Learning, 2012.
3. Salivahanan, Digital Signal Processing,2e, Mc Graw –Hill Education New Delhi,2009
4. NagoorKani,Digital Signal Processing,1e, Mc Graw –Hill Education New Delhi,2010
5. Vaidyanathan P. P., Multirate Systems and Filter Banks, Pearson Education, 2008.
6. Tan L., and Jiang J., Digital Signal Processing, 2/e, Elsevier, 2013.
7. 5. Kumar A. A., Digital Signal Processing, 2/e, Prentice Hall, 2012

Course Plan

Module	Course content	Hours	Sem. Exam Marks
I	The Discrete Fourier Transform: DFT as a linear transformation, Relationship of the DFT to other transforms	1	15
	Properties of DFT and examples	2	
	Linear Filtering methods based on the DFT	2	
	Frequency Analysis of Signals using the DFT	1	

	The Discrete Cosine Transform: Forward DCT, Inverse DCT and DCTY as an Orthogonal Transform	2	
II	Computation of DFT: Radix-2 FFT Algorithms	2	**15**
	IDFT computation using Radix-2 FFT Algorithms	1	
	DFT Computation using Radix-4 FFT Algorithms	2	
	DFT Computation Using Split-Radix FFT Algorithms	2	
	Efficient computation of DFT of Two Real Sequences and a 2N-Point Real Sequence	1	
FIRST INTERNAL EXAM			
III	Design of FIR Filters- Symmetric and Anti-symmetric	1	**15**
	Design of linear phase FIR Filters using Window method	3	
	Design of linear phase FIR Filters using Window method and Frequency Sampling Method	2	
	Design of Hilbert Transformers, Comparison of Design Methods for Linear Phase FIR Filters	2	
IV	Characteristics of Commonly Used Analog Filters	1	**15**
	Design of Analog Butterworth Low Pass Filters	2	
	IIR Digital Filters from Analog Filters (Butterworth) by Impulse Invariance and Bilinear Transformation,	3	
	Frequency Transformations in the Analog Domain	2	
SECOND INTERNAL EXAM			
V	Block diagram and signal flow graph representations	1	**20**
	FIR Filter Structures: Direct Form, Cascade Form and Lattice Structure	2	
	IIR Filter Structures: Direct Form, Transposed Form, Cascade Form and Parallel Form	2	
	Computational Complexity of Digital filter structures	1	
	Digital Signal Processors: Computer architecture for signal processing, General purpose and special purpose DSP hardware, Architectural description of TMS320C5545 fixed point digital signal processor	2	
VI	Multi-rate Digital Signal Processing: Decimation and Interpolation (Time domain and Frequency Domain Interpretation), Sampling Rate Conversion by non-integer factors	2	**20**
	Application examples: High quality analog-to-digital conversion for digital audio and multirate narrowband digital filtering.	1	
	Analysis of finite word length effects in DSP systems: Introduction, fixed-point and floating-point DSP	2	
	Finite word length effects in IIR digital filters: coefficient quantization errors overflow errors, scaling, product round off errors, limit cycle oscillations	2	
	Finite wordlength effects in FFT algorithms: Round off errors, overflow errors and scaling	1	
END SEMESTER EXAM			

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. Mark patterns are as per 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
EC 303	Applied Electromagnetic Theory	3-0-0-3	2015

Prerequisite: : MA201 Linear Algebra & Complex Analysis, MA 101Calculus,MA 102 Differential equations

Course objectives:

1. To develop a solid foundation in the analysis and application of electromagnetic fields, Maxwell's equations and Poynting theorem.
2. To understand boundary conditions of Electric and Magnetic fields and their physical significances.
3. To understand propagation of uniform plane waves in different media.
4. To understand various parameters of transmission lines like VSWR, Reflection coefficient and impedance of transmission lines and to solve the different transmission line problems using Smith chart.

Syllabus:

Co-ordinate transformation, vector algebra, vector calculus, electrostatics, magnetostatics, 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 shall be able to

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. Mathew N O Sadiku, Elements of Electromagnetics, Oxford University Press, 5/e, 2010.
2. Joseph A Edminister , Electromagnetics, Schaum's Outline Series McGraw Hill, 4/e, 1995

References

1. Umran S. Inan and Aziz S. Inan, Engineering Electromagnetics, Pearson , 2010.
2. W. H. Hayt, Engineering Electromagnetics, McGraw Hill, 7/e, 1994.
3. Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, Pearson, 6/e, 2006.
4. G. S. N. Raju, Eletromagnetic Field Theory and Transmission Lines, Pearson, 2005.
5. John D. Kraus, Electromagnetics, 5/e, TMH, 2010.
6. Martin A Plonus , Applied Electromagnetics, McGraw Hill, 2/e,1978.
7. David K. Cheng, Field and Wave Electromagnetics, Pearson , 2/e, 2013.
8. Jordan and Balmain , Electromagnetic waves and Radiating Systems, PHI, 2/e,2013
9. Mahapathra, Principles of Electromagnetics,2e, Mc Graw –Hill Education New Delhi,2015

Course Plan

Module	Course content (42 hrs)	Hours	Sem. Exam Marks

I	Review of vector calculus, Spherical and Cylindrical coordinate system, Coordinate transformation	1	15
	Elemental displacement, area and volume for spherical and cylindrical coordinate system.	2	
	Curl, Divergence, Gradient in spherical and cylindrical coordinate system.	1	
	Electric field – Coulomb's law, Stokes theorem, Gauss law and Amperes current law.	1	
	Poisson and Laplace equations, 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	20
	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	20
	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).	1	15
	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.	2	15
	The hollow rectangular wave guide – modes of propagation of wave- dominant mode, group velocity and	2	

	Attenuation in wave guides, guide wavelength and	2	
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus with maximum 50 % for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 305	MICROPROCESSOR & MICROCONTROLLER	2-1-0 -3	2015

Prerequisite: EC207 LOGIC CIRCUIT DESIGN

Course objectives:

- To differentiate microprocessor and microcontroller & familiarize the working of a Microprocessor.
- To program the controller to make various peripherals work in connection with the application.
- To communicate with various devices using controller
- To design a microcontroller based system with the help of the above interfacing devices

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 (8251,8253,8255,8257,8259,8275,8279).Comparison (tabular form) between 8086,80286,80386,80486 and Pentium. Simple examples in assembly language programming for 8085(internal examination only).Microcontrollers 8051- features, architecture, memory organization, registers, I/O ports, pin configuration and functions. Addressing modes, instruction set, instruction classification. Assembly language programming examples for 8051. Interrupts in 8051, Timer/Counter programming,Interfacing (block schematic and assembly language programming), PIC Microcontrollers,Introduction to development tools.

Expected outcome:

The student should able to:

- Distinguish various types of processor architectures.
- Describe architectures, memory organization of 8085 microprocessor and 8051 and PIC 16F microcontroller.
- Develop programming skills in assembly for interfacing peripheral devices with 8051

Text Books:

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

References:

1. Aditya P Mathur, Introduction to Microprocessor. Tata Mc Graw – Hill
2. Muhammed Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, 2nd edition
3. I.Scott Mackenzie, Raphel C.-W Phan,The 8051 microcontroller, 4th edition.
4. Han Way Hung, “PIC Microcontroller, An introduction to software and hardware interfacing “, Cenage learning.
5. Muhammad Ali Mazidi “ PIC Microcontroller and Embedded systems using assembly and C for PIC 18” Pearson.
6. Jack Ganssle, Embedded Hardware: Know It All, Newness
7. MandaL, Microprocessors and Microcontrollers 1e, McGraw Hill Education India, 2011

6. Nagoorkani, Microprocessors and Microcontrollers 2e, McGraw Hill Education India, 2012
7. PATEL, The 8051 Microcontrollers Based Embedded Systems 1e, McGraw Hill Education India, 2014

Course Plan			
Module	**Course content (42 hrs)**	**Hours**	**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. machine cycles and bus timings.	5	**15**
II	Addressing modes, instruction set, instruction classification. Overview/concept of peripheral IC interfacing with 8085 microprocessor (8251,8253,8255,8257,8259,8275,8279). Comparison (tabular form) between 8086,80286,80386,80486 and Pentium.	5	**15**
	Simple examples in assembly language programming for 8085(internal examination only)	2	**0**
FIRST INTERNAL EXAM			
III	Microcontrollers: Introduction, comparison between microprocessors and microcontrollers, microcontroller families, 8051- features, architecture, memory organization, registers, I/O ports, pin configuration and functions. Addressing modes, instruction set, instruction classification.	7	
IV	Assembly language programming examples for 8051.	3	**15**
	Interrupts in 8051: Types, interrupt source, interrupt handling and programming	2	
	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	
SECOND INTERNAL EXAM			
V	Interfacing: Interfacing (block schematic and assembly language programming) of DIP switch, DIP switches, stepper motor, ADC, DAC, LEDs, 7 segment displays, alphanumeric LCD module with 8051. LEDs & 7 Segment displays	8	**20**

VI	PIC Microcontrollers: Overview of PIC microcontrollers, PIC 18 family, features, programming model, CPU, registers, addressing modes, instruction format, instruction set, resets, timers and CCP devices.	5	**20**
	Introduction to development tools: IDE, cross assembler, builder, linker and debugger.	1	**0**
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 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 and 50% 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	2015

Prerequisite: EC205 ELECTRONIC CIRCUITS

Course objectives:

To provide an insight on the concepts of Power Electronics and Electronic instruments.
To study the applications of Power electronics such as Switched mode regulators and inverters.
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 student should able to:

- Understand the concepts of Power Electronics and the various applications.
- Get an insight on various electronic instruments, their configuration and measurements using them.
- Understand the principle of operation of Transducers

Text Books:

1. Umanand L., Power Electronics Essentials and Applications, Wiley India, 2015.
2. Bell D. A., Electronic Instrumentation and Measurements, PHI, 2003.

References:

1. Mohan N. and T. M. Undeland, Power Electronics: Converters, Applications and Design, John Wiley, 2007.
2. **Mandal**, Power Electronics 1e, McGraw Hill Education India, 2014
3. **Nakra,** Instrumentation, Measurement and Analysis,4e, Mc Graw –Hill Education New Delhi,2016
4. Daniel W. Hart, Power Electronics, McGraw Hill,2011.
5. Doeblin E., Measurement Systems, 5/e, McGraw Hill, 2003.
6. Helfrick A. D. and W. D. Cooper: Modern Electronic Instrumentation and Measurement Techniques, 5/e, PHI, 2003.
7. Patranabis D., Principles of Electronic Instrumentation, PHI, 2008.
8. Kishore K. L., Electronic Measurements and Instrumentation, 3/e, Pearson, 2009.
1. Kalsi H. S., Electronic Instrumentation, 3/e, Tata McGraw Hill, 2010.

Course Plan

Module	Course content (42 hrs)	Hours	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	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	
	Overview of SMPS	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	Switched mode inverters- Principles of PWM switching schemes.	1	**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, inductance and capacitance using bridges.	2	
SECOND INTERNAL EXAM			
V	Transducers - Classification, Selection of transducers.	1	**20**
	Resistance transducers - Principle of operation, resistance, potentiometers,strain gauge.	2	
	Inductive Transducers - Induction potentiometer, variable reluctance transducers, LVDT, eddy current transducers, synchros and resolvers.	2	
	Capacitive transducers - different types, capacitor microphone. Hall Effect transducer, proximity transducer, magnetostrictive transducers.	2	
VI	Electronic Multimeter, Audio Power Meter, RF power meter, True RMS meter.	2	20
	Digital Instruments - Basics, digital measurement of time, phase, frequency, Digital LCR meter and digital voltmeter.	2	
	Frequency synthesizer, Spectrum analyzers, Logic State analyzers (block diagram only).	1	
	Digital storage oscilloscope – Operation –controls – applications.	2	
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 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 100 % for theory.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 361	DIGITAL SYSTEM DESIGN	2-1-0 -3	

Prerequisite: EC207 LOGIC CIRCUIT DESIGN

Course objectives:

- To study synthesis and design of CSSN
- To study synthesis and design of ASC
- To study hazards and design hazard free circuits
- To study PLA folding
- To study architecture of one CPLDs and FPGA family

Syllabus:

Clocked synchronous networks ,asynchronous sequential circuits, Hazards, Faults, PLA,CPLDs and FPGA

Expected outcome:

The student should able to:

1. Analyze and design clocked synchronous sequential circuits
2. Analyze and design asynchronous sequential circuits
3. apply their knowledge in diagnosing faults in digital circuits ,PLA
4. Interpret architecture of CPLDs and FPGA

TEXT BOOKS :

1. Donald G Givone, Digital Principles & Design, Tata McGraw Hill, 2003
2. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning
3. John F Wakerly, Digital Design, Pearson Education, Delhi 2002
4. N. N. Biswas, Logic Design Theory, PHI
5. Richard E. Haskell, Darrin M. Hanna , Introduction to Digital Design Using Digilent FPGA Boards , LBE Books- LLC

REFERENCES

1. Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, Digital Systems Testing and Testable Design, John Wiley & Sons Inc.
2. Z. Kohavi,Switching and Finite Automata Theory, 2nd ed., 2001, TMH
3. Morris Mano, M.D.Ciletti, Digital Design, 5th Edition, PHI.
4. Samuel C. Lee, Digital Circuits and Logic Design, PHI

Course Plan

Module	Course content (42 hrs)	Hours	Sem. Exam Marks
I	Analysis of clocked Synchronous Sequential Networks(CSSN)	2	15%
	Modelling of CSSN – State assignment and reduction	1	
	Design of CSSN	2	
	Iterative circuits	1	
	ASM Chart and its realization	2	
II	Analysis of Asynchronous Sequential Circuits (ASC)	2	15%
	Flow table reduction- Races in ASC	1	

	State assignment problem and the transition table- Design of AS	2	
	Design of Vending Machine controller.	2	
FIRST INTERNAL EXAM			
III	Hazards – static and dynamic hazards – essential	1	**15%**
	Design of Hazard free circuits – Data synchronizers	1	
	mixed operating mode asynchronous circuits	1	
	practical issues such as clock skew	1	
	Synchronous and asynchronous inputs – switch bouncing	2	
IV	Fault table method – path sensitization method – Boolean difference method	2	**15%**
	Kohavi algorithm	2	
	Automatic test pattern generation – Built in Self Test(BIST)	3	
SECOND INTERNAL EXAM			
V	PLA Minimization – PLA folding	2	**20%**
	Foldable compatibility Matrix- Practical PLA	2	
	Fault model in PLA		
	Test generation and Testable PLA Design.	3	
VI	CPLDs and FPGAs – Xilinx XC 9500 CPLD family , function block – architecture – input output block architecture – switch matrix	3	**20%**
	FPGAs – Xilinx XC 4000 FPGA family – configurable logic block – input output block	3	
	Programmable interconnect.	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 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
EC363	OPTIMIZATION TECHNIQUES	4-0-0-4	2015

Prerequisite:nil

Course objectives:

- Understand the need and origin of the optimization methods.
- Get a broad picture of the various applications of optimization methods used in engineering.
- Define optimization problem and its various components.

Syllabus: Engineering applications of optimization, Formulation of design problems as mathematical programming problems, objective function, constraints, classification of optimization problems/techniques,necessary and sufficient conditions for optimality, uni-modality, convexity, Mathematical formulation of LP Problems, Reduction of a LPP to the standard form. Feasible solutions, Graphical solution methods, optimality conditions, degeneracy, Simplex algorithm, Duality in linear programming, dual simplex method, Transportation Problem, Game theory, Network path Models, Nonlinear unconstrained optimization, Modern methods of optimization, Genetic algorithm. Introduction to optimization tools and softwares.

Expected outcome:

- On completion of this course, the students will have a thorough understanding of optimization techniques
- Students will be able to formulate and solving the engineering optimization problems

Text Books:

1. Singiresu S Rao, "Engineering optimization Theory and Practice", New Age International, 2009
2. H.A. Taha, " Operations Research", Fifth Edn. Macmillan Publishing Company, 1992.
3. Hadley, G. "Linear programming", Narosa Publishing House, New Delhi
4. Kalynamoy Deb. "Optimization for Engineering Design- Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi,

References:

1. Ashok D Belegundu, Tirupathi R Chandrupatla, "Optimization concepts and Application in Engineering", Pearson Education.
2. Kanti Swaroop – " Operations Research"
3. J. S. Arora, Introduction to Optimum Design, McGraw-Hill Book Company.
4. A. Ravindran, D. T. Phillips, J. J. Solberg, Operations Research – Principles and Practice, John Wiley and Sons.
5. Papalambros& Wilde, Principles of Optimal Design, Cambridge University Press, 2008

Course Plan

Module	Course content (42 hrs)	Hours	Sem. Exam Marks
I	Introduction: Engineering applications of optimization, Formulation of design problems as mathematical programming problems, objective function, constraints, classification of optimization problems/techniques.	2	15
	Optimization techniques: Classical optimization, unconstrained single and multivariable minimization- necessary and sufficient conditions for optimality, uni-modality, convexity.	5	

II	Linear programming problems-I: Mathematical formulation of LP Problems,slack, surplus and artificial variables. Reduction of a LPP to the standard form, feasible solutions. Graphical solution method, simplex algorithm and solution using tabular method, optimality conditions and degeneracy.	7	**15**
FIRST INTERNAL EXAM			
III	Linear programming problems-II: Duality in linear programming, dual simplex method. Transportation Problem: Formulation of transportation problem, Basic feasible solution using different methods- East West corner method, Vogel approximation method, Optimality methods, MODI method, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of transportation problems.	8	**15**
IV	Game theory : Introduction, 2- person zero – sum game; Saddle point ; Mini-Max and Maxi-Min Theorems (statement only); Graphical solution (2x n, m x 2 game), dominance property. Network path Models: Tree Networks – Minimal Spanning Tree - Prim's Algorithm. Shortest path problems- solution methods – Dijkstra's Method.	8	**15**
SECOND INTERNAL EXAM			
V	Nonlinear unconstrained optimization: Single variable optimization methods- Fibonacci search method, Newton-Raphson method. Multi-variable methodss- Hook-Jeeves pattern search method, Cauchy's (steepest descent) method.	7	**20**
VI	Modern methods of optimization: Genetic algorithm Introduction. Examples of applications in electronics engineering. Introduction to optimization tools and softwares. Solution of optimization Problems using MATLAB	5	**20**
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus with maximum 40 % for theory, derivation, proof and 60% for logical/numerical problems and algorithms.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC365	**Biomedical Engineering**	**3-0-0-3**	**2015**

Prerequisite: EC307 Power Electronics &Instrumentation

Course objectives:

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

1. Ability to understand diagnosis and therapy related equipments.
2. Understanding the problem and ability to identify the necessity of equipment for diagnosis and therapy.
3. Understanding the importance of electronics engineering in medical field.
4. Understanding 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. J J Carr, "Introduction to Biomedical Equipment Technology" : Pearson Education 4th e/d.
2. John G Webster, "Medical Instrumentation application and design", John Wiley 3rd e/d.
3. Richard Aston, "Principle of Biomedical Instrumentation and Measurement".
4. Barbara Christe, Introduction to Biomedical Instrumentation, Cambridge University Press, 2008

Course Plan

Module	Course content (42 hours)	Hours	
I	Introduction, bio-medical instrumentation system, overview of anatomy and physiological systems of the body, Bio-electric potential: Resting and action potential, electrical equivalent of cell, Nernest relation, bio-electric signals and their characteristics of ECG, EEG, EMG, ERG and EOG.	3	15
	Bio potential electrodes and sensors: Types, materials, properties and characteristics, method of selection and applications.	1	
	Transducers for biological applications: Transducers for the measurement of pressure, flow, pulse and respiration.	3	

	Bio-signal acquisition and safety: Physiological signal amplifiers, isolation amplifier, bridge amplifier and chopper amplifier, Electrical safety: physiological effects due to current passage, micro current shock, macro current shock, leakage current, devices to protect against electrical hazards, safety codes for electro medical equipments, electromagnetic interference to medical electronic equipments.	3	
II	Measurement of blood pressure: Direct, indirect and relative methods of blood pressure measurement, auscultatory method, oscillometric and ultrasonic non-invasive pressure measurements.	2	15
	Measurement of blood flow: Electromagnetic blood flow meters and ultrasonic blood flow meters.	2	
	Electrocardiography: Cardiac action potential, electrocardiogram, , ECG lead configurations, ECG recording system, analysis of ECG signals, basic concepts of vector cardiography, phonocardiography and echocardiography.	2	
FIRSTINTERNAL 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. Electromyography: Nerve conduction velocity, instrumentation system for EMG.	3	15
	Physiology of Respiratory system, Tests and Instrumentation for the respiratory measurements, respiratory gas analyzers.	2	
	Diagnosis Equipments: Principle, block schematic diagram, working and applications of oxi meters, plethysmograph , pH meter, blood cell counter, flame photometer, spectrophotometer , colorimeter and chromatographs.	3	
IV	Therapeutic Equipments: Principle, block schematic diagram, working and applications of pacemakers, cardiac defibrillators, heart–lung machine, dialyzers, surgical diathermy equipment, electrotherapy, infant incubators, ventilators and automatic drug delivery systems.	5	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, radiography and fluorography. Computed Tomography: Principle, image reconstruction, scanning system and applications. 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. Magnetic Resonance Imaging: principle, magnetic relaxation and MRI parameters, basic NMR imaging system, biological effects of NMR imaging, MRI instrumentation system, advantages, risks and limitations Positron Emission Tomography: Principle, scanning, PET instrumentation system, advantages of PET scan.	11	20

VI	Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG and temperature, multi channel telemetry system, implantable telemetry system.	2	20
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus with maximum 100 % for theory.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 360?	SOFT COMPUTING	3-0-0 -3	2016

Course objectives:

• To familiarize various components of soft computing like fuzzy logic, neural networks and genetic algorithm.

• To give an overview of fuzzy Logic and to understand the concepts and terminologies of fuzzy systems.

• To give a description on artificial neural networks with its advantages and application.

• To study the fundamentals of Genetic Algorithm (GA).

• 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 student should 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. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India.

2. Laurene V. Fausett, (1993) “Fundamentals of Neural Networks: Architecture, Algorithms and Applications", Prentice Hall.

3. D.E . Goldberg, "*Genetic Algorithms: Search, Optimization and Machine Learning*",Addison Wesley,N.Y, 1989.

References:

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

Course Plan

Module	Course content (42hrs)	Hours	Sem. Exam Marks
I	Soft computing: Introduction of soft computing, soft computing vs hard computing, various types of soft computing techniques, 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.	2	
	Type- 2 fuzzy sets. Operation on fuzzy set-complement, intersection, union, Demorgan's Law Equality & subset hood.	2	
II	Extension Principle and its application. Fuzzy relation-operations, projection, max-min , min-max composition, cylindrical extension.	2	**15**
	Reflexivity, symmetry and transitivity of fuzzy relations. Fuzzy prepositions, fuzzy connectives, linguistic variables, hedges.	3	
	Approximate reasoning or fuzzy inference, Fuzzy rule based system. Fuzzification and defuzzification using centroid, centre of sums.	3	
FIRST INTERNAL EXAM			
III	Introduction to Neural Networks - Applications – Biological neuron- Typical architecture of Artificial Neural Networks - Common activation function.	2	**15**
	Mc. Culloh Pitts Neuron – Architecture, logic implementatons. Supervised and Unsupervised learning-Learning Algorithms .Linear Separability.	3	
	Pattern Classification – Hebb Net, Perceptrons, ADALINE networks (Architecture, Algorithm and simple Applications).	3	
IV	Pattern Association- training algorithms- Hetro Associative Network, Auto Associative Network, Hopfield Network, BAM Network.	3	**15**
	Back propogation learning methods-back propagation algorithm, factors affecting backpropagation training & applications. (Architecture, Algorithm and simple Applications).	3	
SECOND INTERNAL EXAM			
V	Genetic Algorithm (GA) Basic concepts, Genetic representations, (encoding) Initialization and selection, Survival of the Fittest - Fitness Computations.	3	**20**
	Cross over - Mutation –Reproduction, applications. Rank method–Rank space method AI search algorithm.	3	
VI	Introduction to Neural Fuzzy Controller- Neural Fuzzy controller with hybrid structure.	2	**20**
	Parameter learning for Neural fuzzy controllers – Neural Fuzzy controller with Fuzzy singleton Rules.	3	
	Integration of neural networks, fuzzy logic and genetic algorithms.	3	

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. Mark patterns are as per the syllabus with maximum 40 % for theory, derivation, proof and 60% for logical/numerical problems and algorithms.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC333	Digital Signal Processing Lab	0-0-3-1	2015

Prerequisite:
EC213 Electronics Design Automation Lab, EC 202 Signals & Systems, EC301 Digital Signal Processing

Course objectives:

- Enable the students to explore the concepts of design, simulation and implementation of various systems using MATLAB 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 (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 student should able to:

1. 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**	**2015**

Prerequisite: EC307 Power Electronics & Instrumentation

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:

1. Design and Step up DC-DC converter
2. Design and Step up Push pull DC- DC Converter
3. Design and Step up Buck DC-DC Converters
4. Design and Step up Simple SMPS
5. Design and Step up Half bridge and full bridge converters
6. Design and Step up basic Inverter Circuits
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
13. Study of Digital LCR meter, Frequency synthesizer, Spectrum analyzer and Logic State analyzer application.

Expected outcome:

The student should 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	2015

Pre-requisites: MA201 Linear Algebra & Complex Analysis, MA204 Probability, Random Processes and Numerical Methods, EC301 Digital Signal Processing

Course Objectives:

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

Expected outcome:

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

1. Illustrate the digital representation of analog source
2. Compare the performance of various Digital Pulse Modulation Schemes
3. Apply the knowledge of ISI problems in Digital communication to derive Nyquist criteria for zero ISI
4. Analyse the need for introducing ISI in Digital Communication in a controlled manner
5. Construct signal space representation of signal using Gram Schmidt orthonormalisation procedure
6. Compare the error probability for different digital modulation schemes like BPSK, BFSK, QPSK etc.
7. Describe the principle of spread spectrum communication and to illustrate the concept of FHSS and DSSS
8. Understand various Diversity Technique

Syllabus

Overview of Digital Communication, Pulse Code Modulation (PCM), Modifications of PCM, Transmission over baseband channel, Transmission over AWGN Channel, Digital Modulation Schemes, Spread spectrum communication, Transmission over fading channel,Diversity techniques

Text Books

1. Symon Haykins, Digital Communication Systems, Wiley India, 2013.
2. John G Proakis, Masoud Salehi, Digital Communication, McGraw Hill Education Edition, 2014

References:

1. John G Proakis, Masoud Salehi, Gerhard Bauch, Modern Communication Systems using Matlab, Cengage Learning India Pvt Ltd, 2013
2. Nishanth N, Digital Communication, Cengage Learning India Pvt Ltd, 2016
3. Symon Haykins, Communication Systems, 4/e Wiley India, 2012.
4. T L Singal, Digital Communication, McGraw Hill Education (India) Pvt Ltd, 2015

5. Ramakrishna Rao, Digital communication, Tata McGraw Hill Education Pvt. Limited.
6. Hari Bhat, Ganesh Rao, Digital Communication, 3/e, Pearson, 2010
7. Robert G. Gallagar/Principles of Digital Communication, Cambridge University Press, 2008

Course Plan

Module	Course content (54 hrs)	Hours	Sem. Exam Marks
I	**Overview of Digital Communication**- Comparison with Analog Communication **Overview of Random variables and Random process** -Stationarity, Transmission of Random Process through LTI systems, Power Spectral Density (PSD), Importance of random variables and random process in digital communication	4	15
	Pulse Code Modulation (PCM): Pulse Modulation, Sampling process, Performance comparison of various sampling techniques Aliasing, Reconstruction, PAM, Quantization, Noise in PCM system,	**5**	
II	**Modifications of PCM**: Delta modulation, DPCM, ADPCM, ADM, Performance comparison of various pulse modulation schemes, Line codes, PSD of various Line codes.	**5**	**15**
	Transmission over baseband channel: Matched filter, Inter Symbol Interference (ISI), Nyquist Criteria for zero ISI, Ideal solution, Raised cosine spectrum, Eye Pattern	**5**	
FIRST INTERNAL EXAM			
III	**Signal Space Analysis:**Geometric representation of signals, Gram Schmidt orthogonization procedure.	**5**	**15**
	Transmission Over AWGN Channel: Conversion of the continuous AWGN channel into a vector channel, Likelihood function, Maximum Likelihood Decoding, Correlation Receiver	**5**	
IV	**Digital Modulation Schemes:** Pass band transmission model**,** Coherent Modulation Schemes-BASK, BPSK, QPSK, BFSK**,** Non-Coherent orthogonal modulation schemes**,** Differential Phase Shift Keying (DPSK)**,** Detection of Binary modulation schemes in the presence of noise**,** BER for BASK, BPSK, QPSK, BFSK	**8**	**15**
SECOND INTERNAL EXAM			
V	**Spread spectrum communication:** Pseudo noise sequences, Properties of PN sequences. Generation of PN Sequences, Direct Sequence Spread Spectrum (DSSS), Anti jam Characteristics, Frequency Hop spread spectrum with MFSK, Slow and Fast frequency hopping.	**6**	**20**
	Multicarrier Communication: Overview of Orthogonal Frequency	**5**	

	Division Multiplexing (OFDM), Generation and demodulation of OFDM		
VI	**Transmission over fading channel**: multipath channels, classification, Coherence time, Coherence bandwidth, Statistical characterization of multi path channels **Diversity techniques:** Diversity in time, frequency and space.	**6**	**20**
END SEMESTER EXAM			

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. Mark patterns are as per 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
EC304	VLSI	3-0-0-3	2015

Prerequisite:
PH 100 Engineering Physics, EC203 Solid State Devices, EC204 Analog Integrated Circuit.

Course objectives:
To get the knowledge about IC Fabrication Techniques and to get 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:

- At the end of the course, students will be able to Design and Analysis of various MOSFET and CMOS logic circuits

Text Books:

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

References:

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

Course Plan

Module	Course content (42 hrs)	Hours	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, layout of CMOS Inverter, two input NAND and NOR gates	**3**	
IV	**Static CMOS Design**- basic concept, multiple input CMOS logic circuits, static properties, propagation delay and transistor sizing **Dynamic CMOS circuits**- Issues with dynamic circuits, Domino logic	**4**	**15**
	MOSFET Logic Design -Pass transistor logic, Complementary pass transistor logic and transmission gate logic , realization of functions	**3**	
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, Carry-Look ahead adder **Multipliers**-Array multiplier.	**4**	**20**
	Design for Testability – Fault types and models, Controllability and Observability, Scan based Techniques, Built-In Self-Test Techniques tools.	**3**	
END SEMESTER EXAM			

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. Mark patterns are as per 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
EC306	ANTENNA & WAVE PROPAGATION	3-0-0 -3	2015

Prerequisite:EC303 Applied Electromagnetic Theory

Course objectives:

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

Syllabus:

Basic principles of 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 End fire, broadside, binomial and Dolph Chebyshev arrays Principles of practical antennas. Travelling 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:

After completion of the course the student will be able to know:

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

Text Books:

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

References:

1. Jordan E.C. & K G Balmain, Electromagnetic Waves & Radiating Systems, 2/e, PHI, 2000
2. Collin R.E, Antennas & Radio Wave Propagation, McGraw Hill. 1985.
3. Thomas A. Milligan, Modern Antenna Design, IEEE PRESS, 2/e, Wiley Interscience,2005
4. Raju G.S.N., Antenna and Wave Propagation, Pearson, 2013.
5. Sisir K.Das & Annapurna Das,Antenna and Wave Propagation,McGraw Hill,2015

Module	Course content (42 hrs)	Hours	Sem. Exam Marks
I	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	15
	Field strength of space wave, duct propagation, VHF and UHF Mobile radio propagation, tropospheric scatter propagation, fading and diversity techniques.	4	
II	Principle of Log periodic antenna array and Helical antenna.	3	15

	Antennas for mobile base station and handsets.,		
	Design of rectangular Patch antennas. Principle of smart antenna.	3	
FIRST INTERNAL EXAM			
III	Basic principle of beam steering. Traveling wave antennas. Principle and applications of V and rhombic antennas. Principles of Horn, Parabolic dish antenna, Cassegrain antenna	6	**15**
IV	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 Dolph Chebyshev arrays.	4	
SECOND INTERNAL EXAM			
V	Concept of retarded potential. Field, directivity and radiation resistance of a short dipole and half wave dipole.	4	**20**
	Measurement of radiation pattern, gain, directivity and impedance of antenna	3	
VI	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	**20**
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus with maximum 50 % for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 308	EMBEDDED SYSTEMS	3-0-0 -3	2015

Prerequisite:EC206 Computer Organization, EC305 Microprocessors & Microcontrollers

Course objectives:

1. To have a thorough understanding of the basic structure and design of an Embedded System
2. To study the different ways of communicating with I/O devices and standard I/O interfaces.
3. To study the basics of RTOS for Embedded systems.
4. To study the programming concepts of Embedded Systems
5. 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 student should able to:

1. Understand the basics of an embedded system
2. Develop program for an embedded system.
3. Design, implement and test an embedded system.

Text Books:

1. Rajkamal, Embedded Systems Architecture, Programming and Design, TMH, 2003.
2. K.V.Shibu - Introduction to Embedded Systems, 2e, McGraw Hill Education India,2016.

References:

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers - Elsevier 3ed, 2008
2. Tammy Noergaard, Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers, Newnes – Elsevier 2ed, 2012
3. Steve Heath, Embedded Systems Design, Newnes – Elsevier 2ed, 2002
4. David E.Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.
5. Frank Vahid and Tony Givargis, Embedded Systems Design – A Unified Hardware / Software Introduction, John Wiley, 2002.
6. Iyer - Embedded Real time Systems, 1e, McGraw Hill Education New Delhi, 2003.

Course Plan

Module	Course content (42hrs)	Hours	Sem. Exam Marks

I	Introduction to Embedded Systems– Components of embedded system hardware–Software embedded into the system –Embedded Processors - CPU architecture of PIC and ARM processors – CPU Bus Organization and Protocol. Design and Development life cycle model - Embedded system design process – Challenges in Embedded system design.	7	**15**
II	Serial Communication Standards and Devices - UART, HDLC, SCI and SPI. Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus. Parallel communication standards ISA, PCI and PCI-X Bus.	6	**15**
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. Software Implementation, Testing, Validation and debugging, system-on- chip. Design Examples: Mobile phones, ATM machine, Set top box.	7	**15**
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

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. Mark patterns are as per the syllabus with maximum 50 % for theory and 50% for logical/numerical problems, derivation and proof.

SYLLABUS AND COURSE PLAN			
COURSE CODE	**COURSE NAME**	**L-T-P-C**	**YEAR OF INTRODUCTION**
EC 312	**OBJECT ORIENTED PROGRAMMING**	**3-0-0-3**	**2015**

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:

On completion of this course, the students have:

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

Text Books:

1. Hardy, Brian, and Bill Phillips, Android Programming: The Big Nerd Ranch Guide. Addison-Wesley Professional, 2013.
2. E Balagurusamy, Object Oriented Programming with C++ and JAVA, McGrawHill, 2015

References:

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

Course Plan	

Module	Course content (42 hrs)	Hours	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	4	
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
	Templates and Exception Handling	2	
IV	Programming with JAVA - Overview of Java Language, Classes Objects and Methods, Method Overloading and Inheritance, Overriding Methods, Final Variables and Methods, Working with files – File stream operation, file pointers and their manipulation, File updation.	6	15
SECOND INTERNAL EXAM			
V	Interfaces, Packages and Multithreading - Interfaces: Multiple Inheritance, Packages - Java API packages, Multithreaded programming, Managing Errors and Exceptions.	7	20
VI	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, 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. A group assignment on simple android mobile app (eg: managing students' details and rank calculation of a class).
2. Assignment for implementing virtual base class in C++ related to some application.

3. Assignment for implementing a simple interactive applet in Java (eg: calculator)

Question Paper

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 362	MODELLING & SIMULATION OF COMMUNICATION SYSTEMS	3-0-0-3	2015

Prerequisite: MA204 Probability, Random Processes and Numerical Methods, EC301 Digital Signal Processing

Course objectives:

1. To impart the basic concepts of modeling and simulation of Communication Systems
2. To study and evaluate the behavior and performance of the systems.

Syllabus: Simulation and Modelling Methodology, Review of Random Processes, Random Number generation, Modelling of Transmitter and Receiver subsystems, Communication channels and models, Estimation of parameters in simulation, Estimation of performance measures from simulation, Analysis of simulation results.

Expected outcome:

The student should be able to

- Apply modelling and computational techniques to problems in the communication field.

Text Books:

1. M.C. Jeruchim, Philip Balaban , K.Sam Shanmugam, Simulation of communication systems, Kluwer Academic/Plenum Press, New York, 2000
2. Raj Jain. The Art of Computer Systems Performance Analysis, John Wiley and Sons, 1991 (Chapter 25)

Course Plan

Module	Course content (42hrs)	Hours	Sem. Exam Marks
I	Simulation and Modelling Methodology**:** Review of Random Processes, Univariate and multivariate models, Transformation of random variables	3	15
	Bounds and approximations, Random process models, Markov and ARMA Sequences, Poisson Process, Gaussian Process	3	
	Random Number Generation , Generation of Random sequences	1	
	Testing Random Number Generators	1	
II	Modelling of Transmitter and Receiver subsystems: Information sources	1	15
	Channel coding ,Radio frequency and optical modulation,	2	
	Demodulation and detection , Filtering	1	
	Multiple Access : Issues in the simulation of Multiple Access	1	
FIRST INTERNAL EXAM			
III	Communication channels and models: Fading and multipath channels, The Almost Free space channel	3	15

	Conducting and Guided wave media	1	
	Finite state channel models, Methodology for simulating Communication systems operating over Fading Channels.	4	
IV	Estimation of parameters in simulation: Quality of an estimator, Estimating the average level of a waveform,	3	**15**
	Estimating the average power of a waveform, Estimating the power spectral density of a process	2	
	Estimating Delay and Phase.	2	
SECOND INTERNAL EXAM			
V	Estimation of performance measures from simulation: Estimation of SNR	3	**20**
	Estimating Performance measures for digital systems-The Monte Carlo Method	2	
	Importance sampling method	2	
VI	Analysis of simulation results: Model Verification Techniques, Model Validation Techniques	3	**20**
	Transient Removal, Terminating Simulations	2	
	Stopping Criteria, Variance Reduction	2	
END SEMESTER EXAM			

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. Mark patterns are as per 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
EC364	**COMPUTER VISION**	**3-0-0-3**	**2015**

Prerequisite: MA204 Probability, Random Processes and Numerical Methods, EC301 Digital Signal Processing

Course objectives:

1. To review image processing techniques for computer vision
2. To understand shape and region analysis
3. To understand three-dimensional image analysis techniques and motion analysis
4. To study some applications of computer vision algorithms
5. To introduce methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving

Syllabus:

Review of Image processing operations, Image formation models, Image processing and feature extraction, Motion Estimation, Shape representation and Object recognition.

Expected outcome:

The student should able to:

1. Implement fundamental image processing techniques required for computer vision
2. Perform shape analysis and boundary tracking techniques
3. Implement motion related techniques
4. To develop applications using computer vision techniques

Text Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall,2002
2. Robot Vision, B. K. P. Horn, McGraw-Hill,1986

References:

1. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012.
2. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
3. R. Szeliski, Computer Vision: Algorithms and Applications, Springer 2011

Course Plan

Module	Course content	Hours	Sem. Exam Marks
I	Review of image processing techniques : filtering , thresholding	1	15
	Mathematical morphology, Texture	1	
	Binary shape analysis, connectedness , object labelling and counting	2	
	Boundary descriptors	1	
II	Monocular and binocular imaging system	2	15
	Orthographic & Perspective Projection	2	
	Camera models	2	

	Camera Calibration, Stereo vision: introduction; concept of disparity and its relationship with depth	3	
FIRST INTERNAL EXAM			
III	Image Processing for Feature Detection and Image Synthesis, Edge detection	1	**15**
	Corner detection, Harris corner detection algorithm, Line and curve detection,Hough transform	3	
	SIFT operator, Mosaics, snakes	2	
IV	Shape from X - Shape from shading, Photometric stereo, Texture, Occluding contour detection.	3	**15**
	Motion Analysis- Regularization theory,Optical Flow: brightness constancy equation, aperture problem, Horn-Shunck method, Lucas-Kanade method	4	
	Structure from motion.	2	
SECOND INTERNAL EXAM			
V	Object recognition: Hough transforms and other simple object recognition methods	3	**20**
	Shape correspondence and shape matching ,Principal Component Analysis	**3**	
	Shape priors for recognition	**1**	
VI	Application: Photo album, Face detection, Face recognition , Eigen faces , Active appearance and 3D shape models of faces	**3**	**20**
	Application: In-vehicle vision system: locating roadway, road markings, identifying road signs, locating pedestrians	**3**	
END SEMESTER EXAM			

Question Paper

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC366	REAL TIME OPERATING SYSTEMS	3-0-0-3	2015

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

Text Books:

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

References:

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

Course Plan

Module	Course content (42 hrs)	Hours	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	
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	2	**15**
	Memory allocation Strategies (First Fit, Best Fit, Worst Fit, Next Fit), Fragmentation, Swapping, Segmentation, Paging, Virtual Memory, Demand paging	3	
	Page Replacement Policies (FIFO, LRU, Optimal, clock), Thrashing, Working Set Model	2	
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	

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. Mark patterns are as per the syllabus with maximum 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	2015

Prerequisite:EC307 Power Electronics &Instrumentation, EC305 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, Microbots , Recent developments in Robotics.

Expected outcome:

- On completion of this course, the students will have a thorough understanding about Robots and their applications
- Students will be able to analyse and design robotic structures.

Text Books:

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

References:

1. Klafter, R.D., Chmielewski, T.A, Negin, M, Robotic Engineering An Integrated Approach,PHI,2007
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. Robert J. Schilling, Fundamentals of Robotics: Analysis & Control, Pearson Education,2000
5. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi, 1994.
6. Ashitava Ghosal, Robotics, Fundamental concepts and analysis, OXFORD University Press, 2006

Course Plan

Module	Course content (42 hrs)	Hours	Sem. Exam Marks

I	Introduction – Definition and origin of robotics, Robot Anatomy, Robot specifications, Robot characteristics – accuracy, precision, repeatability, Areas of application, classification of robots. Robotic arm – Components and structure, Types of joints and workspace, Common kinematic arrangements, Wrists, End effectors- classifications, tools and grippers.	**7**	**15**
II	Sensors: Types and applications of sensors in Robotics, position and displacement sensors, Tactile sensors, Proximity and Range Sensors, Strain gauge based force-torque sensors, Encoders, Tachometers. Robotic drive systems and actuators: Hydraulic, Pneumatic and Electric drives. 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.	6	**15**
FIRST INTERNAL EXAM			
III	Robotic vision systems: Imaging, Sensing and Digitization, Image processing techniques, Areas of application in robotics and future scope. 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.	10	**15**
SECOND INTERNAL EXAM			
V	Velocity kinematics – Derivation of the Jacobian, Application of velocity kinematics for all 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, Digital and Programmable Logic (PLC) controllers.	5	**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, Machine loading and unloading, Assembly and spray painting. Mobile robots, Microbots , Recent developments in Robotics.	7	**20**
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus with maximum 70 % for theory and 30% for logical/numerical problems, programming, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 370	DIGITAL IMAGE PROCESSING	3-0-0 -3	2015

Prerequisite: MA204 Probability, Random Processes and Numerical Methods, EC301 Digital Signal Processing

Course objectives:

- To study the image fundamentals and mathematical transforms necessary for image transform
- To study the image enhancement techniques
- To study image restoration procedures
- To study image compression procedures
- To study image segmentation and representation techniques

Syllabus:

Digital image fundamentals, 2D Transforms, Image enhancement, Image restoration, Image segmentation, Image compression

Expected outcome:

The student should able to:

1. Distinguish / Analyse the various concepts and mathematical transforms necessary for image processing
2. Differentiate and interpret the various image enhancement techniques
3. Illustrate image segmentation algorithm
4. Analyse basic image compression techniques

Text Books:

1. I.Gonzalez Rafel C, Digital image Processing ,Pearson Education, 2009
2. S Jayaraman, S Esakkirajan, Digital image processing ,Tata Mc Graw Hill,2015

References:

1. Fundamentals of digital image processing: Jain Anil K, PHI,1988
2. Digital image processing : Kenneth R Castleman, Pearson Education,2e,2003
3. Digital Image Processing: Pratt William K, John Wiley,4e,2007

Course Plan

Module	Course content (42 hrs)	Hours	Sem. Exam Marks
I	Image representation, basic relationship between pixels, elements of DIP system, elements of visual perception-simple image formation model	3	15
	Vidicon and Digital Camera working principles	1	
	brightness, contrast, hue, saturation, mach band effect,	1	
	colour image fundamentals-RGB, CMY, HIS models, 2D sampling, quantization.	2	
II	Review of matrix theory, row and column ordering- Toeplitz, Circulant and block matrix,	2	15
	2D transforms - DFT, its properties, Walsh transform, Hadamard	3	

	transform, Haar transform,		
	DCT, KL transform and Singular Value Decomposition.	3	
FIRST INTERNAL EXAM			
III	Spatial domain methods: point processing- intensity transformations, histogram processing, image subtraction, image averaging	3	**15**
	Spatial filtering- smoothing filters, sharpening filters	1	
	Frequency domain methods: low pass filtering, high pass filtering, homomorphic filter.	2	
IV	Degradation model, Unconstraint restoration- Lagrange multiplier and constraint restoration	2	**15**
	inverse filtering- removal of blur caused by uniform linear motion, Weiner filtering,	2	
	Geometric transformations-spatial transformations	2	
SECOND INTERNAL EXAM			
V	Classification of Image segmentation techniques, region approach, clustering techniques	2	**20**
	segmentation based on thresholding, edge based segmentation	2	
	classification of edges, edge detection, hough transform, active contour	3	
VI	need for compression, redundancy, classification of image compression schemes, Huffman coding, arithmetic coding, dictionary based compression, transform based compression,	5	**20**
	Image compression standards- JPEG& MPEG, vector quantization, wavelet based image compression.	3	
END SEMESTER EXAM			

Question Paper

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC332	COMMUNICATION ENGG LAB (ANALOG & DIGITAL)	0-0-3-1	2015

Prerequisite:

EC204 Analog Integrated Circuit, EC208 Analog Communication Engineering, EC302 Digital Communication.

Course objectives:

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

List of Experiments:

Cycle I (Six 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 student should able to:

1. Understand the basic concepts of circuits used in communication system.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 334	MICROCONTROLLER LAB	0-0-3-1	2015

Prerequisite:
EC305 Microprocessors & Microcontrollers

Course objectives:

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

List of Experiments:

Programming experiments using 8051 simulator (KEIL).

1. Addition and subtraction.
2. Multiplication and division.
3. Multiplication by shift and add method.
4. Addition of series of 8 bit binary and decimal numbers.
5. Subtraction of 2 decimal numbers.
6. Sorting of a series of 8 bit numbers.
7. Multiplication by shift and add method.
8. LCM and HCF of two 8 bit numbers.
9. Matrix addition

Interface experiments - Direct down loading the programs from Personal computer.

1. Display (LED, Seven segments, LCD) interface.
2. Parallel interfacing I/O ports (Matrix keyboards)
3. ADC interface.
4. DAC interface with wave form generation.
5. Stepper motor interface.
6. Relay interface.
7. Serial communication with PC
8. Interfacing with serial EEPROM
9. I2C communication with 8051: Read, write and validate data from a serial EPROM or I2C based temperature sensor etc.
10. Simple project work including multiple peripheral interfaces.

Expected outcome:

The student should 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	2015

Prerequisite:
MA204 Probability, Random Processes and Numerical Methods,EC302 Digital Communication

Course objectives:

1. To understand the concept of information
2. To understand the limits of error free representation of information signals and the transmission of such signals over a noisy channel
3. To design and analyze data compression techniques with varying efficiencies a per requirements
4. To understand the concept of various theorems proposed by Shannon for efficient data compression and reliable transmission
5. To have idea on the different coding techniques for reliable data transmission
6. 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:
At the end of the course, students will be able to

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

Text Books:

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

References:

1. Bose, Information theory coding and cryptography, 3e McGraw Hill Education India , 2016
2. J S Chitode, Information Theory and Coding, Technical Publications, Pune, 2009
3. Kelbert & Suhov, Information theory and coding by examples, Cambridge University Press, 2013
4. Shu Lin & Daniel J. Costello.Jr., Error Control Coding : Fundamentals and Applications, 2/e,Prentice Hall Inc.,Englewood Cliffs, NJ,2004
5. D.E.R. Denning, Cryptography and Data Security, Addison Wesley, 1983.
6. David J.C Mackay, Information Theory, Inference and Learning Algorithms, Cambridge,2005.
7. Paul Garrett, The mathematics of Coding Theory, Prentice Hall, 2004.
8. Das Mullick Chatterjee, Principles of Digital communication , Wiley Eastern Ltd, 1986

Course Plan

Module	Course content (54 hrs)	Hours	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 symmetric channel (BSC), Binary erasure channel (BEC) – capacity of band limited Gaussian channels	9	
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**
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 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. Mark patterns are as per the syllabus with maximum 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	2015

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

Course objectives:

1. To study the various microwave sources, their principle of operation and measurement of various parameters
2. To study the various microwave hybrid circuits and formulate their S matrices.
3. 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:
At the end of the course, students will be able to understand the basics of microwave engineering and radar systems.

Text Books:

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

References:

1. Das -Microwave Engineering , 3e, McGraw Hill Education India Education , 2014
2. Kulkarni M, Microwave and Radar Engineering, 4/e, Umesh Publications, 2012.
3. Robert E. Collin, Foundation of Microwave Engineering, 2/e, Wiley India, 2012.
4. Rao, Microwave Engineering, 2/e, PHI, 2012.
5. David M. Pozar , Microwave Engineering,4/e, Wiley India, 2012.
6. Nagaraja N. S., Elements of Electronic Navigation, 2/e, Tata McGraw Hill, 2001.
7. Roy and Mitra, Microwave Semiconductor Devices, PHI, 2013.
8. Raju G. S. N., Microwave Engineering, I.K. International, 2008
9. Vasuki, Microwave Engineering 1e, McGraw Hill Education India, 2015

Course Plan

Module	Course content (42hrs)	Hours	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 loading.	4	
II	**Reflex Klystron Oscillators**: Derivation of Power output, efficiency and admittance	2	

	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	
V	**Solid state microwave devices** – Microwave bipolar transistors, Physical structures, Power frequency limitations equivalent circuit. Principle of **Tunnel diodes** and tunnel diode oscillators.	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 Doppler Radar	5	**20**
	Radar Transmitters. Radar Modulator-Block diagram, **Radar receivers**- noise figure, low noise front ends, Mixers, Radar	3	
END SEMESTER EXAM			

Note:- Analysis is not required in this course

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. Mark patterns are as per the syllabus 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
EC405	OPTICAL COMMUNICATION	3-0-0-3	2015

Prerequisite:
EC203 Solid State Devices. EC205 Electronic Circuits

Course objectives:

1. To understand the concept of light transmission through optical fibers.
2. To understand the concept of optical sources and detectors.
3. To understand the performance comparison of various optical transmission schemes.
4. To understand the working of optical components.
5. To understand the principle of operation of optical amplifiers.
6. To understand WDM technique.

Syllabus: Generallight 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:
At the end of the course, students will be able to:-

1. Know the working of optical source and detectors.
2. Compare the performance of various optical modulation schemes.
3. Apply the knowledge of optical amplifiers in the design of optical link.
4. Analyse the performance of optical amplifiers.
5. Know the concept of WDM
6. Describe the principle of FSO and LiFi.

Text Books:

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

References:

1. Joseph C. Palais – Fiber Optic Communications, 5/e Pearson, 2013.
2. John M Senior- Optical communications, **3/e**, Pearson, 2009.
3. Hebbar,Optical fiber communication, Elsavier,2014
4. Chakrabarthi,Optical Fiber Communicatio, McGraw Hill, 2015.
5. Mynbaev ,Scheiner, Fiberoptic Communication Technology,Pearson, 2001.
6. Bandyopadhay , Optical communicatoion and networks.PHI, 2014.
7. Khare, Fiber optics and optoelectronics, Oxford university press, 2013.
8. Subir kumar sarkar, Optical fibers and fiberoptic communication system,S Chand, 2012.
9. Keiser - Optical Communication Essentials (SIE), 1e McGraw Hill EducationNew Delhi, 2008
10. Arumugam, Optical communication and sensors,Anuradha publications, 2009.
11. T. L. Singal, Optical Fiber Communications Principles and Applications, Cambridge University Press, 2001

Course Plan

Module	Course content (42hrs)	Hours	Sem. Exam Marks

I	Generallight 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 Mode 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, modulators using LEDs and LDs. coupling with fibres, noise in Laser diodes, Amplified Spontaneous Emission noise, effects of Laser diode noise in fibre communications	7	
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**
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

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. Mark patterns are as per the syllabus with maximum 50 % for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 407	COMPUTER COMMUNICATION	3-0-0-3	2015

Prerequisite:NIL

Course objectives:

1. To understand the basic concepts of computer network and how data communication occurs through a computer network.
2. To introduce students to the fundamental techniques used in implementing secure network communications, and give them an understanding of common threats and attacks.

Syllabus: Introduction to computer communication, Transmission modes, Networks, Interconnection of Networks: Internetwork, Network models:OSI model, TCP/IP protocol suite. Switching, Physical Layer, Data Link Layer, Media access control, Ethernet(802.3), Logical link control, Wireless LAN(802.11), Virtual LAN, Networking devices, Logical addressing: IPV4, IPV6, Address mapping, Subnetting, CIDR, ICMP, IGMP, DHCP, Routing, Transport Layer, Congestion Control & Quality of Service, Application Layer, Introduction to system and network security, security attacks, security services and mechanisms. Network Security, System Security, Firewalls, Intrusion detection, IDS, Malicious software and Internet Security, Viruses and related threats, virus countermeasures, denial of service attacks, Hacking.

Expected outcome:

On completion of this course, the students will have a thorough understanding of:

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

Text Books:

1. Data Communications and Networking, 4/e, Behrouz A Forouzan, Tata McGraw-Hill, 2006.
2. Cryptography & Network Security , Behrouz A. Forouzan, IV Edition,Tata McGraw-Hill, 2008

References:

1. Larry Peterson and Bruce S Davie: Computer Network- A System Approach, 4/e, Elsevier India, 2011.
2. J F Kurose, Computer Network A Topdown Approach Featuring the Internet,3/e,Pearson Education, 2010
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	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 (Open Loop, Closed Loop & Congestion control in TCP), 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	

	Defense 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

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. Mark patterns are as per the syllabus with maximum 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	2015

Prerequisite:
MA 101 Calculus, MA102 Differential Equations, MA201 Linear Algebra & Complex Analysis, MA204 Probability, Random Processes and Numerical Methods,EC202 Signals & Systems

Course objectives:

- To introduce the elements of control system and their modeling the system
- 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:
Students should be able to

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

Text Books

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

References

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

Course Plan

Module	Course content (42 hrs)	Hours	Marks
I	Basic Components of a Control System, Applications , Open-Loop Control Systems and Closed-Loop Control Systems	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 modeling of control systems - Mechanical and electromechanical 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 and its evaluation.	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	15
	Relative stability: gain margin and phase margin. Stability analysis with Bode plot.	2	
	Design of Control Systems: PD and PI controllers	2	
	Design with phase-lead and phase-lag controllers (frequency domain approach).	2	
SECOND INTERNAL EXAM			
V	State variable analysis: state transition matrix and equation,State space representation of Continuous Time systems	2	20
	Transfer function from State Variable Representation, Solutions of the state equations	2	
	Concepts of Controllability and Observability Kalman 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

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. Mark patterns are as per 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
EC461	MICROWAVE SOLID STATE DEVICES	3-0-0-3	2015

Prerequisite:
EC403 Microwave & Radar Engineering

Course objectives:

- To study microwave semiconductor devices & applications.
- To study microwave sources and amplifiers.
- To analyse microwave networks
- To introduce microwave integrated circuits

Syllabus:

Limitation of conventional solid state devices at Microwave, Gunn – effect diodes, Microwave generation and amplification, IMPATT and TRAPATT diodes, Bipolar transistors, MESFET, Microwave amplifiers and oscillators, Microwave Network Analysis, Signal flow graphs, Microwave filters, Filter design by image parameter method, Filter transformation and implementation, Introduction to MIC's, Distributed and lumped elements of integrated circuits, Diode control devices

Expected outcome:

Students should be able to understand with active & passive microwave devices & components used in microwave communication systems and analyse microwave networks.

Text Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, 3/e, Pearson Education, 2003.
2. Robert E. Collin, Foundation of Microwave Engineering, 2/e, Wiley India, 2012.
3. David M. Pozar , Microwave Engineering,4/e, Wiley India, 2012

References:

1. Bharathi Bhat and Shiban K. Koul: Stripline-like Transmission Lines for MIC, New Age International (P) Ltd, 1989.
2. I.Kneppo, J.Fabian,etc., Microwave Integrated Circuits,BSP,India,2006.
3. Leo Maloratsky, Passive RF and Microwave Integrated Circuits, Elsevier, 2006.

Course Plan

Module	Course content	Hours	Sem. Exam Marks
I	Introduction, Characteristic, features of microwaves, Limitation of conventional solid state devices at Microwave.	1	15
	Gunn – effect diodes – Gunn effect, Ridley – Watkins-Hilsum theory, Modes of operation, Limited space – Charge accumulation (LSA) mode of Gunn diode.	2	
	Microwave generation and amplification. Structure, Operation, Power output and efficiency of IMPATT and TRAPATT diodes	2	
II	Bipolar transistors – biasing, FET – biasing, MESFET – Structure, Operation.	4	15
	Microwave amplifiers and oscillators – Amplifiers – Gain and stability, Single stage transistor amplifier design.	4	
	Oscillator design – One port negative resistance oscillators.	2	

FIRST INTERNAL EXAM			
III	Microwave Network Analysis – Equivalent voltages and currents, Impedance and Admittance matrices, Scattering matrix, The transmission matrix.	3	**15**
	Signal flow graphs. Impedance matching and tuning – Matching with lumped elements, Single stub tuning, Double stub tuning. Quarter wave transformer, Theory of small reflections.	4	
IV	Microwave filters – Periodic structures – Analysis of infinite periodic structures and terminated periodic structures, Filter design by image parameter method – Constant k, m-derived and composite. Filter design by insertion loss method. Filter transformation and implementation.	7	**15**
SECOND INTERNAL EXAM			
V	Introduction to MIC's:-Technology of hybrid MICs, monolithis MICs. Comparison of both MICs.	4	**20**
	Planar transmission lines such as stripline, microstrip line, slotline etc	**3**	
VI	Distributed and lumped elements of integrated circuits – capacitors, inductors, resistors, terminations, attenuators, resonators and discontinuities.	**5**	**20**
	Diode control devices – switches, attenuators, limiters. Diode phase shifter. Circulators and isolators.	**2**	
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus with maximum 70 % for theory and 30% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 361	**Speech And Audio Signal Processing**	3-0-0-3	**2015**

Prerequisite:EC301 Digital Signal Processing

Course objectives:

1. Familiarize the basic mechanism of speech production and learn the basic concepts of methods for speech analysis and parametric representation of speech
2. Get a overall picture about various applications of speech processing
3. Study of Perception of Sound, Psycho-acoustic analysis, Spatial Audio Perception and rendering,
4. Study of Audio Compression Schemes

Syllabus: Speech production, Time domain analysis, Frequency domain analysis, Cepstral analysis, LPC analysis, Speech coding, Speech recognition, Speech enhancement, Text to speech conversion. Signal Processing Models of Audio Perception, Psycho-acoustic analysis, Spatial Audio Perception and rendering, Audio compression methods, Parametric Coding of Multi-channel audio, Transform coding of digital audio, audio quality analysis.

Expected outcome:

1. Understand basic concepts of speech production, speech analysis, speech coding and parametric representation of speech and apply it in practical applications
2. Ability to develop systems for various applications of speech processing
3. Learn Signal processing models of sound perception and application of perception models in audio signal processing.
4. Acquire ability to implement audio compression algorithms and standards.

Text Books:

1. Douglas O'Shaughnessy, Speech Communications: Human & Machine, IEEE Press, Hardcover 2nd edition, 1999; ISBN: 0780334493.
2. Nelson Morgan and Ben Gold, Speech and Audio Signal Processing: Processing and Perception Speech and Music, July 1999, John Wiley & Sons, ISBN: 0471351547

References:

1. Rabiner and Schafer, Digital Processing of Speech Signals, Prentice Hall, 1978.
2. Rabiner and Juang, Fundamentals of Speech Recognition, Prentice Hall, 1994.
3. Thomas F. Quatieri, Discrete-Time Speech Signal Processing: Principles and Practice, Prentice Hall; ISBN: 013242942X; 1st edition
4. Donald G. Childers, Speech Processing and Synthesis Toolboxes, John Wiley & Sons, September 1999; ISBN: 0471349593
5. Audio Signal Processing and Coding, by Andreas Spanias, Ted Painter and Venkittaram Atti, Wiley-Inter Science publication, 2006
6. Zhouyu Fu; Guojun Lu; Kai Ming Ting; Dengsheng Zhang; , "A Survey of Audio-Based Music Classification and Annotation," Multimedia, IEEE Transactions on, vol.13, no.2, pp.303-319, April 2011doi: 10.1109/TMM.2010.2098858
7. Scaringella, N.; Zoia, G.; Mlynek, D.; "Automatic genre classification of music content: a survey," Signal Processing Magazine, IEEE, vol.23, no.2, pp.133-141, March 2006 doi:10.1109/MSP.2006.1598089
8. Loizou, P. (1998). "Mimicking the human ear," IEEE Signal Processing Magazine, 15(5), 101-130.

Course Plan

Module	Course content (42hrs)	Hours	Sem. Exam Marks
I	Speech Production: Acoustic theory of speech production. Speech Analysis: Short-Time Speech Analysis, Time domain analysis (Short time energy, short time zero crossing Rate, ACF). Parametric representation of speech: AR Model, ARMA model. LPC Analysis (LPC model, Auto correlation method).	5	**15**
II	Frequency domain analysis (Filter Banks, STFT, Spectrogram), Cepstral Analysis**,** MFCC. Fundamentals of Speech recognition and Text-to-speech conversion	8	
FIRST INTERNAL EXAM			
III	Speech coding, speech enhancement, Speaker Verification, Language Identification	7	**15**
IV	Signal Processing Models of Audio Perception: Basic anatomy of hearing System. Auditory Filter Banks, Psycho-acoustic analysis: Critical Band Structure, Absolute Threshold of Hearing, Simultaneous Masking, Temporal Masking, Quantization Noise Shaping, MPEG psycho-acoustic model.	6	**15**
V	Audio compression methods: Sampling rate and bandwidth requirement for digital audio, Redundancy removal and perceptual irrelevancy removal, Transform coding of digital audio: MPEG2-AAC coding standard, MDCT and its properties, Pre-echo and pre-echo suppression, psycho-acoustic modelling, adaptive quantization and bit allocation methods, Loss less coding methods.	8	**20**
VI	Spatial Audio Perception and rendering: The physical and psycho-acoustical basis of sound localization and space perception. Spatial audio standards. Parametric Coding of Multi-channel audio: Mid- Side Stereo, Intensity Stereo, Binaural Cue Coding. Audio quality analysis: Objective analysis methods- PEAQ, Subjective analysis methods - MOS score, MUSHRA score	8	**20**
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus with maximum 50 % for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC465	MEMS	3-0-0 -3	2015

Prerequisite:NIL

Course objectives:

- To understand the operation of major classes of MEMS devices/systems
- To grasp the fundamentals of standard micro fabrication techniques and processes
- To understand the unique demands , environments and applications of MEMS devices
- To create interest for further study in this area

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 should be able to:

1. Understand the working principles of micro sensors and actuators
2. Understand the application of scaling laws in the design of micro systems
3. Understand the typical materials used for fabrication of micro systems
4. Understand the principles of standard micro fabrication techniques
5. Appreciate the challenges in the design and fabrication of Micro systems

Text Books:

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

References:

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

Course Plan

Module	Course content (42hrs)	Hours	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

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. Mark patterns are as per the syllabus with maximum 70 % for theory and 30% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC467	PATTERN RECOGNITION	3-0-0-3	2015

Prerequisite:
MA201 Linear Algebra & Complex Analysis, MA204 Probability, Random Processes and Numerical Methods,

Course objectives:

- To study the fundamental algorithms for pattern recognition
- To instigate the various classification and clustering techniques

Syllabus: Review of Probability Theory and Probability distributions, Introduction to Pattern Recognition and its applications, Bayesian decision theory, Bayesian estimation: Gaussian distribution, ML estimation, EM algorithm, Supervised and unsupervised learning, Feature selection, Linear Discriminant Functions, Non-parametric methods, Hidden Markov models for sequential data classification, Linear models for regression and classification, Clustering

Expected outcome:
At the end of the course, the student should have a clear understanding of:

1. the design and construction and a pattern recognition system
2. the major approaches in statistical and syntactic pattern recognition.
3. the theoretical issues involved in pattern recognition system design such as the curse of dimensionality.
4. implementing pattern recognition techniques

Text Books

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification and scene analysis, John Wiley
2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer

References

1. Robert J.Schalkoff, Pattern Recognition : Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.
2. Tom Mitchell, Machine Learning, McGraw-Hill
3. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.
5. S.Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Edition, Academic Press, 2009.
6. M. Narasimha Murty, SusheelaDevi,Pattern Recognition:An Introduction,Universities Press, 2011

Course Plan

Module	Course content (42 hrs)	Hours	Marks
I	**Introduction:** Basics of pattern recognition system, various applications, Machine Perception, two main paradigms for pattern recognition problems - statistical and syntactic pattern recognition	3	15%

	Pattern recognition system, Design of Pattern recognition system, Object/process of a Pattern recognition system, Pattern recognition Life Cycle, Cost, Decision concepts and boundaries, Learning & Adaptation.	5	
	Statistical Pattern Recognition: Review of probability theory, Gaussian distribution, Bayes decision theory and Classifiers, Optimal solutions for minimum error and minimum risk criteria Normal density and discriminant functions, Decision surfaces	2	
II	**Parameter estimation methods:** Maximum-Likelihood estimation, Expectation-maximization method, Bayesian parameter estimation	3	15%
	Concept of feature extraction and dimensionality, Curse of dimensionality, Dimension reduction methods - Fisher discriminant analysis, Principal component analysis Hidden Markov Models (HMM) basic concepts , Gaussian	4	
FIRST INTERNAL EXAM			
III	**Non-Parameter methods:** Non-parametric techniques for density estimation - Parzen-window method, K-Nearest Neighbour method.	4	15%
	Non-metric methods for pattern classification: Non-numeric data or nominal data Decision trees: Concept of construction, splitting of nodes, choosing of attributes, overfitting, pruning	3	
IV	**Linear Discriminant based algorithm**: Perceptron, Support Vector Machines	6	15%
SECOND INTERNAL EXAM			
V	**Non linear classifiers:** Multilayer perceptrons, Back Propagation algorithm, Artificial Neural networks	4	20%
	Classifier Ensembles: Bagging, Boosting / AdaBoost	2	
VI	**Unsupervised learning:** Clustering - Criterion functions for clustering, Algorithms for clustering: K-means and Hierarchical methods, Cluster validation	6	20%
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus with maximum 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	2015

Prerequisite:
PH 100 Engineering Physics

Course objectives:

1. Explain the physics of absorption, recombination and photoemission from semiconductors.
2. Analyse different types of photo detectors based on their performance parameters.
3. Discuss different LED structures with material properties and reliability aspects.
4. Explain optical modulators and optical components
5. Illustrate different types of lasers with distinct properties.

Syllabus:

Expected outcome:
After completion of the course the student will be able to

- Explain the property of absorption, recombination and photoemission in semiconductors.
- Illustrate different types of lasers with distinct properties
- Explain different LED structures with material properties
- Analyse different types of photo detectors
- 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. Fundamentals of Photonics : B E Saleh and M C Teich, Wiley-Interscience; 1991
2. Bandyopadhay ,Optical communicatoion and networks.PHI, 2014.
3. Mynbaev ,Scheiner,Fiberoptic Communication Technology, Pearson, 2001.
4. Piprek, Semiconductor Optoelectronic Devices, Elsevier, 2008.
5. Alastair Buckley, Organic Light-Emitting Diodes,Woodhead , 2013.
6. Xun Li, Optoelectronic Devices Design Modelling and Simulaton, Cambridge University Press, 2009

Course Plan

Module	Course content (42hrs)	Hours	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	
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 onwavelength 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**
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

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. Mark patterns are as per the syllabus with maximum 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	2015

Prerequisite:
EC403 Microwave & Radar Engineering, EC405 Optical Communication

Course objectives:
To provide experience on design, testing, and analysis of few electronic devices and circuits used for microwave and optical communication engineering.

List of Experiments

Microwave Experiments: (Six 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: (Six 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
EC 402	NANOELECTRONICS	3-0-0 -3	2015

Prerequisite:
PH 100 Engineering Physics ,EC203 Solid State Devices ,EC304 VLSI

Course objectives:
•To learn and understand basic and advance 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 should 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. Poole, Introduction to Nanotechnology, John Wiley 2006.
3. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.
4. K. Goser, P. Glosekotter, J. Dienstuhl, Nanoelectronics and nanosystems, Springer 2004.
5. Supriyo Dutta, Quantum Transport- Atom to transistor, Cambridge, 2013.
6. Murty, Shankar, Text book of Nanoscience and Nanotechnology, Universities Press,2012.
7. Pradeep, Nano the Essentials, McGrawHill, 2007.
8. Ramsden, Nanotechnology, Elsevier, 2011.
9. Vladimir Mitin Michael A. Stroscio, Introduction to Nanoelectronics, Cambridge University Press, 2010

Course Plan

Module	Course content (42hrs)	Hours	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, Schrodinger's Equation, wave function	2	
	Low dimensional structures Quantum wells , wires and dots, Density of	1	

	states and dimensionality		
	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	
	Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods.	2	
	Fabrication of nanoparticle- grinding with iron balls, laser ablation, reduction methods, sol gel, self assembly, precipitation of quantum dots.	2	**15**
FIRST INTERNAL EXAM			
III	Introduction to characterization of nanostructures, tools used for of nano materials characterization, microscope-optical, electron, and electron microscope.	2	
	Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope	2	**15**
	X-Ray Diffraction analysis, PL & UV Spectroscopy, Particle size analyser.	2	
IV	MOSFET structures, Heterojunctions	2	
	Quantum wells, modulation doped quantum wells, multiple quantum wells	2	**15**
	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	
	Quantum transport in nanostructures, Coulomb blockade	2	**20**
	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	
	Resonant tunnel effect, RTD, RTT, Hot electron transistors	2	
	Coulomb blockade effect and single electron transistor, CNT transistors	2	
	Heterostructure semiconductor laser	1	**20**
	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

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. Mark patterns are as per the syllabus with maximum 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	2015

Prerequisite:

EC208 Analog Communication Engineering, EC302 Digital Communication, EC403 Microwave & Radar Engineering

Course objectives:

To understand 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 student should able to understand the evolution, basics and technology of advanced communication system

Text Books:

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

References:

1. Singal, Wireless communications, Mc Graw Hill, 2010.
2. Nathan, Wirelesscommunications,PHI, 2012.
3. Mishra, Wireless communications and Networks, McGraw Hill, 2/e, 2013.
4. W.C.Y.Lee, Mobile Cellular Telecommunication, McGraw Hill, 2010.
5. Jochen Schiller, Mobile Communications, Pearson, 2008.
6. Dalal, Wireless communication, Oxford Universities Press, 2014.
7. Stallings, Wireless communications and Networks, Pearson, 2009.
8. Schwartz Mobile, Wireless communications, Cambridge Universities Press, 2013.
9. Tomasi, Advanced Electronic Communication Systems, 6/e, Pearson, 2015.

Course Plan

Module	Course content (42hrs)	Hours	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),	4	

	Compression of Moving Pictures (MPEG). Basic blocks of MPEG2 and MPE4,Digital Video Broadcasting (DVB)		
	Modulation: QAM (DVB-S, DVB-C), OFDM for Terrestrial Digital TV (DVB –T). Reception of Digital TV Signals (Cable, Satellite and terrestrial). Digital TV over IP, Digital terrestrial TV for mobile.	4	**15**
	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	
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	5	

	(DECT) , Enhanced Data Rate for Global Evolution (EDGE), Ultra wideband systems (UWB), Push To Talk (PTT) technology, Mobile IP		
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus 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
EC462	MIXED SIGNAL CIRCUIT DESIGN	3-0-0 -3	2015

Prerequisite:
EC204 Analog Integrated Circuit, EC 304 VLSI, EC308 Embedded Systems

Course objectives:

• To get the knowledge about various analog and digital CMOS circuits and to get the skill of analysis and design of analog and digital CMOS circuits.

Syllabus:

CMOS Amplifiers**:** CS,CG,CD stages, Cascoded stages,Folded cascode Amplifier,MOS Current Mirror, MOSFET cascode current mirror, Differential Amplifiers,MOS telescopic cascode amplifier,CMOS OP AMPS, Design of classical Two Stage OP AMP ,Comparator,Band gap References, Phase Locked Loop,Dynamic analog circuits, Data Converters, Switched Capacitor Circuits, Data Converters- Specifications ,DAC ,ADC Architecture

Expected outcome:

At the end of the course, students will be able to Design and Analysis of various analog and digital CMOS circuits.

Text Books:

1. Razavi B., Fundamentals of Microelectronics, Wiley student Edition2014.
2. Phillip E. Allen, Douglas R. Holbery, CMOS Analog Circuit Design, Oxford, 2004.

References:

1. Razavi B., Design of Analog CMOS Integrated Circuits, Mc Graw Hill, 2001.
2. Baker, Li, Boyce, CMOS: Circuits Design, Layout and Simulation, Prentice Hall India, 2000

Course Plan

Module	Course content (42hrs)	Hours	Sem. Exam Marks
I	**CMOS Amplifiers-** Common Source with diode connected loads and current source load, CS stage with source degeneration, CG stage and Source Follower (Only Voltage Gain and Output impedance of circuits)	4	
	Cascoded stages - Cascoded amplifier, Cascoded amplifier with cascoded loads , Folded cascode Amplifier	4	**15**
II	**MOS Current Mirror**- Basic circuit ,PMOS and NMOS current mirrors Current mirror copying circuits, MOSFET cascode current mirror circuits	3	
	Differential Amplifiers-Differential Amplifier with MOS current source Load, with cascaded load and with current mirror load, MOS telescopic cascode amplifier. (Only Voltage Gain and Output impedance of circuits)	4	**15**
FIRST INTERNAL EXAM			
III	**CMOS OP AMPS-** Two Stage Operational Amplifiers - Frequency compensation of OPAMPS - miller compensation**,** Design of classical Two Stage OP AMP	3	**15**

	Comparator- Characterization of a comparator-static and dynamic ,A Two stage open loop comparator (analysis not required)	3	
IV	**Band gap References-** Supply Independent Biasing, Temperature independent references –band gap reference	5	**15**
	Phase Locked Loop – Simple PLL ,Basic PLL Topology ,Charge Pump PLL, Basic Charge Pump PLL	3	
V	**Dynamic analog circuits** – charge injection and capacitive feed through in MOS switch, Reduction technique	3	**20**
	Switched Capacitor Circuits- sample and hold circuits ,Switched Capacitor Integrator, Ladder filters	3	
VI	**Data Converters-** DAC Specifications-DNL, INL, latency, SNR, Dynamic Range ADC Specifications-Quantization error, Aliasing, SNR, Aperture error	4	**20**
	DAC Architecture – Resistor String, Charge Scaling and Pipeline types. **ADC Architecture-** Flash and Pipe line types	3	
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus 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
EC464	LOW POWER VLSI	3-0-0 -3	2015

Prerequisite:
EC204 Analog Integrated Circuit, EC 304 VLSI, EC308 Embedded Systems

Course objectives:

- To identify the power dissipation mechanisms in various MOS logic styles
- To Familiarize with the suitable techniques to reduce power dissipation

Syllabus:
Physics of Power dissipation in MOSFET devices, Sources of power dissipation in CMOS, Circuit techniques for leakage power reduction, Design and test of low voltage CMOS, Non clocked circuit design style, Adiabatic switching.

Expected outcome:

The student should able to:

1. Identify the sources of power dissipation in digital IC systems. Understand the impact of power on system performance and reliability
2. Understand leakage sources and reduction techniques
3. Recognise advanced issues in VLSI systems, specific to the deep-submicron silicon technologies
4. Classify the mechanisms of power dissipation in CMOS integrated circuits

Text Books:

1. Kaushik Roy, Sharat C Prasad, Low power CMOS VLSI circuit design, Wiley India, 2000
2. Gray Yeap, Practical low power digital VLSI design, Springer, 1998

References:

1. Kiat Seng Yeo, Kaushik Roy, Low voltage, low power VLSI sub systems, Tata McGraw Hill, 2004
2. Anatha P Chandrakasan, Robert W Brodersen, Low power digital CMOS Design, Kluwer Academic,1995
3. Christian Piguet, Low power CMOS circuits, Taylor & Francis,2006
4. Abdellatif Bellaouar, Mohamed I Elmasry, Low power digital VLSI design, Kluwer Academic,1995

Course Plan

Module	Course content (42 hrs)	Hours	Sem. Exam Marks
I	**Physics of Power dissipation in MOSFET devices** MIS structure, Need for low power circuit design	2	15
	Threshold voltage, body effects,	1	
	Short channel effects-surface scattering, punch through, velocity saturation, impact ionization	2	
	Hot electron effects, drain induced barrier lowering, narrow width effects	2	
II	**Sources of power dissipation in CMOS**-Switching power dissipation,	2	15
	Short circuit power dissipation, glitching power dissipation	2	

	Leakage power dissipation , Transistor leakage mechanisms of deep submicron transistors	3	
FIRST INTERNAL EXAM			
III	**Circuit techniques for leakage power reduction** – standby leakage control using transistor stacks	2	**15**
	multiple V_{th} techniques, Dynamic V_{th} techniques	2	
	supply voltage scaling techniques, Deep submicron devices design issues	2	
	Minimizing short channel effect	2	
IV	**Design and test of low voltage CMOS** – Circuit design style- clocked design style- Basic concept	2	**15**
	Domino logic (domino NAND gate)	1	
	Differential Current Switch Logic.	2	
SECOND INTERNAL EXAM			
V	**Non clocked circuit design style**-fully complementary logic	2	**20**
	NMOS and pseudo –NMOS logic	2	
	differential cascade voltage switch logic(DCVS),	2	
	pass transistor logic	2	
VI	**Adiabatic switching** – Adiabatic charging, adiabatic amplification	2	**20**
	One stage and two stage adiabatic buffer	2	
	fully adiabatic system	1	
	Adiabatic logic gates, pulsed power supplies	2	
END SEMESTER EXAM			

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. Mark patterns are as per the syllabus 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
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 student should 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. Anti-Hacker Tool Kit, Mike Shema, Mc Graw Hill
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives,Nina Godbole and Sunit Belpure, Wiley

References:

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

Course Plan

Module	Course content (42hrs)	Hours	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	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	**15**
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**

Question Paper

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC468	SECURE COMMUNICATION	3-0-0 -3	2015

Prerequisite:NIL

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

1. Exposed to the different approaches that handle security and the algorithms in use for maintaining data integrity and authenticity.
2. Enabled student to appreciate the practical aspects of security features design and their implementation

Text Books:

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

Course Plan

Module	Course content (42hrs)	Hours	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	
	Polynomial arithmetic: Finite fields of the form GF (2n).	4	15
	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	
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			

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC472	INTEGRATED OPTICS & PHOTONIC SYSTEMS	3-0-0 -3	2015

Prerequisite:
EC303 Applied Electromagnetic Theory, EC405 Optical Communication

Course objectives:

- This course discusses basic goals, principles and techniques of integrated optical devices and photonic systems, and explains how the various optoelectronic devices of an integrated optical system operate and how they are integrated into a system.
- The course includes study about various components like optical waveguides, optical couplers, design tools, fabrication techniques, and the applications of optical integrated circuits. Some of the current state-of-the-art devices and systems will also be investigated.

Syllabus: Review of Electromagnetics: Maxwell's equations, optical waveguides and devices, Waveguide Fabrication Techniques, Electro-Optic Waveguides, Polymer Waveguide Device, Losses in optical wave guide, Wave guide input and output couplers, coupled mode theory, Light Propagation in Waveguides, FFT-BPM, FD-BPM, Electro-Optic Modulators: Types, Integrated semiconductor laser, integrated semiconductor optical amplifier, integrated optical detectors, applications of optical integrated circuits, devices and systems for telecommunications, microwave carrier generation by optical techniques, photonic crystals, nanophotonic device.

Expected outcome:
The student will have an in depth knowledge of

- devices that are basic components of integrated optics and photonic systems including Optical wave guides, optical couplers, Lasers, Detectors and modulators
- light propagation in waveguides
- The fabrication process of Optical Integrated devices
- Applications of Optical Integrated devices
- Nano photonic devices

Text Books:

1. Robert Hunsperger, Integrated optics :Theory and technology 6/e Springer, 2009
2. Lifante, Integrated Photonics: Fundamentals ,John Wiley 2003

References:

1. KeicoIizuka, Elements of photonics, John Wiley, 2002 .
2. Pappannareddy, Introduction to light wave systems,Artech House,1995
3. H. Nishihara, M. Haruna, and T. Suhara, Optical Integrated Circuits, McGraw-Hill Professional, 1989.

RELATED LINKS
Website of IEEE photonics society: www.ieee.org/photonics.

Course Plan

Module	Course content (42hrs)	Hours	Sem. Exam Marks
I	Review of Electromagnetics , Maxwell's equations - Wave equation	3	15
	Analysis of optical waveguides and devices- Planar waveguides, chanel waveguides, graded index waveguides.	4	

II	Waveguide Fabrication Techniques -substrate materials for optical IC , Epitaxially Grown Waveguides- Electro-Optic Waveguides,	4	
	Types of Polymers-Polymer Waveguide Devices, Optical Fiber Waveguide Devices	3	**15**
FIRST INTERNAL EXAM			
III	Losses in optical wave guide, measurement of losses. Wave guide input and output couplers, types of couplers, coupling between wave guides,	4	**15**
	Optical Fiber Couplers and Splitters, coupled mode theory	3	
IV	Light Propagation in Waveguides: The Beam Propagation Method-Fresnel Equation - Fast Fourier Transform Method (FFT-BPM) - Solution based on discrete fourier transform - Method Based on Finite Differences (FD-BPM), Boundary Conditions	7	**15**
V	Electro-Optic Modulators - Basic Operating Characteristics- The Electro-Optic Effect,Mach-Zehnder Modulator, acousto optic modulator,	4	**20**
	Integrated semiconductor laser, integrated semiconductor optical amplifier, integrated optical detectors, structures.	3	
VI	Applications of Optical Integrated Circuits-Spectrum Analyser-Temperature and High Voltage Sensors,	3	**20**
	Devices and Systems for Telecommunications- Microwave Carrier Generation by Optical Techniques, - Photonic Crystals-Nanophotonic Device.	4	
END SEMESTER EXAM			

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