Appendix – VI

COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY

B.TECH DEGREE COURSE

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

Scheme of Examinations and Syllabus
(2015 Admission onwards)

B.TECH DEGREE COURSE IN ELECTRONICS & COMMUNICATION ENGINEERING

Scheme of Examinations (2015 admission onwards)

SEMESTER I [Stream B]

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
GE 15-1101B	Computer Programming	3	1	0	3	40	60	100
AS 15-1102B	Engineering Chemistry	3	1	0	3	40	60	100
GE 15-1103B	Engineering Graphics	2	1	3	5	40	60	100
GE 15-1104B	Basic Electrical Engineering	3	0	0	3	40	60	100
GE 15-1105B	Basic Electronics Engineering	3	0	0	3	40	60	100
AS 15-1106B	Environmental Studies	3	1	0	3	40	60	100
GE 15-11L1B	Electrical Engineering Workshop	0	0	3	1	25	25	50
GE 15-11L2B	Computer Programming Laboratory	0	0	3	1	25	25	50
	TOTAL	**17**	**4**	**9**	**22**			

CA – Continuous Assessment**, ESE –** End Semester Examination

SEMESTER II [Stream B]

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
AS 15-1201B	Calculus	3	1	0	3	40	60	100
AS 15-1202B	Engineering Physics	3	1	0	3	40	60	100
GE 15-1203B	Engineering Mechanics	4	1	0	4	40	60	100
GE 15-1204B	Basic Civil Engineering	3	0	0	3	40	60	100
GE 15-1205B	Basic Mechanical Engineering	3	0	0	3	40	60	100
HS 15-1206B	Technical Communication and Professional Ethics	2	1	0	2	40	60	100
GE 15-12L1B	Civil Engineering Workshop	0	0	3	1	25	25	50
GE 15-12L2B	Mechanical Engineering Workshop	0	0	3	1	25	25	50
HS 15-12L3B	Language Lab	0	0	1	1	25	25	50
HS 15-12L4B	NSS/Nature Conservation	0	0	1	1	50	-	50
	TOTAL	**18**	**4**	**8**	**22**			

Stream B: Computer Science & *Engg., Electronics and Communication Engg., Information Technology*

B.TECH DEGREE COURSE IN ELECTRONICS AND COMMUNICATION ENGINEERING

Scheme of Examinations (2015 admission onwrads) (Semesters 3 to 8)

SEMESTER III

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	ESE	
AS 15-1301	Linear Algebra & Transform Techniques	3	1	0	3	40	60	100
EC 15-1302	Discrete Computational structures	3	1	0	3	40	60	100
EC 15-1303	Network Theory	3	1	0	3	40	60	100
EC 15-1304	Digital Electronics	3	1	0	3	40	60	100
EC 15-1305	Solid State Electronics	3	1	0	3	40	60	100
EC 15-1306	Electronic Circuits I	3	1	0	3	40	60	100
EC 15-13L1	Basic Electronics Lab	0	0	3	2	25	25	50
EC 15-13L2	Digital Electronics Lab	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

SEMESTER IV

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	ESE	
AS 15-1401	Complex Variables and Partial Differential Equations	3	1	0	3	40	60	100
EC 15-1402	Microprocessor Architectures & Programming	3	1	0	3	40	60	100
EC 15-1403	Electronic Circuits II	3	1	0	3	40	60	100
EC 15-1404	Signals & Systems	3	1	0	3	40	60	100
EC 15-1405	Communication Engineering I	3	1	0	3	40	60	100
EC 15-1406	Digital System Design	3	1	0	3	40	60	100
EC 15-14L1	Digital Programming Lab	0	0	3	2	25	25	50
EC 15-14L2	Electronic Circuits Lab I	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

SEMESTER V

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	ESE	
AS 15-1501	Numerical and Statistical Methods	3	1	0	3	40	60	100
EC 15-1502	Electromagnetic Theory	3	1	0	3	40	60	100
EC 15-1503	Embedded Systems	3	1	0	3	40	60	100

EC 15-1504	Communication Engineering II	3	1	0	3	40	60	100
EC 15-1505	Analog & Integrated Circuits	3	1	0	3	40	60	100
EC 15-1506	Digital Signal Processing	3	1	0	3	40	60	100
EC 15-15L1	Mini Project	0	0	3	2	25	25	50
EC 15-15L2	Electronic Circuits Lab II	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

SEMESTER VI

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
EC 15-1601	Electronic Measurements & Instrumentation	3	1	0	3	40	60	100
EC 15-1602	Microwave Techniques & Devices	3	1	0	3	40	60	100
EC 15-1603	VLSI Design	3	1	0	3	40	60	100
EC 15-1604	Information Theory & Coding	3	1	0	3	40	60	100
EC 15-1605	Power Electronics	3	1	0	3	40	60	100
EC 15-1606*	Elective – I	3	1	0	3	40	60	100
EC 15-16L1	Digital Signal Processing Lab	0	0	3	2	25	25	50
EC 15-16L2	Communication Lab I	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

**Elective-I is to be selected from the list below*

SEMESTER VII

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
GE 15-1701	Principles of Management	3	1	0	3	40	60	100
EC 15-1702	Antennas & Propagation	3	1	0	3	40	60	100
EC 15-1703	Digital Image Processing	3	1	0	3	40	60	100
EC 15-1704	Control Systems Engineering	3	1	0	3	40	60	100
EC 15-1705*	Elective II	3	1	0	3	40	60	100
EC 15-17L1	Embedded Systems Lab	0	0	3	2	25	25	50
EC 15-17L2	Communication Lab II	0	0	3	2	25	25	50
GE 15-17L3	Entrepreneurship Development	0	0	2	1	50	-	50
EC 15-17L4	Project Phase I & Industrial Internship†	0	0	2	2	50	-	50
	TOTAL	**15**	**5**	**10**	**22**			

**Elective-II is to be selected from the list below*

†Industrial internship with a minimum duration of 2 weeks during May - June vacation before the commencement of 7th Semester classes is desirable

SEMESTER VIII

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
EC 15-1801	Electronic Product Design	3	1	0	3	40	60	100
EC 15-1802	Wireless Communication	3	1	0	3	40	60	100

EC 15-1803	Computer Communication & Networking	3	1	0	3	40	60	100
EC 15-1804*	Elective III	3	1	0	3	40	60	100
EC 15-18L1	Seminar			3	2	50	-	50
EC 15-18L2	Project Phase 2			11	6	200	-	200
EC 15-18L3	Comprehensive Viva Voce			0	2	-	50	50
	TOTAL	**12**	**4**	**14**	**22**			

**Elective-III is to be selected from the list below*

LIST OF ELECTIVES

Semester VI	Semester VII	Semester VIII
EC15-1606A: Advanced Digital System Design	EC15-1705A: Digital Integrated Circuit Design	EC15-1804A:ASIC Design
EC15-1606B:Computational Electromagnetics	EC15-1705B: EMI/EMC	EC15-1804B: Radar and Navigation
EC15-1606C: Adaptive Signal Processing	EC15-1705C: Neuro-Fuzzy Systems	EC15-1804C: Mechatronics
EC15-1606D: Object Oriented Programming	EC15-1705D: Computer Organisation and Architecture	EC15-1804D: Bio Informatics
EC15-1606E: Probability and Random Process	EC15-1705E: Optical Fiber Communication	EC15-1804E: Multimedia Communication Systems
EC15-1606F: Finite Element Methods	EC15-1706F: Nano Electronics	EC15-1804F: RF circuit Design

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II,III with subsections (a),(b) (10 marks each with options to answer either II or III) from Module I
Question nos. IV,V with subsections (a),(b (10 marks each with options to answer either IV or V) from Module II
Question nos. VI,VII with subsections (a),(b) (10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII,IX with subsections (a),(b) (10 marks each with options to answer either VIII or IX) from Module IV

LIST OF OPTIONAL SUBJECTS

Sl. No:	Subject	L	T	P	No: of Hours/Semester	CA Marks
1	Personality Enrichment	1	2		30	50
2	General Aptitude	1	2		30	50
3	Foreign Language	1	2		30	50
4	Advanced Computer Programming	1		2	30	50
5	Healthy Living	1		2	30	50
6	Theatre Arts	1		2	30	50
7	Imaging Devices	1		2	30	50
8	Disaster Management	1		2	30	50

One or more optional subjects may be offered in any semester outside regular teaching hours and the students may opt to study them if they wish. The course may be conducted by using experts from inside or outside the University on Self Supporting manner. The Fee may be fixed based on the expenses in a non-profit manner with the students of the department given a subsidised rate of fee and those from outside may also be allowed at a higher fee. The regular students may be issued the mark list with the optional subject included in current semester and the outsiders may be issued a certificate separately.

COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY

B.TECH DEGREE COURSE

IN

ELECTRONICS & COMMUNICATION ENGINEERING

Syllabus III– VIII Semesters
(2015 Admission onwards)

SEMESTER III

AS 15-1301 LINEAR ALGEBRA AND TRANSFORM TECHNIQUES

Course Objectives:

To acquire fundamental knowledge in linear algebra and transformation techniques and apply in Engineering disciplines

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To Solve linear system of equations and to determine Eigen values and vectors of a Matrix
2. To Understand the concept of vector space and sub space
3. To Determine Fourier series expansion of functions and transform.
4. To Solve linear differential equation and integral equation using Laplace transform.

Module I

Linear Algebra 1: Rank of a matrix, solution of linear system of equations- existence, uniqueness, general form - Eigen values and Eigen vectors - properties of Eigen values - Diagonalization of a matrix - Cayley Hamilton theorem (without proof) Verification-Finding inverse and power of a matrix using it - Quadratic form-orthogonal reduction of quadratic form to Canonical form.

Module II

Linear Algebra 2: Vector space-subspace-Linear dependence and independence-Spanning of a subspace- Basis and Dimension. Inner product- Inner product spaces - Orthogonal and Orthonormal basis –Gram- Schmidt Orthogonalization process. Linear Transformation.

Module III

Fourier Analysis: Periodic function, Fourier series, Functions of arbitrary period, Even and odd functions, Half Range Expansion, Harmonic analysis, Complex fourier Series, Fourier Integrals, Fourier Cosine and Sine Transform, Fourier Transform.

Module IV

Laplace Transforms: Gamma functions and Beta function-Definition and properties, Laplace transforms. Inverse Laplace Transform, Shifting theorem, Transform of Derivative and Integrals, Solution of differential equation and integral equation using Laplce transform, Convolution, Unit step function, Second Shifting theorem, Laplace transform of periodic function.

References:

1. Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
2. Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.
3. Hsiung,C.Y and Mao, G. Y. (1999). *Linear algebra*. World Scientific, New Jersey.
4. Hoffman, K. and Kunze, R. (1971). *Linear algebra*. Prentice Hall of India, New Delhi.
5. Venkataraman,M.K. (1999). *Linear algebra*. The National Publishing Co, Chennai.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

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EC 15-1302 DISCRETE COMPUTATIONAL STRUCTURES

Course Objectives:

To enable the student to apply the theoretical knowledge gained on discrete computation to engineering / research problems.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the concepts of discrete maths
2. To learn graph theory and group theory and its representation
3. To apply the linear algebra concepts as applicable to engineering concepts

Module I

Discrete Mathematics: Binary relations, Construction Techniques; Equivalence, order and inductive proof; Analysis Techniques: Elementary logic, Algebraic Structures and Techniques.

Module II

Graph Theory:-Finite and infinite graphs, paths and circuits. Trees and fundamental circuits, Cut-sets and Cut vertices Planar and Dual Graphs, Matrix representation of graphs, Applications.

Module III

Group Theory: Elements of group theory, representation theory, Representation of finite groups, symmetric groups, rotation groups.

Module IV

Application of linear algebra - Linear Algebra in Parallel Distributed Processing: vectors &its application to represent One Unit in PDP system; Matrices and linear systems; Matrix Multiplication and Multilayer Systems; Transposes and outer product; Outer products, Eigenvectors and Learning; Matrix inverses, change of Basis, Nonlinear Systems

References::

1. K N Srinivasa Rao, *Linear algebra and group theory for physicists*, John Wiley,(1996) (Module III)
2. Narsingh Deo, *Graph theory with applications to Engineering and computer science*, PHI (1994) (Module II)
3. James LHein ,*Discrete mathematics* , Jones and Bartlett Publishers (1996)(Module I)
4. David E Rumelhart, James L. McClelland, *Parallel Distributed Processing*(Module IV)
5. James LHein ,*Discrete structures, Logic and computability* , Jones and Bartlett Publishers 3/e, (2010)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-1303 NETWORK THEORY

Course Objectives:

T o be able to gain an overall idea of network characterisation, analysis and synthesis.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be

1. To introduce the concepts of circuits and networks
2. To familiarize the theorems and techniques associated with analysis of networks
3. To use Laplace transforms to find out the steady state response and frequency response of linear circuits and system.
4. To perform network characterisation using network parameters
5. To classify and design different filters
6. To synthesize different passive networks

Module I

Circuit concepts–Circuit elements and networks, classifications; Energy sources- Dependent, independent, ideal and practical sources; Standard signals and Waveforms – periodic and non periodic signals, alternating currents and voltages, Step function, Ramp function, Impulse function; complex impedance; Methods of Analysing Circuits – Node analysis, Mesh analysis; Source Transformations; Circuit Theorems- Superposition, Thevenin's, Norton's, Reciprocity, Maximum Power Transfer; Resonance – Series, Parallel, Q, Bandwidth.

Module II

Transients - DC and sinusoidal response of RL, RC and RLC circuits, Initial and final conditions, Rise and decay of current, Time constant; Laplace Transforms – Laplace transform of important Network functions; Application of Laplace Transforms in circuit analysis – circuit elements in S domain, Transient analysis of RL, RC, and RLC networks with impulse, step, exponential, pulse and sinusoidal inputs, Transfer function and Impulse function in circuit analysis; S domain analysis - complex frequency, transform impedance, Significance of poles and zeros, Restriction of poles and zeros in driving point and transfer functions, Ruth-Hurwitz criteria for stability of Network functions.

Module III

Characterization of two port networks using different parameters – Z, Y, Hybrid and Transmission parameters;Interconnections of two port Networks – Cascade, Series and Parallel, T and π representation of two port Networks; Passive filters – Filter fundamentals, Classification of Filters, Characteristic impedance, Transfer function, frequency response; Design of Constant K - Low Pass, High Pass, Band Pass & Band Reject Filters - T and π; Design of m derived Low Pass and High Pass filters - T and π ; Attenuators – T and π; Equalizers – Series and shunt.

Module IV

Realizability and Synthesis of passive networks – causality, stability, Hurwitz polynomial, Positive real functions,driving point immitance; Basic Philosophy of synthesis- removal of a pole at infinity, removal of a pole at origin, removal of conjugate poles, removal of a constant, Impedance and admittance functions, Foster's method, Cauer method.

References:

1. A. Sudhakar and Shyam Mohan. S. Palli, *Circuits and Networks: Analysis and Synthesis*, Tata McGraw Hill, 4/e,(2010)
2. W H Hayt, J E Kemmerly & S M Durbin, *Engineering Circuit Analysis*, Tata McGraw-Hill, 7/e, (2010).
3. D. Roy Choudhury, *Networks and systems*, New Age International,2/e, (2006)
4. Smarajit Ghosh, *Network Theory: Analysis and Synthesis*, PHI publications, 6/e, (2010)
5. Ravish.R.Singh, *Electrical Networks*, Tata McGraw Hill, 6/e, (2010)
6. K Channa Venkatesh and D. Ganesh Rao, *Network Theory*, Pearson Education, 2/e, (2010).
7. VanValken Berg, *Network Analysis*, PHI publications, 3/e, (2010).
8. John.D.Ryder, *Networks, Lines and Fields*, PHI Publications,2/e,(2010)
9. DeCarlo / Lin, *Linear Circuit Analysis*, Oxford University Press, 2/e,(2005)
10. Franklin F.Kuo, *Network Analysis and Synthesis* ,Wiley India, 2/e, (2011)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

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EC 15-1304 DIGITAL ELECTRONICS

Course Objectives:

To decide the level of sophistication and choice of digital components/devices needed to design a system based on the features of the application

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To introduce the concepts and techniques associated with the number systems and codes.
2. To minimize the logical expressions using Boolean postulates/other techniques
3. To understand, design and analyse various combinational circuits using basic gates /auxillary devices like PLA
4. To understand, design and analyse various sequential circuits using basic gates / auxillary devices
5. To understand the a parameters of logic family and TTL family characteristic
6. To learn the fundamentals of hardware modelling

Module I

Codes and Boolean Algebra : Binary arithmetic, Binary coded Decimal, Excess - 3 code, Gray Code. Error detection and correction: parity, 7 bit Hamming code . Boolean algebra -minimization of Boolean function using Karnaugh Map (up to 6 variables) and Quine - McClusky methods. Formation of switching functions from word statements, realisation using basic gates and universal gates.

Module II

Combinational circuits: Half adder, Full adder, Subtractor, Binary Parallel adder, Carry look ahead adder, BCD adder, multiplexer, demultiplexer, Basic decoder and encoder circuits. Implementation of simple combinational circuits using ROM and PLA.

Arithmetic circuits: Serial Adder, Difference between parallel adder and serial adder, Binary multiplication, Binary division circuits.

Module III

Sequential circuits: Flip-flops - RS /JK / T / D flip- flops, shift registers - counters -asynchronous and synchronous counters, Up-Down counter, Ring counter, Johnson counter - sequence generators - state table and diagrams.

Logic families: Standard logic levels - Current and voltage parameters - fan in and fan out - Propagation delay, noise consideration. TTL family NAND gate working principle, need for totem pole configuration, TTL inverter characteristics, Open collector gate and tri-state logic gate.

Module IV

Hardware modelling using HDL: Entity Declaration- Architecture Body- Basic Language Elements –Identifiers- Data Objects- Data Types. Behavioural Modelling: Process Statement- Variable Assignment Statement- Signal Assignment Statement- Wait Statement- If Statement - Case Statement- Null Statement- Loop Statement- Exit Statement- Next Statement- Dataflow Modelling: Concurrent Signal Assignment Statement- Concurrent versus Sequential Signal Assignment, Structural Modelling: Component Declaration- Component Instantiation. Modelling of Basic Binary Arithmetic Circuits.

References:

1. Taub & Schilling, *Digital Integrated Electronics*, Tata Mc Graw Hill,(2008), ISBN-13: 978-0-07-026508
2. Anand Kumar, *Fundamentals of Digital Circuits*, PHI learning, 2/e, (2010), ISBN: 978-81-203-3679-7
3. Thomas L Floyd, *Digital Fundamentals*, Pearson, 10/e,(2011)
4. R P Jain, *Modern Digital Electronics*, Tata Mc Graw Hill, 4/e, (2009).
5. S Limaye, *VHDL – A Design Oriented Approach*,TMH,(2008),, ISBN: 10:0-07-064825-5
6. Gaganpreet Kaur, *VHDL basics to programming*, Pearson,(2011)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-1305 SOLID STATE ELECTRONICS

Course Objectives:

To predict the working of a semiconductor device whose doping and construction details are known or to suggest the doping and constructional details for device catering a particular application.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To impart the basic concepts of semiconductor Physics
2. To create an insight into the theory of P-N junctions and the working of various diodes.
3. To understand the working of JFET and MOSFET
4. To understand the theory of BJT and its applications.

Module I

Carrier Concentrations: Effective mass, Formation of Energy band, E-K diagram, The Fermi level, Carrier concentration at equilibrium, Direct and Indirect recombination of electrons and holes, Hall effect, Steady-state carrier generation,

Transport Phenomena: Drift and Diffusion of Carriers, Semiconductor in Equilibrium, Einstein Equation, Excess carrier generation and Recombination, Quasi-Fermi levels , carrier lifetime, Continuity and Diffusion equations, Haynes-Shockley experiment

Module II

P-N Junctions: Space Charge at a junction, Steady state condition, The Contact Potential, Depletion Region, Current at a junction, Carrier injection, Junction breakdown phenomena, Time variation of stored charge, Reverse recovery transient, junction diode switching characteristics, P-N junction Capacitance

Junction Diodes: Metal-Semiconductor Junction, Varactor Diodes, PIN diodes, Tunnel Diode, Current and Voltage in an illuminated junction, Photo Diode, Photo detector, Solar Cells, Light Emitting Diode

Module III

Bipolar Junction Transistor (BJT): Structure and basic operation, Charge transport and current in a BJT, Terminal currents, generalised biasing, Ebers-Moll Model, Charge control analysis, BJT switching: Turn-on and Turn-off transients, Base narrowing

Module IV

FET, MOSFET: Construction and Operation of FET, I-V Characteristics of FET, Pinch-off and Transconductance. MESFET, MOSFET, Band bending, Effect of bias voltage, Threshold voltage, accumulation, Depletion, Inversion, MOS Capacitor, C-V characteristics, effects of real surfaces, work function difference, interface charge, Threshold voltage in MOSFET, I-V Characteristics of MOSFET

TextBook:

1. Ben G. Streetman: *Solid State Electronic Devices*, 5/e, Pearson Education. ISBN 9788120318403

References:

1. Jasprit Singh *Semiconductor Devices*, Wiley India, 1/e, (2001), ISBN 81-265-1102-8. (Modules 2,3)
2. S.M.Sze: *Physics of Semiconductor Devices*, Wiley India, **3/e**, ISBN: 978-0-471-14323-9 (Modules 1,3)
3. D.K.Bhattacharya and Rajnish Sharma, *Solid State Electronic Devices*, Oxford University Press(Module 1)
4. Kanaan Kano, *Semiconductor Devices*, Pearson Education (Module 1)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-1306 ELECTRONIC CIRCUITS I

Course Objectives:

To analyse the different circuits and design circuits using discrete electronic components.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To study the working of various electronic circuits and their equivalent circuit.
2. To analyze the different transistor circuits at low and high frequencies
3. To design the circuits using discrete components as per the specifications.
4. To study the switching behaviour of BJT
5. To design nonlinear circuits

Module I

RC Filters, Diodes and their applications: RC Filters, Diode and their types, Rectifiers, Filters, Clipper, Clamper, Zener diode and its applications.

Bipolar Junction Transistors: CB, CE, CC Configurations, Operating point, Biasing circuits, Bias Stability, Thermal runaway and thermal stability

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Module II

Transistor Analysis

Transistors at low frequencies: Two port devices and the Hybrid model, General analysis of an amplifier using h parameters, analysis of CE, CB and CC amplifiers.

Transistors at high frequencies: Hybrid Π model, Amplifier response at high frequencies, Gain- Bandwidth product

Module III

Field Effect Transistors: FET & MOSFET, characteristics, biasing and small signal low frequency analysis of CD, CS and CG configurations

Transistor Power Amplifier: Circuits and operations of class-A, Class-B and Class-C amplifiers, Push–Pull amplifiers

Module IV

Switching characteristics of a BJT - BJT switches with inductive and capacitive loads - Non saturating switches - Astable, monostable and bistable multivibrators using BJT - Voltage and current time base generators - Miller & bootstrap configurations

.

TextBooks:

1. Milman & Halkias, *Integrated Electronics*, Tata McGraw Hill , 2/e, (2009), ISBN 9780070151420
2. Milman & Taub, *Pulse Digital & Switching waveforms*, Tata McGraw Hill, 3/e, (2011) ISBN 97800710727247 (Module 4)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-13L1 BASIC ELECTRONICS LABORATORY

Course Objectives:
To implement basic Electronic circuits.

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze basic discrete circuits and design them.
2. To understand the characteristics of basic devices.

Experiments

1. Characteristics of Diodes & Zener diodes
2. Characteristics of Transistors (CE & CB)
3. Characteristics of JFET
4. Frequency responses of RC Low pass and high pass filters. RC Integrating and Differentiating Circuits
5. Rectifying circuits

   i) HW rectifier ii) FW rectifier iii) FW Bridge rectifier

   iv) Filter circuits - Capacitor filter, inductor filter and π section filter

6. Zener Regulator with & without emitter follower.
7. Biasing of Active devices

   i) Voltage biasing, current biasing and Feedback biasing of BJT
   ii) Biasing of JFET
8. Clipping and clamping circuits

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

EC 15-13L2 DIGITAL ELECTRONICS LABORATORY

Course Objectives:

To design and build digital systems using basic digital components, test and analyse the real outputs

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To design and analyse various combinational circuits using basic gates
2. To understand and use auxiliary circuits, like latches, bus drivers MUX, DeMUX
3. To understand Shift registers / counters and their applications
4. To understand the timing diagrams and timing issues
5. To develop teamwork skills

Experiments

1. Half adder and full adder using standard logic gates / NAND gates.
2. Code converters - Binary to Gray and gray to Binary with mode control
3. Binary addition and subtraction (a) 1's complement (b) 2's complement(using 7483)
4. BCD adder using 7483.
5. Study of MUX, DeMUX &Decoder Circuits and ICs
6. Set up R-S JK & JK Master slave flip flops using NAND/NOR Gates
7. Asynchronous UP / DOWN counter using JK Flip flops
8. Design and realization of sequence generators.
9. Study of shift registers and Implementation of Johnson and Ring counter using it.
10. Study of IC counters 7490, 7492, 7493, 74163 and 74192.
11. Study of seven segment display and decoder driver (7447).

References:

1. Herbert Taub, Donald Schilling , *Digital Integrated Electronics*, Tata Mc Graw Hill, 1/e, (2008), ISBN: 9780070265080
2. Soumitra Kumar Mandal, *Digital Electronics, Principles and applications*, Tata Mc Graw Hill, 2/e, (2011), ISBN 0070153825

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45% minimum in the end semester examination for a pass.

SEMESTER IV

AS 15-1401 COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATIONS

Course Objectives:

To understand and use complex variables, function integrals ,partial differential equation in Engineering discipline.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To Transform a region to another region using conformal mapping
2. To Evaluate real integrals using residue theorem
3. To Formulate and solve of partial differential equation
4. To Determine solution of partial differential equation for vibrating string and heat conduction

Module I

Analytic function- Cauchy-Riemann equation (Cartesian and polar)-Harmonic function- construction of analytic function given real or imaginary parts- Conformal mapping of standard elementary function and bilinear transformation.

Module II

Cauchy's integral theorem, Cauchy's integral formula and for derivatives-Taylor's and Laurent's expansion (without proof) - Singularities-Residues-Cauchy's Residues theorem- Contour integration involving unit circle.

Module III

Formation of partial differential equation eliminating arbitrary constants and function—Solution of first order equation-four standard types- Lagrange's equation—Linear homogeneous partial differential equation with constant coefficient

Module IV

One dimensional wave equation, Alembert's solution and one dimensional heat flow equation—solution by the method of separation of variables- application of Fourier series solution. Solution of Laplace's equation over a rectangular region by the method of separation of variables.

References:

1. Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (10/e). John Wiley & Sons, Hoboken, N.J
2. Grewal, B.S. (2013). *Higher engineering mathematics*. (43/e). Khanna Publishers, New Delhi.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

.

EC 15-1402 MICROPROCESSOR ARCHITECTURES AND PROGRAMMING

Course Objectives:

To understand the organization of x86 family microprocessor and design efficient systems using a microprocessor

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the evolution of microprocessors and fundamental concepts of advanced microprocessors / architectures
2. To study the architecture of 8086 microprocessor and its instruction set
3. To develop efficient programs in Assembly Level language for x86 family of microprocessors
4. To understand interfacing possibilities and challenges in x86 based system
5. To understand the concept of segmentation , paging , protected mode etc wrf x86 family
6. To understand the ideas of multitasking/multi user OS and CISC/RISC architectures

Module I

Introduction to microprocessors: Microcomputers and microprocessors, 8/ 16/ 32/ 64-bit microprocessor families.

Internal architecture of Intel 8086 microprocessor: Block diagram, Registers, Internal Bus Organization, Functional details of pins, Control signals, External Address / Data bus multiplexing, De-multiplexing, Memory Address space and data organisation, Memory segmentation and segment registers, IO Address space. Basic 8086/8088 configuration, Minimum mode and maximum mode. Comparison of 8086 and 8088.

Module II

Instruction set and Assembly language Programming of 8086: Instruction set, Instruction Classifications,

addressing modes, Assembler Directives, Strings, Procedures and Macros Assembly language Program development tools: editor, assembler, linker, locator, debugger and emulator.

Module III

Interfacing concepts and devices: Memory interface: Concept of memory chip/ chips interface to 8086 with

examples Direct Memory Access (DMA) data transfer Programmable interfacing devices: - Programmable peripheral interface (Intel 8255), Programmable timer interface (Intel 8253/ 54) -Block diagram and modes of operation .Hardware and Software aspects of Interfacing these peripherals to 8086. 8087 Numeric coprocessor interface.

Module IV

Multiuser /Multitasking operating system concepts and the need for protection.

Introduction to 80386: Architecture of 80386, Real and protected modes of operation, Virtual memory, Address translation with Segmentation and Paging, Virtual 8086 mode. RISC architecture, Instruction Level Parallelism- concept and limitations-Pipelining and Superscalar architecture, Branch Prediction.

References:

1. Lyla B.Das, *The x86 Microprocessors:Architecture,programming and Interfacing (8086 to Pentium)*, Pearson Education,(2010), ISBN:9788131732465
2. Douglas V.Hall, *Microprocessors and interfacing, Programming and Hardware*, Tata Mc Graw Hill,2/e,(2006), ISBN: 9780070601673.
3. Barry B Brey, *The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64 –bit Extensions*, Pearson/ Prentice Hall, 8/e, (2009), ISBN 0135026458/ 9780135026458.
4. A K Ray and K M Bhurchandi, *Advanced Microprocessors and peripherals*, Tata Mc Graw Hill, 2/e, (2009), ISBN 9780070140622
5. Jean Loup Baer, *Microprocessor Architecture*, Cambridge University Press, (2015), ISBN: 9780521187350.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-1403 ELECTRONIC CIRCUITS II

Course Objectives:

To design oscillators and amplifiers with different gain or bandwidth requirements. They should also be able to specify the blocks required for building an Opamp.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To develop the skill of analysis and design of various circuits using electronic devices.
2. To understand the feedback techniques
3. To understand wide banding techniques.
4. To appreciate the importance of Opamp and its internal circuit.

Module I

Feedback amplifiers - Properties of negative feedback. The four basic feedback topologies-Series-shunt, series-series, shunt-shunt, shunt-series. Analysis and design of discrete circuits in each feedback topologies - Voltage, Current, Tran conductance and Tran resistance amplifiers, its loop gain, input and output impedance., Stability of feedback circuits. Effect of feedback on amplifier poles, frequency compensation-Dominant pole and Pole-zero.

Module II

Wide band amplifiers - Wide banding techniques – CC–CE /CD-CS cascade, cascode amplifier, Darlington pair – Wide banding using inductors. **Sweep circuits**- Bootstrap, Miller sweep and current sweep circuits - analysis. Schmitt trigger - analysis.

Module III

Differential Amplifiers - BJT differential pair, large signal and small signal analysis of differential amplifiers, Input resistance, voltage gain, CMRR, non-ideal characteristics of differential amplifier. Frequency response of differential amplifiers, MOS differential amplifiers.

Module IV

OPAMP- Internal block schematic of analog IC (op amp) -Biasing used in IC- Current sources, Active load, cascode load, current mirror circuits, Wilson current mirror circuits. – Level Shifters- Power amplifier stages. Open loop gain input- output impedance & bandwidth calculation using small signal equivalents. Frequency compensation and slew rate.

Text Book:

1. Millman & Halkias, *Electronic Devices & Circuits*, Tata McGraw Hill,3/e, (2010), ISBN 978007070021(Module 1 & II)
2. Jacob Milman & Taub, *Pulse Digital & Switching waveforms*, 3/e, (2001), Tata McGraw Hill ISBN 97800710727247(Module II)
3. Sedra & Smith, *Microelectronic circuits*, Oxford University Press, 5/e, (2008), ISBN 019511663(Module III & IV)

References:

1. Gaykwad , *Op-amps and Linear integrated Circuits*, Pearson Education/ Prentice-Hall India Ltd, 4/e,(2010),ISBN: 978-81-203-2058-1
2. Schilling &Belove, *Electronic Circuits, Discrete & Integrated* , 3/e, (2002), Tata McGraw Hill,ISBN9780070528987.
3. Jacob Millman & Arvin, *Micro Electronics*, 2/e, (1999), McGraw Hill ISBN 9780074637364
4. Paynter , *Introductory Electronics Devices and Circuits* 7/e,(2008),Pearson Education ISBN 9788131722817
5. Horenstein, *Microelectronics Circuits & devices*, Prentice-Hall India, 2/e,(2009),ISBN: 978-81-203-1135-0

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-1404 SIGNALS AND SYSTEMS

Course Objectives:

To identify the different classes of signals and systems and analyse them using Laplace transform, Fourier series, Fourier transform and Z transforms.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the concept of a signals and systems their classifications and analysis using differential /difference equations
2. To understand the concept of impulse response and perform convolution
3. To understand the need for sampling and reconstruction and Sampling theorem
4. To analyse LTI systems using Laplace transforms /Z transform
5. To understand and evaluate the frequency response of LTI systems
6. To understand Linear feedback systems and perform root locus analysis.

Module I

Continuous time (CT) and Discrete time (DT) Signals -Transformations of the independent variable- exponential and sinusoidal - unit step and impulse functions / sequences – Classification of signals - CT and DT Systems - Properties of systems - Linear time-invariant (LTI) systems – The representation of signals in terms of impulses - convolution - Properties of LTI systems - Singularity functions – LTI Systems described by differential and difference equations and calculation of impulse responses.

Module II

Sampling – Introduction - Representation of a continuous-time signal by its samples - the sampling theorem –The effect of under sampling: aliasing - Sampling with a zero-order hold - Reconstruction of a signal from its samples using interpolation - Sampling of discrete-time signals – **Laplace transform** - The region of convergence for Laplace transforms - The inverse Laplace transform - Properties of the Laplace transform - Analysis and characterization of First-order and second-order LTI systems using the Laplace transform.

Module III

Fourier Series and Transforms - The response of continuous-time LTI systems to complex exponentials – Fourier series representation of Continuous time periodic signals - Convergence of Fourier series – Properties - Continuous- time Fourier transform representation of Aperiodic signals – Fourier transform of periodic signals - Properties - Fourier transform and Fourier series pairs - the discrete-time Fourier series - Properties - Discrete-time Fourier transform - Properties of Discrete-time Fourier transform - Properties .

Module IV

The z-transform- The region of convergence –Pole zero plot - Properties of the z-transform - Inverse z-transform (partial fraction method) - Analysis and characterization of LTI systems using z-transforms - System function – Introduction to Linear feedback systems - Some applications and consequences of feedback - Root - locus analysis of linear feedback systems.

References:

1. Alan V Oppenheim, Alan S Willsky, *Signals and Systems*. Prentice Hall India ,2/e,(2010)
2. S.S. Soliman, M.D. Srinath, *Continuous and Discrete signals and systems*, Prentice Hall India, 2/e, (2004).
3. C.L. Phillips, J.M. Parr, E.A. Riskin, *Signals Systems and Transforms*. Pearson Education, 4/e, (2008).

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-1405 COMMUNICATION ENGINEERING I

Course Objectives:

To gain knowledge of the various aspects of communication systems such as modulation, demodulation, noise handling, data conversion, waveform coding and multiplexing

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand amplitude modulation in detail including modulation index, bandwidth and power requirement, modulator and demodulator circuits, transmitter and receiver block diagrams
2. To study the theory of angle modulation, analyze the spectrum, modulators and discriminators; and to characterize the performance of the receivers
3. To acquire basic understanding of different forms of noise in a communication system, their description and the effect of noise in various types of modulation
4. To familiarize with the basics of sampling and quantization, and to study the various waveform coders

Module I

Introduction to continuous wave modulation – need for modulation - Amplitude modulation - modulators, spectrum, Demodulation. DSBSC signals - spectrum, modulator, demodulator.SSB signals-spectrum, modulator, demodulators. ISB modulation –VSB modulation .AM transmitters –high level and low level. AM receivers – TRF receivers, Super heterodyne receiver, Double Super heterodyne receiver – SSB receiver.

Module II

Angle modulation-FM &PM - mathematical analysis, principles, waveforms, frequency deviation, frequency analysis, bandwidth requirement, phasor representation, Transmission bandwidth. Generation of FM-direct, indirect-FM transmitters.FM receivers-block diagram– demodulators – Tuned circuit frequency discriminators, slope detector, balanced slope detector, Foster-Seeley discriminators, ratio detectors. Characteristics of receivers – sensitivity, selectivity, double spotting, AGC circuitry

Module III

Noise – external, internal- signal-to-noise ratio – noise figure –noise calculations – equivalent noise temperature,-noise figure in cascaded networks. White noise, filtered white noise, noise equivalent bandwidth, Narrow band noise.

Effect of noise in Systems; Linear and angle modulation systems, threshold effect and threshold extension, pre-emphasis and de-emphasis filtering.

Module IV

Sampling Process: Sampling theorem, Interpolation Formula, Practical difficulties in signal reconstruction- aliasing, antialiasing filter, practical sampling. Quadrature sampling of band pass signals. Pulse Modulation: PAM, PPM, PWM, Multiplexing- TDM, FDM. Frequency domain analysis .

Waveform Coding Techniques: PCM system- quantization process- uniform and nonuniform quantization, Quantization Noise & Signal to noise ratio, Robust quantization, companding- A Law and μ Law characteristics. DPCM-transmitter and receiver. Delta Modulation - transmitter and receiver, quantization error. Adaptive delta modulation.

References:

1. George Kennedy, *Electronic communication systems*, McGraw Hill ,5/e,(2011)
2. Simon Haykin, *Communication Systems*, John Wiley & Sons, 4/e.
3. Simon Haykin, *Digital Communications*, John Wiley & Sons, (2011).
4. B. P. Lathi, *Modern Digital and Analog Communication Systems*, Oxford University Press, 3/e, (2009)
5. Roddy & Coolen, *Electronic Communications*, Pearson Education/ Prentice-Hall India Ltd 4/e, (2008)
6. Robert J Schoenbeck, *Electronic Communications Modulation & Transmission*, Prentice Hall, 2/e.
7. Wayne Tomasi, *Electronic Communications Systems (Fundamentals through Advanced)*, Pearson Education ,5/e,(2008)
8. Taub& Schilling, *Principles of Communication Systems*, Tata McGraw Hill, 3/e,(2007)
9. Ziemer ,*Principles of Communication : System modulation and noise 5/e*, Wiley India
10. Hari Bhatt and Ganesh Rao, *Analog Communication-Simplified Approach*, Pearson Education (2010)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

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EC 15-1406 DIGITAL SYSTEM DESIGN

Course Objectives::
To design, analyse and interpret digital systems.

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyse and design using standard combinational circuits.
2. To design Synchronous sequential system
3. To understand various design techniques and timing issues for sequential digital networks
4. To design using CPLD and FPGA

Module I
Standard Combinational Modules: Binary Decoders – decoder networks, Binary Encoders, Priority Encoders, Multiplexers – multiplexer trees, Demultiplexers, Shifters – barrel shifter, Programmable Modules- PLA, PAL, ROM, Network of ROMs. Implementation of combinational systems with decoder, multiplexers, ROMs and PLAs.

Module II
Synchronous sequential systems- state description of finite state system – Mealy and Moore Machines, representation of the state transition and output functions, time behaviour of finite state machines, finite memory sequential systems, equivalent sequential systems and minimization of the number of states, Binary specification of sequential systems, Different types of sequential systems- modulo-p counter – pattern recognizer – block pattern recognizer – sequential decoders.

Module III
Sequential Networks: Canonical form of Sequential Networks, Timing characteristics of sequential networks – setup time – hold time – propagation delay – maximum clock frequency, analysis of canonical sequential networks, Design of canonical sequential networks, Flip flop modules, Analysis of network with flip flops, Design of networks with flip flops. Standard Sequential Modules: Registers, Shift registers, Counters, Multimodule implementation of sequential systems – array of registers – Networks of shift registers - cascade counters – parallel counters, Design of sequential systems with standard sequential modules.

Module IV
CPLDs and FPGA: FPGA types- FPGA based system design-FPGA programming technologies: antifuse-static RAM-EPROM-EEPROM.FPGA families: Actel- Actel1 logic module, Xilinx- xilinx LCAXC3000CLB, Altera-Altera FLEX logic element. Logic expander.

References:

1. Milos Ercegovac, Tomas Lang, Jaime H. Moreno, *Introduction to Digital Systems*, John Wiley & Sons, (1999)
2. John F Wakerly, *Digital Design: Principles & Practices*, Pearson Education, 4/e, (2008)
3. John M.Yarbough, *Digital Logic Applications and Design*, Thomson Learning, 1/e, (1991)
4. Micheal John Sebastian Smith, Application Specific Integrated Circuits,Pearson, (2001),ISBN: 978-81-7758-408-0.

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 14L1 DIGITAL PROGRAMMING LABORATORY

Course Objectives:

To design, test and analyze the performance of digital systems and microprocessor based systems

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze the digital circuits in a programming and simulation platform.
2. To understand the principles and techniques of assembly-level programming using MASM
3. To learn the use of DOS and BIOS interrupts
4. To interface peripheral to 8086 based trainer kit
5. To develop teamwork skills

Experiments

1. Block level system design in Simulink® / LabVIEW environment
2. Programming using HDL
3. Introduction to DEBUGGING tool
4. Assembly language program development using Macro assembler
   i. Creating an Assembler source file
   ii. Assembling source program with MASM
   iii. Creating a RUN module
   - Typical programming examples (at least 15nos)
5. Interface I/O Devices like stepper motor, key board, ADC AND DAC to 8086

References:

1. Peter Abel, Niyaz Nizamuddin, *IBM ®PC Assembly language and Programming*, Prentice Hall India ,5/e ,(2001), ISBN: 9788120320949
2. Lyla B.Das, *The x86 Microprocessors:Architecture,programming and Interfacing (8086 to Pentium)*, Pearson Education,(2010), ISBN 978-81-317-3246-5

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

EC 15- 14L2 ELECTRONIC CIRCUITS LABORATORY I

Course Objectives:

To design discrete circuits satisfying different gain and wave shape requirements.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze basic discrete circuits
2. To understand amplifying and switching circuits.

Experiments

1. Amplifying circuits

   (i) Simple common emitter amplifier configuration - gain and bandwidth.
   (ii) Common source amplifier
   Functions of each component, gain measurement, frequency responses
2. Feedback amplifier circuits - Current series and voltage shunt - gain and bandwidth
3. Oscillators - RC phase shift. Wein Bridge, crystal oscillator
4. Multivibrators - Astable, Bistable, Monostable
5. Switch & Sweep circuits - Simple transistor sweep, bootstrap sweep
6. Power amplifiers.
7. SPICE: Simulation of experiments listed above using SPICE

(*It is desirable to carry out the implementation followed by simulation*)

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SEMESTER V

EC 15- 1501 NUMERICAL AND STATISTICAL METHODS

Course Objectives:

To understand the concept of Probability, Statistics and Numerical methods which arise in engineering application

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To Solve algebraic and transcendental equations by numerical methods
2. To Perform numerical differentiation and integration
3. To Find the mean and variance of a probability distribution including the binomial distribution.
4. To Use statistical tests in testing hypotheses on data

Module I

Numerical solution of algebraic and transcendental equation by - Regula-Falsi method, Newton Raphson's method. Gauss Seidal iteration method to solve a system of equations and convergence (without proof) Newton's forward and backward interpolation formula. Lagrange interpolation, Newton's divided difference and central differences

Module II

Numerical differentiation at the tabulated points with forward, backward and central diffrences. Numerical integration with trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Taylor series method. Euler method, Modified Euler method, Runge–Kutta method of second and fourth order for solving 1st order ordinary differential equation.

Module III

Random variable (discrete and continuous) Expectation-mean and variance of probability distribution. Binomial, Poisson and Normal distribution and Fitting of this Distribution to the given data. Curve fitting-fitting of straight line, parabola, exponential.

Module IV

Population and Sample-Sampling Distribution (of mean and variance) Testing of Hypothesis-level of significance, Z-test statistic, Chi square test for variance, for goodness of fit and F-test .

References:

1. Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
2. Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.
3. Kandaswamy, P. Thilagavathy, K. And Gunavathy, K. (2007) *Numerical methods*.S Chand &Co, New delhi.
4. Richard A. Johnson. Irvin Miller and John E. Freund.(2010). *Probability and statistics for engineers*. (eighth edition). Pearson, New Delhi.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1502 ELECTROMAGNETIC THEORY

Course Objectives:

To apply knowledge of mathematics, science and engineering to understand Electrostatics,Magnetostatics and Electromagnetics. Deep understanding of Maxwell's equations would enable the student to familiarize with Electromagnetic Wave Propagation.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze fields and potentials due to static changes using vector analysis tools
2. To know how materials affect electric and magnetic fields
3. To understand the significance of Maxwell's Equations in Electromagnetics.
4. To acquire knowledge on various boundary conditions
5. To understand the relation between the fields under time varying situations
6. To understand the propagation of uniform plane waves.

Module I

Vector Analysis : Vector Algebra, Coordinate Systems and Transformation – Cartesian, Cylindrical and spherical coordinates, Vector Calculus – Differential length, area and volume, Line, surface and volume integrals, Del operator, Gradient of a scalar, Divergence of a vector, Divergence Theorem, Curl of a vector, Stoke's Theorem, Laplacian of a scalar.

Module II

Electrostatics: Electrostatic Fields – Coulomb's Law and field intensity, Electric fields due to continuous charge distributions, Electric flux density, Gauss's Law, Applications of Gauss's Law, Electric Potential, Relationship between E and V, Electric dipole, Energy density in Electrostatic fields.

Electric fields in material space – Properties of materials, Convection and conduction currents, Conductors, Polarization in Dielectrics, Dielectric constant and strength, Continuity equation, relaxation time, Boundary conditions; Electrostatic Boundary value problems– Poisson's and Laplace's Equations, Uniqueness Theorem, Resistance and capacitance [Parallel-plate, coaxial, spherical capacitors].

Module III

Magnetostatics and Maxwell's equations: Magnetostatic fields – Biot-Savart's Law, Ampere's circuital law, Applications of Ampere's circuital law, Magnetic flux density, Magnetic scalar and vector potentials. Magnetic forces, Materials and devices – Forces due to magnetic fields, Magnetic torque and moment, Magnetic dipole, Magnetization in materials, Classification of Magnetic Materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy, Magnetic circuits. Faraday's Law, Displacement current, Time-harmonic fields, Maxwell's equations for static fields and time varying fields.

Module IV

Electromagnetic wave propagation : Electromagnetic waves-Wave propagation in lossy dielectrics- Wave equations, propagation constant, intrinsic impedance of the medium, complex permittivity, loss tangent, Plane waves in lossless dielectrics, Plane waves in free space – uniform plane wave, Plane waves in good conductors – skin effect, Poynting vector, Poynting's Theorem, Reflection of a plane wave at normal incidence – standing waves, Reflection of a plane wave at oblique incidence – parallel and perpendicular polarization, Brewster angle.

References:

1. M. N. O. Sadiku, *Principles of Electromagnetics*, 4/e, Oxford University press.(2009).
2. W.H.Hayt, and J.A.Buck, *Engineering Electromagnetics*, Tata McGraw Hill, 7/e, (2011).
3. Jordan and Balmain, *Electromagnetic waves and radiating systems*, PHI Ltd, 2/e,(2010)
4. Kraus and Fleisch, *Electromagnetics with applications*, Tata McGraw Hill, 5/e, (2010).
5. Joseph A. Edminister, *Electromagnetics*, Schaum series - Tata McGraw Hill, 2/e, (2011).
6. W.H.Hayt, and J.A.Buck, *Problems and solutions in Electromagnetics*, TMH, 7/e, (2011).
7. Lonngren, *Fundamentals of Electromagnetics with Matlab*, PHI Ltd, 2/e, (2007).
8. Umran.S.Inan and Aziz.S.Inan, *Engineering Electromagnetics*, Pearson Education, (2010).

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

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EC 15- 1503 EMBEDDED SYSTEMS

Course Objectives:
To design an embedded system

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze the circuit design capability for answering some of the real life problems
2. To acquire Embedded system programming skills.
3. To understand the design of an embedded system.

Module 1
Overview of Embedded System: - Embedded System, Categories of Embedded System, Requirements of Embedded Systems, Challenges and Issues in Embedded Software Development, major application areas of embedded system. Typical embedded system- Core of the embedded system, memory, sensors and actuators, Communication Interface, reset circuit, Brown-out protection circuit, oscillator circuit, Watchdog timer .Overview of the 8051 family. 8051 architecture- memory organization, registers and I/O ports. Addressing modes, instruction sets, and assembly language programming. Programming timer/counter. Interrupts- handling and programming. Introduction to C programming in 8051.

Module II
8051 interfacing - keyboard, stepper motor, ADC, DAC, LED and LCD module interface. Applications – frequency counter and temperature measurement. Bus architectures & protocol of I2C, SPI, CAN, RS232.

Module III
Memory-Technology & devices -Flash memory-NAND Flash -NOR Flash-DRAM-SDRAM/ DDR/ DDR2. Introduction to embedded CPUs: Basic architecture of ARM core family-features of ARM 926EJS core. Basic architecture of MSP430-features of MSP430.

Module IV
Introduction to embedded firmware & operating systems: Boot loader -Realtime kernel-Embedded OS- Tasks, Processes and Threads, Multiprocessing and Multitasking, Task scheduling, Task communication and synchronisation, Device Drivers.

References:

1. Shibu K.V, *Introduction to Embedded Systems*, Tata McGraw Hill, (2009)
2. K Uma Rao, Andhe Pallavi ,*The 8051 and MSP430 Microcontroller Architecture Programming and Applications*, Pearson,(2010)
3. Rajkamal, *Microcontrollers - Architecture, programming, Interfacing and system Design*, Pearson Education, (2005)
4. Daniel W. Lewis, *Fundamentals of Embedded Software where C and Assembly Meet*, PHI Ltd, (2003)
5. Steve Heath, *Embedded system design* ,second edition , Elsevier,2/e,(2002)
6. Kantha Rao, *Embedded systems*, PHI, ISBN: 978-81-203-4081-7
7. Subrata Ghoshal, *8051 Microcontroller internals, instructions, programming and Interface*, Pearson, ISBN:9788131731437
8. Steve Furber, ARM System on Chip Architecture, Pearson ,2/e,(2009)
9. Andrew Sloss, Dominic Symes , Chris Wright -*ARM Developers Guide, Designing & Optimizing system software*
10. Tammy Noergaard, *Embedded System Architecture , A comprehensive guide for Engineers and Programmers*, Elsevier ,(2005), ISBN-10: 0750677929, ISBN-13: 978-0750677929

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1504 COMMUNICATION ENGINEERING II

Course Objectives::
To get a clear understanding of different digital modulation techniques and their performance analysis, optimal receiver design etc.,

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the fundamentals of modern digital communication system design
2. To evaluate the performance of digital signaling schemes on realistic communication channels with Emphasis on physical layer digital communications, including waveform design and receiver design.
3. To understand Statistical channel modeling, modulation and demodulation techniques, optimal receiver design, performance analysis techniques, source coding, quantizations
4. To familiarise with digital modulation techniques and its importance.
5. To Conduct analysis of baseband signals in time and frequency domain.
6. To understand the concept of spread spectrum communication systemTo gain knowledge about the circuits of different op amp applications

Module I
Introduction to Digital Communication:, Random variables & random process-Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Complex baseband representation of signals, Gram-Schmidt orthogonalisation procedure.

Module II
Digital Modulation & demodulation techniques: Digital communication system, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation. square-law, and envelope detection Detector.

Module III
Base band data transmission: Signal transmission through bandlimited channels : Line codes-NRZ, RZ Pulse shape design for channels with ISI: Nyquist pulse, Partial response signalling, Channel with distortion: Eye Pattern, Zero forcing Equalizer,

Module IV
Spread spectrum systems: -Fundamental concepts - pseudo noise sequence-performance of direct sequence spread spectrum systems-analysis of direct Sequence spread spectrum systems- the processing gain and anti jamming margin-frequency hopped spread spectrum systems –time hopped spread spectrum systems-time synchronization.

Text Books:

1. Simon Haykin, *Digital Communication*, John Wiley& Sons, (2005)
2. Simon Haykin, *Communication Systems*, John Wiley& Sons , (2004)
3. Taub & Schilling, *Principles of Communication Systems*, Tata McGraw Hill, (1991)
4. Simon Haykin, Communication Systems, John Wiley & Sons, 4/e.
5. Simon Haykin, Digital Communications, John Wiley & Sons, (2011)

References:

1. B. P. Lathi, *Modern Digital and analog Communication Systems*, Oxford University Press, 3rd Ed.
2. Bernard Sklar, *Digital Communications Fundamentals and applications* ,Pearson ed., (2006)
3. Hwei Hsu, Schaum's Outline, *Analog and Digital Communications*, McGraw Hill, (2003).

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1505 ANALOG AND INTEGRATED CIRCUITS

Course Objectives::

T o have understood the concepts of operational amplifiers and should be able to design any operational amplifier circuit.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able to

1. To understand the basics of operational amplifiers
2. To gain knowledge about the circuits of different op amp applications
3. To understand the various types of active filters using opamp
4. To gain knowledge about the different specialized ICs using opamp and its applications

Module I

Introduction to operational amplifiers Op-amp parameters - ideal op amp Frequency response, frequency compensation. Slew rate and its effect; Input bias current –offset - drift - compensating networks CMRR, SVRR, finite gain bandwidth and its effect in opamp circuits' performance.

Open loop configurations Op amp in closed loop configuration: Different feed back configurations- Voltage series feedback and voltage shunt feedback - concept of virtual ground- linear circuits: Summer- Subtractor, Integrator and differentiator voltage follower - V/I converters, I/V converters and its applications - Differential amplifiers with one op amp and 3 op amps- Use of offset minimizing resistor (ROM) and its design. Instrumentation amplifier IC and its application

Module II

Op amp applications- Log amplifier- Antilog amplifier- Comparators: zero crossing- using voltage reference- regenerative (Schmitt trigger) comparators, window detector application – OPAMP as comparators - Astable and monostable multivibrators using op amps- Triangular and saw tooth wave generators- - RC phase shift and Wien bridge oscillators-Sample and hold circuit- Peak detector circuit. Precision rectifiers.

Module III

Filters: Transfer functions - LPF, HPF, BPF, BRF Approximation methods - Butter worth - Chebyshev -Active Filters - I order and II order filters, Quality factor-Design – Gyrator - Negative Impendence Converter - Filter using Simulated Inductance - Universal Active Filters - All Pass filters. Switched Capacitive Filters.

Module IV

Specialized ICs and applications: Voltage regulator IC 723, current limiting, short circuit protection, Thermal protection -555 timers – Functional block diagram- Astable Multivibrator, Monostable Multivibrator and its applications.- 566 VCO chip- Phase locked loop (PLL) - block diagram, Mathematical Derivation of capture range, lock range and pull in time capture and lock range- 565 PLL - PLL applications: Frequency multiplication and division- AM demodulation - FM detection - FSK demodulation Analog multiplier circuits and applications.

Text Books:

1. Gaykwad, *Op-amps and Linear integrated Circuits*, Pearson Education/ Prentice-Hall India Ltd, 4/e,(2010) (All Modules)
2. Sedra&Smith, *Microelectronic circuits*, Oxford University Press, 5/e, (2009), ISBN :0195116631 (Module II)
3. Sargio Franko, *Design with operational Amplifiers Analog ICs*, Tata McGraw Hill, 3/e, (2003), ISBN :9780070530447 (Module II &III)
4. R F Coughlin ,*Op amps and Linear Integrated circuits* , Pearson Education/ PHI Ltd, 6/e,(2010) (Module II)
5. K R Botkar, *Integrated circuits*, Khanna Publishers, 9/e(Module III&IV)

References:

1. Gray, *Analysis and Design of Analog Integrated Circuit*, John Wiley, 4/e, ISBN 9788126515691.
2. D A Bell, *Opamps and Linear integrated Circuits*, Prentice-Hall India ,2/e
3. Jacob Millman & Arvin , *Micro Electronics* , McGraw Hill (1999),ISBN: 9780074637364
4. Razavi ,*Fundamentals of Microelectronics*, Wiley India, ISBN: 9788126523078

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1506 DIGITAL SIGNAL PROCESSING

Course Objectives::

On successful completion of teaching-learning and valuation activities, a student would be able to design simple digital filters and analyse them. He/She will know the different types of DSP processors and the architectures related to them.

Course Outcomes:

1. To understand the need for DFT and the properties associated with it
2. To introduce to FFT algorithms (DIT and DIF)
3. To know the various forms in which FIR and IIR filters can be realized
4. To design simple FIR/IIR filters of different types
5. To introduce to frequency transformation techniques
6. To understand the effects of Finite register length in FIR and IIR filter design
7. To gain knowledge on different types of DSP processors available and their architecture

Module I

Discrete Time Fourier Transform (DTFT) – Properties - Discrete Fourier Transform (DFT) – Properties – circular convolution – Linear convolution – Efficient computation of DFT : Fast Fourier Transform (FFT) – Decimation in Time (DIT) – Decimation in Frequency (DIF) – practical considerations Discrete Hilbert transforms- Introduction to Discrete Hilbert Transforms, DCT, STFT, Wavelet Transform.

Module II

Finite Impulse Response (FIR) Filters – Basic structures – direct, cascade, linear phase, frequency sampling and lattice - Design of FIR filters – Fourier series truncation – Windowing: Rectangular, Bartlett - Blackman – Hanning- Hamming – Frequency Sampling – Finite register length effects - Application of FIR filters.

Module III

Infinite Impulse Response (IIR) Filters – Basic structures : Direct form I & II , cascade and Parallel – Design of IIR Filters – Butterworth – Chebyshev - Impulse Invariance – Bilinear Transformation – Frequency transformations –Finite register Length effects – Applications of IIR Filters – Dual Tone multi frequency generation and detection.

Module IV

General and Special purpose Digital Signal Processors –Harvard architecture – Pipelining – Hardware Multiplier Accumulator -Special Instructions - Fixed and Floating Point Processors – TMS320C54X –Architecture –Instruction set - Addressing modes – TMS320C67X – Architecture - Instruction set Addressing modes .

References:

1. Oppenheim, Alan V, and Ronald W. Schaffer., *Discrete Time Signal Processing*, Prentice Hall / Pearson Education 2/e,(1989).
2. Sen M.Kuo, Woon-Seng Gan, *Digital Signal Processors: Architectures, Implementations, And Applications*, Pearson Education, (2005)
3. Emmanuel C. Ifeachor & Barni W.Jerris, *Digital Signal Processing ,a practical approach*, Pearson education,2/e,(2002)
4. John G Proakis & Dimitris G Manolakis , *Digital Signal Processing*, Pearson education,4/e,(2007)
5. Andreas Antoniou , *Digital Filters Analysis & Design*, Prentice Hall India , 2/e,(2000)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 15L1 MINI PROJECT

Course Objectives:

To design a circuit, the integration to make it as a product, and the documentation of that work.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze the circuit designing capability and the documentation capability.
2. To understand the process of making an electronic product.

Each batch comprising of 3 to 5 students shall design, develop and realize a complete electronic product. Basic elements of product design must be considered. Fully software/simulation projects are not allowed. Each student shall submit a project report at the end of the semester. The project report should contain the design and engineering documentation including the Bill of Materials and test results. Product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations and aesthetics / ergonomic aspects taken care of in the project shall be given due weight.

Guidelines for evaluation:

Attendance and Regularity	5
Work knowledge and Involvement	15
End-Semester presentation & Oral examination	10
Level of completion and demonstration of functionality/specifications	10
Project Report	10
Total	*50*

***Note**: External projects and R&D projects need not be encouraged at this level. Points (i) & (ii) to be evaluated by the project guide & co-ordinator and the rest by the final evaluation team comprising of 3 teachers including the project guide.*

EC 15- 15L2 ELECTRONIC CIRCUITS LABORATORY II

Course Objectives:

To analyze and design any circuit using operational amplifiers.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze and design linear circuits using opamp
2. To understand and design circuits using opamps for waveform generation
3. To design different types of active filters using opamp
4. To study the different specialized ICs like 555, 723 etc using opamp

Experiments

1. Linear circuits

   Circuits using OP- Amps - Inverting & non inverting amplifiers , Summing Amplifier, Differential Amplifier, Instrumentation Amplifier, Integrators & Differentiators , Measurements of offset voltage and its compensation. Precision rectifiers
2. Circuits using op-amps for waveform generation

   i) Astable, monostable multivibrators.
   ii) Wein bridge oscillator
   iii) Triangular, Saw tooth waveform generators
3. Second order Active RC filters: High pass, Low pass
4. Astable and monostable multi-vibrator circuit using 555
5. Voltage regulator using 723
6. Filters using simulated inductance

(*It is desirable to carry out the implementation followed by simulation*)

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

SEMESTER VI

EC 15- 1601 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

Course Objectives:

To understand the principles of electronic measurements, different measuring instruments, sensors and transducers.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze the errors in measurements and their rectification.
2. To understand the various measurement techniques available.
3. To understand the various industrial applications of instrumentation.

Module I.

Introduction- Measurements- Monitoring, Control, Analysis. Instruments- Transducer, Signal Conditioner and Transmitter, Display/Recording Devices. Static characteristics of Instruments. Estimation of Static errors and reliability-errors, types of errors, probability of errors, limiting errors, Reliability Principles. Dynamic characteristics of Instruments- Transfer function-Zero, first and second order instruments-Dynamic response of first and second order Instruments.

Module II.

Transducers and Sensors: Transducers- active and passive, Magnetic effect based Transducers. - Selection Criteria- Smart Sensors and IEEE 1451 Standard. Temperature measurements-RTD, Thermocouples. Displacement Measurement- Strain Measurement-Pressure Measurement- Measurement of acceleration, force, and Torque. LVDT. Piezo-electric transducers. Bridge measurements:-DC bridges for low, medium and high resistance-ac bridges for capacitance and inductance. Sources of error in bridge circuits- Precautions.Vector impedance meter,. Multimeters: - Principles of analog and digital multimeters, ADC and DAC - performance specification –Different types weighted, R-2R, successive approximation, flash, integrating.

Module III.

Signal generators: - Sine-wave Generators-AF and RF Signal Generators- Non-sinusoidal Generators, Function generator- Sweep frequency generator- Frequency synthesizers. Digital Signal Generators- Arbitrary Wave form Generator, Data Generator. Signal analyzers-Wave Analyzer –Harmonic Distortion Analyzer, Spectrum Analyzer. FFT Analyzer, Vector Analyzer, Logic Analyzer. Digital storage oscilloscope (DSO).Recording instruments- Strip chart recorders, x-y- recorders.

Module IV.

Industrial Instrumentation: Basis of Pressure measurements, Flow measurements and Level Measurement. Data Acquisition System, Telemetry- Characteristics and different types. Industrial Communication Techniques- OSI Net Work Model, Network Topologies, Interface Standards- RS 232, IEEE 488 (GPIB), HART, Ethernet or CSMA/CD. Virtual instrumentation Systems

References:

1. Arun K Ghosh, *Introduction to Measurements and Instrumentation*, PHI Learning Pvt.Ltd, 3/e, (2010).
2. M.M.S Anand, *Electronic Instruments and Instrumentation technology*, PHI Learning Pvt.Ltd, India,(2010).
3. Oliver-Cage, *Electronic Measurements and Instrumentation*, Tata McGraw Hill,(2008)
4. Albert D.Helfrick & W.D.Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, PHI, (2011).
5. H S. KALSI, *Electronic Instrumentation*, Tata McGraw Hill,3/e
6. K. Padmanabhan, S. Ananthi, *A Treatise on Instrumentation Engineering*, Ik International, Pvt. Ltd.
7. C.S. Rangan, G.R. Sharma ,*VSV Mani, Instrumentation Devices and Systems* , Tata McGraw Hill,2/e,(2001)
8. D. Patranabis, Principles *of Industrial Instrumentation*, PHI Learning Pvt.Ltd, 1/e, (2011).
9. BC. Nakara, KK Chaudhary, *Instrumentation Measurements and Analysis.* Tata McGraw Hill.
10. Ernest O Doebelin,Dhanesh N Manik,*Doeblins's Measurements System*,6/e,(2011),McGrawHill

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1602 MICROWAVE TECHNIQUES & DEVICES

Course Objectives:

To understand the operating principles of various microwave components, devices and measurement techniques.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To apply electromagnetic theory to understand the working of transmission lines and waveguides
2. To familiarise with different planar transmission lines
3. To characterise Microwave networks and devices using S parameters
4. To design Microwave Filters
5. To acquire knowledge on Microwave Measurements
6. To understand the working principle of common solid state microwave devices

Module I

Introduction to microwaves - frequency range, significance, applications; Guided waves: TE, TM, TEM waves, Velocities of propagation; Transmission line theory: Lumped element circuit model, Transmission line parameters, Transmission Line equations, Characteristic impedance, Input impedance of a Lossless Line, short circuited and open circuited lines, Standing Waves, Reflection Coefficient, VSWR, Impedance matching devices – Quarter wave transformer, Stub matching, Smith Chart and its applications; Waveguides - Rectangular Waveguide: TE waves, TM waves, dominant and degenerate modes, Impossibility of TEM waves in wave guides; Excitation of modes in Rectangular Waveguides; Planar Transmission lines: Strip lines, Microstrip lines, Slot lines and Coplanar lines.

Module II

Scattering matrix - Concept of N port scattering matrix representation - Properties of S matrix- S matrix formulation of two-port junction; Microwave Passive devices - Tee junctions – E plane Tee, H plane Tee, Magic Tee, Rat race, Two hole directional coupler, Isolator, Circulator, Phase shifter, Attenuator, Power divider; S matrix of E plane Tee, H plane Tee, Magic Tee, Directional coupler, Circulator only; Microwave Resonators: Transmission line resonators – $\lambda/2$ and $\lambda/4$ resonators, Rectangular and Circular Cavity resonators - Resonant frequency and Q factor, Cavity excitation and tuning, Coupled cavities; Microstrip resonators – Disc/ring resonators

Module III

Microwave filters – Implementation at Microwave frequencies, Low Pass Butterworth / Chebyshev Filter design by Insertion loss method and implementation using discrete components, Design of Stepped impedance Butterworth / Chebyshev LPF. Microwave measurements and applications**:** Measurement of Power, VSWR, frequency, wavelength, insertion loss, impedance and attenuation; Basic concepts of Network Analyzer and Anechoic chamber; Applications of Microwaves - ISM applications, Radiation hazards.

Module IV

Solid state microwave devices:- Diodes – Principle of operation and applications of Crystal diode, PIN diode, Varactor diode, Tunnel diode, Gunn diode and Avalanche Transit time devices; Basic principle of operation of parametric amplifiers, Manley-Rowe power relations, Negative resistance amplifiers; Microwave tubes - High frequency limitations – Structure and Principle of operation of Two Cavity Klystron, Reflex Klystron, Travelling Wave Tube Amplifier, Magnetron Oscillator (detailed mathematical analysis not needed).

References:

1. David.M. Pozar, *Microwave Engineering*, John Wiley, 2/e, (2003).
2. Samuel Y Liao, *Microwave Devices & Circuits*, Pearson Education, 3/e, (2003).
3. Jordan and Balmain, *Electromagnetic waves and Radiating systems*, PHI Ltd, 2/e, (2010).
4. Peter A. Rizzi, *Microwave Engineering – Passive circuits*, PHI Ltd, 1/e, (2010).
5. Robert E. Collin, *Foundations for Microwave Engineering*, Wiley India, 2/e, (2009).
6. Annapurna Das and Sisir K Das, *Microwave Engineering*, Tata McGraw Hill, 2/e, (2009).
7. Herbert J.Reich, *Microwave Principles*, Affiliated East-West Press Limited.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1603 VLSI DESIGN

Course Objectives:

To gain knowledge about the various aspects of nMOS and CMOS logic design and the issues relating to VLSI design

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able to

1. To gain knowledge about the different processing steps in IC fabrication and the various second order MOS device effects
2. To understand the concept of nMOS, CMOS and switch logic and to design these circuits using the design rules
3. To learn about the various performance estimation parameters like resistance, capacitance and time delay and the concept of scaling in MOS circuits
4. To understand the concepts of timing issues in VLSI system design

Module I

VLSI process integration: fundamental considerations in IC processing - NMOS IC technology - CMOS IC technology- n-well process, p-well process, twin-tub process, silicon on insulator - Ion implantation in IC fabrication.

Second order MOS device effects: short-channel effect, narrow width effect, sub-threshold current, field dependent carrier mobility, device saturation characteristics, drain punch through, hot electron effect.

Module II

Switch logic- pass transistors and transmission gates, Gate logic - The basic inverter using NMOS - pull up to pull down ratio- transfer characteristics- Alternate forms of pull up. CMOS logic – inverter, NAND, NOR, 0 compound gates - CMOS inverter DC characteristics. Design rules and Layout of static MOS circuits: general principles & steps of lay-out design - use of stick diagrams – NMOS and CMOS design rules - Layout examples of inverter, NAND and NOR - Interlayer contacts, butting and buried contacts - use of layout tools like MICROWIND for integrated circuits.

Module III

Circuit characterization and performance estimation: resistance estimation - sheet resistance, capacitance estimation

Switching characteristics of CMOS inverter- rise time, fall time, delay time, delay unit, inverter delays - driving large capacitive loads - cascaded inverters, super buffers, BiCMOS drivers. Scaling of MOS circuits: scaling models and scaling factors for device parameters, limitations of scaling.

Module IV

Timing issues in VLSI system design: timing classification- synchronous timing basics – skew and jitter- latch based clocking- self timed circuit design - self timed logic, completion signal generation, self timed signalling– synchronizers and arbiters.

References:

1. Weste and Eshraghian, *Principles of CMOS VLSI Design-A Systems Perspective*, Pearson Education,2/e.
2. Jan M. Rabaey, A. Chandrakasan, B. Nikolic, *Digital Integrated Circuits- A Design perspective*, Pearson education, 2/e,(2003)
3. Douglas A Pucknell, Kamran Eshraghian , *Basic VLSI Design*, Prentice Hall India, 3/e,(2010)
4. S M Sze, *VLSI Technology*, Mc Graw Hill, 2/e,(2003)
5. Wolf, Modern *VLSI Design-System- on -Chip Design*, Pearson Education, 3/e,(2002)
6. Mead & Conway , *Introduction to VLSI System Design* , Addison-Wesley Publishing Co., (1980)
7. Fabricius, *Introduction to VLSI Design*, McGraw-Hill, (1990)
8. Thomas E. Dillinger , *VLSI Engineering* , PHI,
9. Charles H Roth Jr ,*Fundamentals of Logic Design* , Jaico Publishers,5/e
10. Albert Raj and T. Latha, *VLSI Design*, PHI Learning private limited,(2008),ISBN-976-61-203-3431-1

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1604 INFORMATION THEORY & CODING

Course Objectives:

To get a clear understanding of source coding, channel capacity, coding theorem and the different types of coding and decoding techniques

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze and understand about understand Entropy and Loss-less Source Coding
2. To understand the concepts of Channel Capacity and Coding Theorem
3. To learn about different linear block codes and decoding techniques
4. To learn about the different convolutional codes

Module I

Entropy and Loss-less Source Coding: Entropy, Entropy of discrete random variables- Joint, conditional and relative entropy- Chain rule for entropy, Mutual information and conditional mutual information, Relative entropy and mutual Information

Lossless source coding- Discrete Memory-less sources, Uniquely decodable codes- Instantaneous codes- Kraft's inequality – Average codeword length, Optimal codes- Huffman coding, Arithmetic Coding, Lempel-Ziv Coding, Shannon's Source Coding Theorem.

Module II

Channel Capacity and Coding Theorem: Channel Capacity- Discrete memory-less channels (DMC) and channel transition probabilities, Capacity computation for simple channels- Shannon's Channel Coding Theorem, Converse of Channel Coding Theorem

Continuous Sources and Channels: Differential Entropy- Mutual information- Waveform channels- Gaussian channels- Shannon-Hartley Theorem, Shannon limit, efficiency of digital modulation schemes-power limited and bandwidth limited systems.

Module III

Coding – linear block codes-generator matrices-parity check matrices-encoder-syndrome and error correction-minimum distance-error correction and error detection capabilities-

BCH codes-description-coding & decoding –Reed Solomon codes-coding & decoding cyclic codes-coding and decoding.

Module IV

Convolutional codes-encoder -state diagram-distance properties-maximum likelihood decoding-viterbi decoding- sequential decoding interleaved convolutional codes-Turbo coding- coding & decoding -Trellis coding- coding & decoding- Low-Density Parity check (LDPC) codes.

References:

1. John P Proakis&Salehi *Digital Communication*, McGrawHill,5/e, (2008), ISBN 9780070591172
2. Thomas M. Cover and Joy A. Thomas, *Elements of Information Theory*, Wiley India, ISBN 9788126508143
3. Shu Lin and Daniel. J. Costello Jr, *Error Control Coding: Fundamentals and applications*, Pearson India, 2/e.
4. Richard B Wells, *Applied Coding and Information Theory* , Pearson Education ,(2009)
5. J C Moreira *Essentials of Error Control Coding* Wiley India ,(2006) ,ISBN 9788126528691
6. Bernard Sklar, *Digital Communication Fundamentals and applications* ,Pearson education , (2006)
7. B. P. Lathi, *Modern Digital and analog Communication Systems*, Oxford University Press, 3/e
8. Ranjan Bose, *Information Theory ,Coding and Cryptography* ,Tata McGraw-Hill ,2/e, (2008)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15 – 1605 POWER ELECTRONICS

Course Objectives:
To understand and acqire knowledge about various power semiconductor devices.

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze various single phase and three phase power converter circuits
2. To understand the basic principle of switching circuits.
3. To familiarize the operation principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications
4. To learn the requirements imposed by electric drives

Module I
Power Semiconductor devices: Basic structure, I V characteristics, switching characteristics and operation of devices like power diode, Bipolar Junction Transistor, Power MOSFET, thyristors, Gate Turn off thyristor, Insulated Gate Bipolar Transistor and TRIAC, two transistor model of thyristor, series and parallel connections of thyristors, protection of thyristors, snubber circuits, Gate and Base drive, firing circuits with resistor and UJT.

Module II
Power Electronic Circuits: Line frequency single phase and three phase diode rectifiers, performance parameters, controlled rectifiers: single phase, semi converter, full converter (with R and R L loads), three phase half converter and full converter (with R and R L loads). Inverters: single phase half bridge and full bridge inverters, three phase inverters, basic concept of Pulse Width Modulation, single pulse, multiple pulse and sinusoidal pulse, basic concept of resonant pulse inverters.

Module III
DC-DC Converters: Various types of commutation techniques, principle of chopper operation, types of chopper circuits, step down operation and step up operation, analysis of Buck regulator, Boost regulator and Buck-Boost regulator. Power Supply Applications: Switching DC power supply, over view of Switching power supplies, control of SMPS, power supply protection, Power Conditioners, Power Line disturbances and Uninterruptible Power supply (UPS), various block of UPS.

Module IV
Motor Drive Applications: Introduction, types of DC motors, basic characteristics of DC motor, operating modes, Single phase drives: Half converter, semi converter and full converter drives. Types of AC motors, induction motor drives, performance characteristics, various types of control drives: such as stator voltage, rotor voltage and frequency control, criteria for selecting drive components.

References:

1. Ned Mohan, Tore M. Undeland, William P. Robbins ,*Power electronics converter, applications and design*, John Wiley.
2. Muhammad H. Rashid, *Power Electronics Circuits, Devices and Applications*, PHI and Pearson Education, 3/e
3. John G Kassakian, Martin F Schlecht, George C Verghese, *Principles of Power Electronics*, Pearson,3/e, (2010).
4. Jai P Agrawal , *Power Electronic System, Theory and Design*,Pearson,(2001)
5. Daniel W. Hart, *Power Electronics*, TataMcGrawHill,1/e,(2011)

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 16L1 DIGITAL SIGNAL PROCESSING LABORATORY

Course Objectives::

To understand and apply DSP concepts.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze and familiarize of Signal processing tool box-MATLAB
2. To understand the techniques involved in DSP.
3. To gain knowledge about frequency responses and spectrum

Experiments

i. Generation of basic input signals (*both discrete & continuous*)
ii. DFT and spectral analysis - computation of DFT, properties of DFT
iii. Convolution
iv. Correlation
v. Digital filter design- FIR & IIR Filters
vi. FFT
vii. Spectral estimation

The above experiments should be done using MATLAB and DSP Trainer Kit. The student should be able to apply the above tools in a small application.

References:

1.Vinay.K.Ingle, John G. Proakis, *Digital Signal Processing using MATLAB*, Thomson, 1/e, (2003)
2. Dr.Shailendra Jain, *Modelling and Simulation using MATLAB* – Simulink, 1/e, (2011)

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

EC 15- 16L2 COMMUNICATION LABORATORY I

Course Objectives:

To design circuits of both analog and digital modulation techniques

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze and design various active filters
2. To design circuits of different analog modulation techniques like AM, FM etc., its generation and demodulation.
3. To study the PLL characteristics and demodulation using PLL
4. To design different pulse modulation techniques like PAM, PWM, PPM - its generation and demodulation

Experiments

i. Active Filters - Band Pass, Band reject (II order Butterworth)-Magnitude and phase characteristics, Q- factor.
ii. Amplitude modulation - frequency modulation
iii. Balanced modulator
iv. PLL characteristics and demodulation using PLL
v. AM generation and demodulation using OP-AMPs and IC multipliers
vi. PAM .modulator and demodulator
vii. PWM modulator and Demodulator
viii. PPM modulator and Demodulator.

Simulation of experiments listed above using various CAD tools like MATLAB,PSPICE,SIMULINK,
(*It is desirable to carry out the both simulation and experiments*)

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

EC 15 -1606A ADVANCED DIGITAL SYSTEM DESIGN

Course Objectives:

To design sequential digital circuits, asynchronous sequential circuits, digital Programming Devices and fault diagnosis.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the design of sequential circuits, asynchronous circuit and fault diagnosis.
2. To familiarize the various programmable devices in digital domain.

Module I

Sequential Circuit Design

Analysis of clocked synchronous sequential circuits and modeling- State diagram, state table, state table assignment and reduction-Design of synchronous sequential circuits-design of iterative circuits-ASM chart and realization using ASM.

Module II

Asynchronous Sequential Circuit Design

Analysis of asynchronous sequential circuit – flow table reduction-races-state assignment-transition table and problems in transition table- design of asynchronous sequential circuit-Static, dynamic and essential hazards – data synchronizers –mixed operating mode asynchronous circuits – designing vending machine controller.

Module III

Fault Diagnosis And Testability Algorithms

Fault table method-path sensitization method – Boolean difference method-D algorithm -Tolerance techniques – The compact algorithm – Fault in PLA – Test generation-DFT schemes – Built in self test

Module IV

Synchronous Design Using Programmable Devices

Programming logic device families – Designing a synchronous sequential circuit using PLA/PAL – Realization of finite state machine using PLD – FPGA – Xilinx FPGA-Xilinx 4000

References:

1. Charles H.Roth Jr *Fundamentals of Logic Design* Thomson Learning (2004)
2. Nripendra N Biswas *Logic Design TheoryPrentice* Hall of India,(2001)
3. Parag K.Lala *Fault Tolerant and Fault Testable Hardware Design* B SPublications,(2002)
4. Parag K.Lala *Digital system Design using PLD* B S Publications,(2003)
5. Charles H Roth Jr.*Digital System Design using VHDL*Thomson learning,(2004)
6. Douglas L.Perry *VHDL programming by Example*, Tata McGraw.Hill - (2006)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1606B COMPUTATIONAL ELECTROMAGNETICS

Course Objectives:

To understand and select appropriate numerical techniques for the EM modelling of microwave and millimeter-wave circuits / antennas.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To learn and understand various types of computational techniques.
2. To understand Method of moments technique and its application in simple problems electromagnetic fields.
3. To learn FDTD technique and its application in simple problems electromagnetic fields.
4. To understand FEM techniques and its application in simple problems electromagnetic fields.
5. To use some of the most popular commercial EM tools and to critically evaluate the numerical results.

Module 1

Introduction: Elements of Computational Methods, Basis Functions, Sub-domain Basis Functions, Entire-domain Basis Functions, Convergence and Discretization Error - Convergence Test, Order of Convergence, Disctretization Error and Extrapolation, Discretization of Operators, Discretization Error in FDM, FDTD, and FEM, Stability of Numerical Solutions, Stability of FDTD Solution, Stability of Matrix Solution, Accuracy of Numerical Solutions, Modeling Errors, Truncation Error, Round-off Error,Validation, Spurious Solutions, Formulations for the Computational Methods

Module II

Method of Moments: Basis Functions**,** Sub-domain Basis Functions, Entire-domain Basis Functions, Point Matching and Galerkin's Methods, Eigen value Analysis using MoM**.** Solution of Integral Equations using MoM**,** Static Charge Distribution on a Wire, Analysis of Stripline, Analysis of Wire Dipole Antenna**,** Scattering from a Conducting Cylinder of Infinite Length, Greens functions.

Module III

Finite Difference Time Domain Analysis: FDTD Analysis in One-Dimension: Pulse Propagation in a Transmission Line, Spatial Step Δx and Numerical Dispersion, Time Step Δt and Stability of the Solution, Source or Excitation of the Grid, Absorbing Boundary Conditions, Applications of One-Dimensional FDTD Analysis, Reflection at an Interface, Determination of Propagation Constant, Design of Material Absorber, Exponential Time- stepping Algorithm in the Lossy Region, FDTD Analysis in Two-Dimensions, Unit Cell, Numerical Dispersion in Two-Dimensions, Time Step Δt for Two-Dimensional Propagation, Absorbing Boundary Conditions for Propagation in Two, Dimensions, Perfectly Matched Layer ABC's FDTD Analysis in Three-Dimension, Yee Cell, Numerical Dispersion in Three-Dimension, Time Step Δt for Three-Dimensional Propagation, Absorbing Boundary Conditions and PML for Three-Dimensions Implementation of Boundary Conditions in FDTD, Perfect Electric and Magnetic Wall Boundary Conditions, Interface Conditions

Module IV

Finite Element Method: Basic Steps in Finite Element Analysis**,** Discretization or Meshing of the Geometry**,** Derivation of the Element Matrix**,** Assembly of Element Matrices**,** Solution of System Matrix**,** Post-processing**,** FEM Analysis in One-dimension**,** Treatment of Boundary and Interface Conditions**,** Accuracy and Numerical Dispersion**,** FEM Analysis in Two-dimension, Element Matrix for Rectangular Elements**,** Element Matrix for Triangular Elements**,** Assembly of Element Matrices and System Equations**,**Capacitance of a Parallel Plate Capacitor**,** Cut-off Frequency of Modes in a Rectangular Waveguide**,** FEM Analysis of Open Boundary Problems

References:

1. Ramesh Garg, *Analytical and Computational Methods in Electromagnetics*, Artech House, (2008)
2. Matthew N. O. Sadiku, *Numerical Techniques in Electromagnetics*, CRC press, 2/e, (2000).
3. David B. Davidson, *Computational Electromagnetics for RF and Microwave Engineering*, Cambridge Uty press, 2/e,(2010)
4. Allen Teflove, Susan C Hagness, *Computational Electrodynamics: The FDTD Method.*, Artech House publications,3/e,(2005)
5. R.F. Harrington, *Field Computation by Moment Method.*, Wiley,(1993)
6. John Volakis, and Kubilay Sertel, *Frequency Domain Hybrid Finite Element Methods for Electromagnetics*, Morgan & Claypool Publishers ,(2006)
7. Balanis.C.A. *Advanced Engineering Electromagnetics*, Wiley *Publications*, (1989)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15 – 1606C ADAPTIVE SIGNAL PROCESSING

Course Objectives:

To understand and design adaptive signal Processing system

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze need for adaptive signal Processing system and their properties
2. To understand various performance measures and their characteristics
3. To familiarise various adaptive algorithms
4. To perform adaptive modelling and design of filters and arrays for beam forming

Module I

Adaptive Systems – Definition & Characteristics – Properties - Open loop and closed loop adaptation –Example of adaptive system – Adaptive linear combiner – Input signal and Weight vectors – Desired response and Error – Performance Function – Gradient - Minimum mean square error – Example of performance surface - Alternative expressions of the Gradient – De-correlation of error and input components.

Module II

Properties of Quadratic performance surface – Normal form of input correlation matrix – Eigen values and vectors - Geometrical significance - Searching the performance surface – Methods – Gradient search methods – Stability and rate of convergence – learning curve – Newton's Method – Steepest Descent Method – Comparison of learning curves –Gradient estimation and its effect on adaptation – Performance penalty – Variance of gradient estimate – Excess Mean Square Error and Time constants – Misadjustment.

Module III

Adaptive Algorithms - The LMS Algorithm – Derivation - Convergence – Learning curve – Noise –Misadjustment – Performance - LMS/ Newton Algorithm – Properties –Sequential regression algorithm – Adaptive recursive filter – Random search algorithms – RLS Algorithm – The matrix inversion Lemma – Convergence.

Module IV

Adaptive modeling and system identification – Multipath communication channel –FIR digital filter synthesis –Introduction to adaptive arrays and beamforming – Sidelobe cancellation – Beamforming with a pilot signal –spatial configurations – Adaptive algorithms.

References:

1. Bernard Widrow and Samuel D. Stearns, *Adaptive Signal Processing*, Pearson Education, ISBN:9788131705322
2. Simon Haykin, *Adaptive Filter Theory*, Pearson Education, 4/e, (2002).
3. B. Farhang-Boroujeny, *Adaptive Filters – Theory and Applications*, John Wiley and Sons, (1998), ISBN:978-0-471-98337-8
4. Ali H Sayed, *Fundamentals of Adaptive Filtering*, John Wiley and Sons, 1/e,(2003)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15 - 1606D OBJECT ORIENTED PROGRAMMING

Course Objectives:

To efficiently develop a program code using object oriented programming approach

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To differentiate between procedural and Object oriented concepts in programming
2. To understand the concept of objects , class, inheritance, polymorphism
3. To develop efficient programs utilising proper functions and handles

Module I

Object oriented technology, comparison with procedural programming (C and C++),key concepts of object programming, input and output in C++, declarations ,control structures, functions.

Module 2

Classes and Objects, declaring objects, accessing member variables, defining member functions, inline functions, static member variables and functions, friend function, overloading, constructors and destructors, overloading constructors, copy constructors anonymous objects, dynamic initialization using constructors, dynamic operators and constructors, recursive constructors encapsulation

Module 3

Inheritance, types of inheritance, virtual base class, abstract class, advantages and disadvantages of inheritance, pointers and arrays, C++ and memory

Module 4

Binding, polymorphism and virtual functions, generic programming with templates, exception handling, string handling and file handling

Text Books:

1. Ashok N Kamthane , Pearson education - *Object oriented programming with ANSI and TURBO C++*, Thomson Learning.
2. Saurav Sahay – *Object oriented programming with C++*, Oxford

References:

1. Malik *C++ Programming :From Problem Analysis To Program Design*, , Thomson Learning
2. Forouzan, – *Computer Science :A Structured Approach Using C++,2/e*, Thomson Learning.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15 – 1606E PROBABILITY AND RANDOM PROCESS

Course Objectives:

To understand the fundamentals of probability theory and random processes and apply these concepts with engineering applications.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To develop a deep understanding of random process
2. To explain the concepts of expectation and conditional expectation and describe their properties
3. To Formulate and solve the engineering problems involving random processes.
4. To analyze linear systems employing the theory of stochastic processes
5. To develop skills in building stochastic models using Markov chains.
6. To learn about different probability distributions.

Module I

Random Variables - Discrete and continuous random variables - Probability density functions and distribution functions - Mathematical Expectations - Properties - Mean and Variance -Joint moments, Moment-generating and characteristic functions and their applications, conditional expectation; covariance and correlation; independent, uncorrelated and orthogonal random variables, covariance matrix and properties- Central limit theorem. Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution. Vector-space representation of random variables, linear independence, inner product, Schwarz Inequality

Module II

Random processes - Classification of random processes and examples - Continuous random process – Discrete random process - Continuous random sequence - Discrete random sequence - Stationary process and evolutionary process - Strict sense stationary process - Wide sense stationary process - Auto correlation, auto covariance and cross correlation - Their relation, properties and problems - Poisson process - Mean, variance, autocorrelation of the Poisson process - Properties

Module III

Markov process - Classification of Markov process - Markov chain - Transition probability matrix. Ergodic process - Time average of random process - Power spectral density and its properties - Spectral representation of real WSS process - Wiener-Khinchin Theorem - Calculation of spectral density given the autocorrelation function

Module IV

Linear time invariant systems - WSS process as input, stationarity of the output, auto-correlation and power-spectral density of the output; examples with white-noise as input to the analog communication coherent & non coherent receiver (AM, FM & PM)

References:

1. Papoulis and S.U. Pillai , *Probability, random variable and stochastic processes* , Tata McGraw Hill, 4/e,(2002), ISBN-: 978-0071226615
2. Stark and Woods, *Probability and Random processes with Application to Signal Processing*, Pearson Education, 3/e,(2002), ISBN 978-81-7758-356-4
3. Sam Shanmugam, *Random signals: Detection ,Estimation and Data analysis*, John Wiley,1/e, (1988), ISBN:978-0-471-81555-6
4. F M Dekking , C K Kraaikamp, L E Meester , *A Modern Introduction to Probability and Statics Understanding Why and How*, Springer , 1/e ,(2005) ,ISBN 978-1-85233-896-1
5. Leon Garcia, *Probability and Random process for Electrical Engineers*, Pearson Education ,2/e, 1994
6. Dougherty, *Random Process for Image and Signal Processing* , Prentice hall of India , ISBN: 81-203-2334-3
7. Wim C van Etten, *Introduction to random Signal and noise*, Wiley India, 1/e, (2005) ISBN 978-81-265-265-2163-0
8. Richard A. Johnson, Miller &Freud's, *Probability And Statistics For Engineers*, PHI Publications ,7/e ,(2008), ISBN 978-01-3143-745-6
9. Peebles, *Probability Random Variables and Random signal principles*, Tata Mc GrawHill ,4/e, (2001)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15 – 1606F FINITE ELEMENT METHOD

Course Objectives:
To analyse one, two and three dimensional problems using finite element analysis.

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the concepts of variational methods of approximation.
2. 2. To analyse one and two dimensional problem using finite element analysis
3. To use alternative formulations for 3D problems using FEA

Module I
Linear vector spaces- Linear transformations and functionals- linear, bilinear and quadratic forms- theory of normed spaces- theory of inner products spaces- concepts from variational calculus- variational methods of approximation- Ritz method- weighted residual method- Galerkin method- subdomain method-collocation method.

Module II
Finite element analysis of one dimensional problems- procedure- I-D elements and interpolation functions-analysis of one dimensional second and fourth order equations- approximation errors in FEM- computer implementation.

Module III
Finite element analysis of two dimensional problems- 2-D elements and interpolation functions- 2nd order equations involving a scalar valued function- comments on mesh generation and composition of boundary condition- analysis of plane elasticity and incompressible fluid flow problems- time dependent problems transient heat transfer)- isoparametric elements and numerical integration.

Module IV
Alternative formulations- the least square formulations- the mixed formulation- Eigen value problem- non linear problems- 3-D elements and interpolation functions- formulation of 3-D problems (2 & 3-D Navier Stokes equations, 3D heat transfer equations).

References:

1. Reddy J. N., *An Introduction to Finite Element Method*, McGraw Hill, (2005).
2. Reddy J. N, *Applied Functional Analysis and Variational Methods in Engineering*, McGraw Hill, (1986).
3. Zenkiewicz O., *Finite Element Method*, 5th Edition, Butterworth- Heinemann, (2000).
4. Huebner K. H., *The Finite Element Method for Engineers*, John Wiley, (1975).
5. Saeed Moaveni, *Finite element analysis*, Prentice Hall, (2014).
6. S. S. Rao, *The Finite Element Method in Engineering*, 4th Edition, Elsevier, (2005)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

SEMESTER VII

GE 15- 1701 PRINCIPLES OF MANAGEMENT

Course Objectives:

To identify and analyse problems by applying the principles of management

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To inculcate the ability of formulating, analysing, and solving management problems through the application of scientific management.
2. To introduce the importance of Productivity and Project Management.
3. To get exposed to personnel, marketing and financial management.
4. To understand the principles of economics and IPR aspects.

Module I

Basic concept of Management: Introduction, definitions of managements, characteristics of management, levels of management, management skills, Scientific management - Contributions of Gilbreth and Gantt. **Functions of Management:** Planning, forecasting, organizing, staffing, directing, motivating, controlling, co-coordinating, communicating, decision making. **Organization:** Introduction, definition of organization, system approach applied to organization, necessity of organization, elements of organization, process of organization, principles of organization, formal and informal organization, organization structure, types of organization structure. **Forms of Business Organization:** Concept of ownership organization, types of ownership, Individual ownership, partnership, joint stock company, private and limited company, co-operative organizations, state ownership, public corporation.

Module II

Productivity and Production: Measurement of productivity, productivity index productivity improvement procedure, Organization by product function. **Inventory control:** Classification, Functions, inventory models, inventory costs, EOQ, Materials Requirement Planning – Objectives, Functions and methods. **Project Management:** Functions, Characteristics and feasibility studies.

Module III

Personnel Management: Introduction, definition, objectives, characteristics, functions, principles and organization of personnel management, Recruitment and training methods. **Markets and Marketing:** Introduction, the market, marketing information, market segmentation, consumer and industrial markets, pricing, sales, physical distribution, consumer behaviour and advertisement. **Financial Management:** the basic concepts of financial accounts, inflation, profitability, budgets and controls, cost accounting, valuation of stock, allocation of overheads, standard costing, marginal costing, Break even point.

Module IV

Economics: Principles of economics, problem of scarcity, demand, supply, utility, time value of money, inflation and deflation, determination of price, Consumer Optimization, Consumer Response, Consumer Demand Curve. **IPR Aspects**: General introduction to IPR, eligibility for patent, patent information and prior art search, procedure for filing patent application, rights of patent owner and duration, ownership of patent and commercialization, assignment, licensing and technology transfer, designs and Utility models.

References:

1. Fraidoon Mazda, Engineering Management, Addison-Wesley, (1997).
2. Koontz and O'Donnell, Essentials of Management, Mc Graw Hill, (1978).
3. Kotler P., Marketing Management, Prentice Hall, (2011).
4. Prasanna Chandra, Finance Management, Tata Mc Graw Hill, (2008).
5. Monks, J. G., Operations Management, Mc Graw Hill, (1982).
6. Cornish W. R., & Llewellyn, Intellectual Property, Sweet & Maxwell, 6th Ed., (2007).
7. WIPO, Intellectual Property Hand book, WIPO Publication, (2004).
8. David Hunt, Long Nguyen and Matthew Rodgers,Patent Searching: Tool and Techniques,John Wiley (2007).
9. Neil F. Sullivan, Transfer of Technology, Cambridge University Press, (1995).
10. Lipsey, R., & Chrystal, K. A., Economics, Oxford University Press, 13 Ed. (2013).
11. Case E. Karl & Ray C. Fair, Principles of Economics, Pearson Education, 8th Ed. (2009).
12. Mankiw, N. G., Principles of Economics, Thomson South-Western, 3rd Ed. (2005).

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1702 ANTENNAS AND PROPAGATION

Course Objectives::

To understand and analyse the designed antenna based on its radiation characteristics

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand basic terminology, parameters and concepts of Antennas
2. To analyze the electric and magnetic field of various basic antennas
3. To study the performance of Antenna Arrays
4. To acquire knowledge on antenna types as well as their application
5. To understand the propagation of the waves at different frequencies through different layers of atmosphere

Module I

Radiation Mechanism, Antenna parameters: Radiation Pattern, Radiation Power Density, Radiation Intensity, Beamwidth, Directivity, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth Polarization Input Impedance, Antenna Radiation Efficiency, effective aperture area. Radiation Integrals and Auxiliary Potential Functions: The Vector Potential A for an Electric Current Source J The Vector Potential F for a Magnetic Current Source

Module II

Radiation from an infinitesimal dipole, total power radiated and its radiation resistance. Radiation from half wave dipole radiation fields and its radiation resistance. near field and far field. Small loop antennas

Antenna arrays: Point Sources - arrays of 2 Isotropic Sources and N element point sources, , Principle of Pattern Multiplication, Uniform Linear Arrays - Broadside Arrays, Endfire Arrays

Module III

Types of antennas: Yagi-Uda Antenna, Turnstile Antenna, Helical Antenna- Axial mode helix, Normal mode helix, Biconical Antenna, Log periodic Dipole Array, Spiral Antenna, Microwave antennas: Horn antennas, E plan and H plane Sectoral Horn, Parabolic reflector, Microstrip Patch Antennas.

Module IV

Fundamentals of Wave propagation: Ground waves, Space waves and Sky wave. Free space propagation, Frii's Transmission Equation, Path loss, Plane earth loss, Spherical earth effects, Multipath Effects, Tropospheric refraction, Path profiles - Line of sight versus non-line of sight.

Refraction and Reflection of sky waves by ionosphere – ray paths – skip distance – virtual height-critical frequency- maximum usable frequency -vertical and oblique incidence.

References:

1. C. A Balanis, *Antenna Theory, Analysis and design*, John Wiley student edition, 3/e, (2009), ISBN:978-81-265-2422-8
2. J.D. Kraus, R. J Marhefka , Ahmed S Khan, *Antennas and wave propagation* , Tata McGraw Hill, Special Indian dition,4/e,(2010)
3. Jordan and Balmain, *Electromagnetic waves and Radiating systems*, Pearson Education / PHI Ltd, 2/e, ISBN:978-81-203-0054-5
4. D Ganesh Rao, B Somanathan Nair & Deepa Raghunath, *Antennas and Radio Wave propagation*, Sanguine Technical publishers, (2006)
5. G.S.N Raju, *Antennas and Wave Propagation*, Pearson education,(2008), ISBN: 978-81-317-0184-3
6. A.R.Harish and M.Sachidananda, *Antennas and Wave Propagation*, Oxford Higher Education, (2007)
7. F.E. Terman, *Electronic and Radio Engineering*.

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1703 DIGITAL IMAGE PROCESSING

Course Objectives::
To understand and apply various transformations and formulate solutions to general image processing problem

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the fundamentals of grey scale image ,color image and transforms
2. To understand image enhancement techniques
3. To understand image segmentation techniques
4. To understand image restoration techniques
5. To expose students to current technologies and issues that are specific to image processing

Module I
Digital Image Fundamentals: Representation of digital image -Elements of visual perception – Image sampling and quantization- Basic relationship between pixels.
Review of Matrix Theory: Row and column ordering-Toeplitz, Circulant and Block Matrices
Image Transforms: 2D DFT, Hadamard, Haar, DCT, Wavelet Transforms.

Module II
Image Enhancement: Spatial domain methods: Basic Gray Level Transformations-Histogram Processing: Equalization and specification- Fundamentals of Spatial Filtering: Smoothing, Sharpening spatial filters. Frequency domain methods: low pass filtering, high pass filtering, homomorphic filtering.

Module III
Image segmentation: Detection of discontinuities: Point Line and Edge Detection - Edge linking and boundary detection - Hough transform – Thresholding - Region based segmentation: Region growing-Region splitting and merging - Use of motion in segmentation.
Representation and Description: Representation, Boundary Descriptors: Shape numbers, Fourier descriptors, statistical moments - Regional Descriptors: Topological descriptors, texture.

Module IV
Image Restoration: Degradation Model- Restoration in the presence of Noise only-Spatial Filtering – Periodic Noise reduction by frequency domain filtering- Linear position Invariant degradations-Estimating the degradation function- Inverse filtering - Wiener filter - Constrained Least squares filtering.
Fundamentals of Colour image processing: Colour models - RGB, CMY, YIQ, HIS - Pseudo colour image processing - intensity slicing, gray level to color transformation.

References:

1. Gonzalez and Woods, *Digital Image Processing*, Pearson Education,3/e, (2008)
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall India, (2010)
3. William K Pratt, *Digital Image Processing*, John Wiley and Sons, 4/e, (2007)

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1704 CONTROL SYSTEMS ENGINEERING

Course Objectives:

To understand the fundamental concepts of Control systems and mathematical modelling of the system and to do its stability analysis

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To represent the system using mathematical model ·
2. To determine the response of different order systems for various inputs
3. To analyse the stability of the analog control system
4. To analyse the stability of digital control system
5. To undertake state space analysis and solve state equations.

Module 1

General schematic diagram of control systems - open loop and closed loop systems – concept of feedback modelling of continuous time systems – Review of Laplace transform - transfer function - block diagrams – signal flow graph - mason's gain formula - block diagram reduction using direct techniques and signal flow graphs - examples - derivation of transfer function of simple systems from physical relations - low pass RC filter - RLC series network

Module II

Analysis of continuous time systems - time domain solution of first order systems – time constant - time domain solution of second order systems - determination of response for standard inputs using transfer functions - steady state error - concept of stability - Routh-Hurwitz techniques - construction of bode diagrams - phase margin - gain margin - construction of root locus - polar plots and theory of Nyquist criterion - theory of lag, lead and lag-lead compensators.

Module III

Basic elements of a discrete time control system - sampling - sample and hold - Examples of sampled data systems pulse transfer function - Review of Z-transforms - system function - mapping between s plane and z plane - analysis of discrete time systems –- examples - stability - Jury's criterion - bilinear transformation – stability analysis after bilinear transformation - Routh-Hurwitz techniques

Module IV

Introduction to the state variable concept - state space models - phase variable and diagonal forms from time domain- diagonalization - solution of state equations - homogenous and non homogenous cases - properties of state transition matrix - state space representation of discrete time systems - solution techniques - relation between transfer function and state space models for continuous and discrete cases - relation between poles and Eigen values– Controllability and observability.

References:

1. Dorf R.C. & Bishop R.H., *Modern Control Systems*, Addison Wesley,9/e,(2001)
2. K. Ogata, *Modern Control Engineering* Prentice Hall of India , 5/e, (2010)
3. Norman S. Nise, *Control Systems Engineering* John Wiley and Sons Inc,4/e, ISBN 9788126510979
4. Kuo B.C., *Digital Control Systems*, Second Edition, Oxford University Press, 2/e,(2007)
5. Ogata K., *Discrete Time Control Systems*, Pearson Education, (2001)
6. Nagarath I.J. &Gopal M., *Control System Engineering*, Wiley Eastern Ltd,(1995)
7. ZiemerR.E.,Tranter W.H&FaninD.R ,*Signals and Systems*, Pearson Education Asia
8. J Wilkie, M Johnson, R katebi, *Control Engineering an Introductory Course*, Palgrave (2002)
9. G. Frankline, J David Powell, A E Naeini, Feedback *Control of Dynamic Systems*, Pearson Education 5/e,(2011).
10. Kuo B C &Golnaraghi ,*Automatic Control Systems* 8/e, (2003), Wiley India, ISBN 9788126513710
11. Gopal, *Control System principles and design* McGrawhill,3/e

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 17L1 EMBEDDED SYSTEMS LABORATORY

Course Objectives:

To design a complete embedded system for a real life problem solving and test it.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To Design, develop and validate a programs in 8051 kit
2. To get hands on experience with the embedded system development
3. To familiarise ARM kit

Experiments

1. Familiarisation with 8051 based kit, peripherals, cross assembler/ cross-compiler (eg. KEIL)
2. Simple exercise to study the programming of 8051.
3. Simple exercise to use User interface of the kit (display/ keyboard etc..).
4. Simple exercise to the Interrupt Programming.
5. UART communication with 8051:
6. Communication with PC over its RS232 port.
7. I2C communication with 8051:
8. Read, write and validate data from a serial EPROM or I2C based temperature sensor etc.
9. 8051 interfacing with various sensors and ADC/ DAC .
10. 8051 for motor control :
11. Control the speed of a stepper motor or DC motor.
12. Familiarization of ARM kit.
13. Familiarisation of PCB Design

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

EC 15- I7L2 COMMUNICATION LABORATORY II

Course Objectives:

To design and analyze digital modulation techniques and different types of communication systems

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To design digital modulation techniques and it performance measurement
2. To understand matched filter receiver, error correction and coding
3. To study the various communications systems and their bilding blocks through simulation/ coding and hardware setups
4. To perform image analysis through soft computing

Experiments

Communication experiments based on Communication Engineering II / Information theory & Coding

1. Digital modulation techniques and it performance measures
2. Matched filter receiver for rectangular pulse.
3. Error correction & coding.& LPDC, Viterbi algorithm
4. Link power budget calculation.

Using MATLAB/ Software simulation tools

Experiments based EMT/Microwave techniques & Devices/ Antennas & Propagation

Microwave Communication

(a) Study of Klystron source-Power, mode and impedance, SWR, guide wavelength
(b) Gunn Source-Characteristics, Hybrid T, Directional coupler, Circulator
(c) FET M/W source-SWR, Impedance, Guide wavelength, Tees
(d) Study of Microwave links

Experiments Based on Digital Image processing/ Multimedia/ Optical fiber/Computer Communication Systems

Development of an optical fiber communication transmitter and receiver module.
A small project work using ANN, image processing / multimedia standard or biomedical instrumentation

Instructors can replace experiments with suitable experiments from corresponding theory subjects.

Using MATLAB/ Software simulation tools

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners .A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

GE 15- I7L3 ENTREPRENEURSHIP DEVELOPMENT

Course Objectives:

To develop awareness about the importance of entrepreneurship opportunities available in the society

Course Outcomes:

On successful completion of the course, a student would be able

1. To understand the scope of an entrepreneur
2. To analyze key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc
3. To understand challenges faced by the entrepreneur

Exercises:

1. To study the types of entrepreneurs and the factors affecting entrepreneurial growth.
2. To make an assessment of the major motives influencing an entrepreneur
3. To make an overview of the various stress management techniques
4. How to identify and select a good business opportunity?
5. Preparation of a techno economic feasibility report for a given project
6. Preparation of a preliminary project report for a given project
7. To identify the various sources of finance and management of working capital
8. Carry out the costing and break even analysis of a proposed project
9. Preparation of a PERT / CPM chart for the various activities involved in a project
10. To make a study of the various causes and consequences of sickness in small business and identify corrective measures.

References:

1. Roy Rajeev, *Entrepreneurship*, Second edition, Oxford Latest Edition, (2011).
2. E. Gordon & K. Natarajan, *Entrepreneurship Development*, Fourth edition, Himalaya, (2007).
3. Coulter, *Entrepreneurship in Action*, Second edition, PHI, (2008).
4. P. C. Jain, *Handbook for New Entrepreneur*, Oxford University Press, (2003).
5. S. S. Khanka, *Entrepreneurial Development*, Fifth edition, S. Chand and Co, 2013.

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Note: There will only be continuous evaluation for this course. The evaluation will be based on the performance of the student in the exercises given above. A minimum of 50% marks is required for a pass.

EC 15- I7L4 PROJECT PHASE I & INDUSTRIAL INTERNSHIP

Course Objectives:

To identify a research / industry related problem for the undergraduate project work with the guidance of the respective faculty and prepare a design and work plan for a relevant problem of real world driven by the industrial exposure received through internship

Course Outcomes:

On successful completion, a student would be able to

1. Conduct literature survey in a relevant area of one's course of study and finally identify and concentrate on a particular problem.
2. Formulate a project proposal through extensive study of literature and / or discussion with learned resource persons in industry and around.
3. Generate a proper execution plan of the project work to be carried out in Phase II through thorough deliberations and improve presentation skillsTo understand and analyze a technically solvable social problem

PROJECT PHASE I

Each batch comprising of 3 to 5 students shall identify a project related to the curriculum of study. At the end of the semester, each student shall submit a project synopsis comprising of the following.

- Application and feasibility of the project
- Complete and detailed design specifications.
- Block level design documentation
- Detailed design documentation including circuit diagrams and algorithms / circuits
- Bill of materials in standard format and cost model, if applicable
- Project implementation action plan using standard presentation tools

Guidelines for evaluation:

Attendance and Regularity	5
Theoretical knowledge and Involvement in study or project	15
End-Semester presentation & Oral examination	10
Level of completion of design as per specifications	10
Project Phase 1 Report	10
Total	*50*

Note: *Points (i)-(iii) to be evaluated by the respective project guides and project coordinator based on continuous evaluation. (iv)-(v) to be evaluated by the final evaluation team comprising of 3 internal examiners including the project guide, coordinator & a senior faculty member.*

The project phase I includes the literature survey, schematic block or algorithms, design of the project and implementation of the initial phase of the project. A report on the work done in this phase shall be submitted by each student by the end of the VIII semester. There will be an internal examination of the project that includes oral presentation regarding the overall project and demonstration, if any, of the completed work. The evaluation panel shall consist of at least three faculty members including the project guide.

INDUSTRIAL INTERNSHIP

Industrial internship with a minimum duration of 2 weeks during May - June vacation before the commencement of 7th Semester classes is desirable.

LIST OF ELECTIVES

EC 15 - 1705A DIGITAL INTEGRATED CIRCUIT DESIGN

Course Objectives:
To design a CMOS digital circuit

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze the design of combinational and sequential digital circuits using CMOS.
2. To analyse and design arithmetic building blocks and Shifters
3. To understand various Memory Architectures

Module I
Designing combinational logic gates in CMOS
Introduction - Static CMOS Design - Complementary CMOS, Ratioed Logic, Pass-Transistor Logic - Dynamic CMOS Design - Dynamic Logic: Basic Principles, Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates

Module II
Designing sequential logic circuits
Static Latches and Registers - The Bistability Principle - Multiplexer-Based Latches - Master-Slave Edge-Triggered Register - Low-Voltage Static Latches - Static SR Flip-Flops - Dynamic Latches and Registers - Dynamic Transmission-Gate Edge-triggered Registers - C^2MOS—True Single-Phase Clocked Register (TSPCR) - Alternative Register Styles - Pulse Registers - Sense-Amplifier Based Registers

Module III
Designing arithmetic building blocks
Datapaths in Digital Processor Architectures - The Adder - The Full Adder: Circuit Design Considerations – The Binary Adder: Logic Design Considerations - The Multiplier - Partial-Product Generation - Partial Product Accumulation - Final Addition - The Shifter - Barrel Shifter - Logarithmic Shifter

Module IV
Designing memory and array structures
Memory Classification - Memory Architectures and Building Blocks - The Memory Core - Read-Only Memories - Nonvolatile Read-Write Memories - Read-Write Memories (RAM) - Contents-Addressable or Associative Memory (CAM) - Memory Peripheral Circuitry - The Address Decoders - Sense Amplifiers

References:

1. Jan M. Rabaey, A. Chandrakasan, B. Nikolic, *Digital Integrated Circuits- A Design Perspective*, Pearson education,2/e,(2003)
2. Hubert Kaeslin, ETH Zürich *Digital Integrated Circuit Design – From VLSI Architectures to CMOS Fabrication*, ISBN:9780521882675, *(2008)*
3. John F Wakerly, *Digital Design – Principles and Practices*, Pearson education, Fourth edition

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15 – 1705B EMI/EMC

Course Objectives:
To understand the real world EMI issues and offer EMC design solutions

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the EMI sources and their measurements and the non ideal behaviour of various components
2. To understand the techniques for EM compatabilty in PCB designs .
3. To familiarize the fundamentals needed for solving EMI/EMC issues arising in electronics industry
4. To learn how to minimise the interference due to conducted emission .

Module I
Introduction to EMC, Aspects of EMC, decibels and common EMC units. EMC requirements for Electronic systems: Governmental requirements, Product requirements. Antennas, elemental dipole antennas, characterization of antennas, Directivity and gain, effective aperture, Antenna Factor

Module II
Non Ideal behavior of components: Wires, resistance and internal inductance of wires, external inductance and capacitance of parallel wires, Resistors, Capacitors, Inductors, Ferrites and common-mode chokes.

Module III
Spectra of digital circuit waveforms, spectral bounds for Trapezoidal waveforms, Spectrum analyzers. Radiated Emissions and Susceptibility: Simple emission models for wires and PCB lands, Differential-mode versus common- mode currents, differential-mode current model, common-mode current model. Simple susceptibility models for wires and PCB lands.

Module IV
Conducted Emissions and Susceptibility: Measurement of conducted emissions, The Line Impedance Stabilization Network (LISN), Common and differential mode current gain, power supply filters. Electro static Discharge (ESD), origin of ESD and effects of ESD. Shielding, shielding effectiveness –far-field sources, shielding effectiveness – near-field sources,

References:

1. Clayton R. Paul, *Introduction to Electromagnetic compatibility*, John Wiley and Sons Inc,1992, ISBN-10:0471549274, ISBN- 13: 978-0471549277
2. Henry W Ott, *Electromagnetic Compatibility Engineering*, John Wiley and Sons,1/e,(2009), ISBN-13: 978-0470189306, ISBN- 10: 0470189304
3. Archambeault Bruce R, Ramihi Omar M, Brench, *EMI/EMC Computational Modelling Handbook*, Springer publications,2/e,(2001)
4. James E. Vinson, Joseph C. Bernier, Gregg D. Croft , Juin Jei Liou, *ESD Design and Analysis Handbook*, Springer, 1/e, (2002), ISBN-10: 140207350X, ISBN-13: 978-1402073502
5. Ernest O Doebelin, Dhanesh.N.Manik, *Doeblin's Measurement System*, TMH, 6/e, (2011)

Type of Questions for End Semester Examination

PART A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)
PART B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1705C NEURO-FUZZY SYSTEMS

Course Objectives:

To apply Neural Network and Fuzzy Logic to Systems Engineering

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the basics of Neural Networks and essentials of Artificial Neural Network
2. To understand Fuzzy sets and Fuzzy Logic system components
3. To differentiate between Neuro – Fuzzy and Fuzzy – Neural Controllers

Module I

Basics of Artificial Neural Networks-Biological Aspects, Development of Neural Network Principles, Artificial Neural Networks, Artificial neural net terminology, Model of a neuron, Topology, Perceptrons, Widrow-Hoff LMS algorithm; Multilayer networks, Back propagation algorithm, variants of Back propagation Learning, Types of learning-Supervised, Unsupervised, Reinforcement learning. Characteristics of Neural Networks. Basic Learning Laws. Activation Dynamic Models, Synaptic Dynamic Models, Learning Methods, Stability and Convergence. Feed Forward Neural Networks and Feed Back Neural Networks, Boltzmann Machine. Competitive Learning Neural Networks.

Module II

Neural Networks Based Control- Representation and identification, modeling the plant, control structures –supervised control, Model reference control, Internal model control, Predictive control. Architectures for Complex Pattern Recognition Tasks- Associative Memory, Pattern Mapping, Stability-Plasticity Dilemma-ART, Temporal Patterns, Pattern Variability: Neocognitron. Direct and Indirect Adaptive Control Using Neural Networks. Applications of neural nets - Pattern recognition, Optimization, Associative memories, Speech and Decision making. Vector quantization.

Module III

Fuzzy Logic- Introduction, Fuzzy Sets, Concept of Fuzzy Number, Operation of Fuzzy sets, Properties of Fuzzy Set, Fuzzy versus probability, Fuzzy relations and Fuzzy relation calculations – Fuzzy members – Indices of Fuzziness –Comparison of Fuzzy quantities – Methods of determination of membership functions. Fuzzy Rule systems and interpretability of Fuzzy Rule systems, Knowledge Processing with Fuzzy Logic, Fuzzy Linguistic variables, Linguistic Modifier, Fuzzy Implication Relations/ Compositional Rules.

Module IV

Fuzzy Logic Control- Mamdani Model. Fuzzy Controllers: Basic construction of fuzzy controller –Analysis of static properties of fuzzy controller – Analysis of dynamic properties of fuzzy controller. Construction of FLC. Fuzzy PD controllers, Fuzzy PI Controllers. Case study – fuzzy control for smart cars.Neuro – Fuzzy and Fuzzy – Neural Controllers: Neuro – fuzzy systems: A unified approximate reasoning approach – Construction of role bases by self- learning: System structure and learning algorithm – A hybrid neural network based Fuzzy controller with self- learning teacher. Fuzzified CMAC and RBF network based self-learning controllers.

References:

1. B. Yegnanarayana, *Artificial Neural Networks*, Prentice Hall of India,(2009)
2. Yaochu Jin, *Advanced Fuzzy Systems Design and Applications*, Springer.
3. Bart Kosco, *Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence*, Prentice Hall of India.
4. Laxmidhar Behera, Indrani Kar, *Intelligent Systems and Control-Principles and applications*. Oxford.
5. M.Ganesh, *Fuzzy Set and Fuzzy Logic*, Prentice Hall of India.
6. John Harris, *An Introduction to Fuzzy logic Applications*, Springer.
7. James J Buckley, *Fuzzy Probabilities-New approach and Applications*, Springer.
8. James A Anderson, *An Introduction to Neural Networks*, Prentice Hall of India,(2009)
9. Robert J Schalkoff_*Artificial Neural network*, TMH,(2011),
10. Satish kumar, *Neural Networks-A class room approach*,TMH,(2011)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1705D COMPUTER ORGANISATION & ARCHITECTURE

Course Objectives:
To understand the architecture of a processor, ALU, memory organisation.

Course Outcomes:
On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the architecture of processor.
2. To understand the design of processors.
3. To understand memory organisation.

Module 1
Introduction to Processor Architecture – Design Methodology- System Representation – Gate level – Register level – Processor level – CPU Organization – Data Representation – Basic Formats – Fixed Point Numbers – Floating Point Numbers – Instruction Sets – Instruction Formats – Instruction Types – Programming Considerations.

Module 2
Datapath Design – Fixed Point Arithmetic – Addition and Subtraction – Multiplication – Division – Arithmetic Logic Units – Combinational ALUs – Sequential ALUs – Floating Point Arithmetic – Pipeline Processing – Control Design : Basic Concepts – Introduction – Hardwired Control – Design Examples – Microprogrammed Control – Basic Concepts – Multiplier Control Unit – CPU Control Unit – Pipeline Control – Instruction Pipelines – Pipeline Performance – Superscalar Processing

Module 3
Memory Organisation – Memory Hierarchy – Main memory – RAM and ROM chips – Memory Address Map – Memory Connection to CPU – Auxiliary Memory – Magnetic disks – Magnetic Tape – Associative Memory – Hardware Organization - Read Operation – Write Operation – Cache Memory : Associative Mapping – Direct Mapping – Set Associative Mapping –Virtual Memory – Address Space and Memory Space – Address Mapping Using Pages – Associative Memory Page Table – Page Replacement – Memory Management Hardware – Segmented Page Mapping

Module 4
System Organization – Communication Methods – Basic Concepts – Bus Control – I/O and System Control – I/O Organization – Isolated Versus Memory Mapped I/O - Programmed I/O – DMA and Interrupts – I/O Processors – Operating Systems – Parallel Processing – Processor Level Parallelism – Multiprocessors – Fault Tolerance.

Reference:

1. Patterson D.A. & Hennessy J.L., *Computer Organization and Design*, Morgan Kaufmann Publishers, (2002)
2. John.P.Hayes *Computer Architecture and Organization*, McGraw-Hill International Editions, Computer Science Series, (1998).
3. Morris Mano *Computer System Architecture*, Prentice-Hall India, Eastern Economy Edition, (2009)
4. Carl Hamacher, Zvonko Vranesic & Safwat Zaky, *Computer Organization*, Mc Graw Hill, (2001)
5. Pal Choudhuri P., *Computer Organization and Design*, Prentice-Hall India, 2nd Edition, (2003)
6. William Stallings, *Computer Organization and Architecture*, Pearson Education, 4th Edition, (2006)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1705E OPTICAL FIBER COMMUNICATION

Course Objectives:

To understand the working of various sources, detectors and couplers in Opto Electronics & Optical Communication

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze optical networks and fibers
2. To understand the working of different components of fiber optic networks
3. To understand the design issues in an optical link

Module I

Overview of optical communication systems, History of optical communications, Wave theory of light, Reflection and refraction of plane waves; Optical waveguides Planar waveguides, Characteristics of optical fibers , numerical aperture, Wave propagation in multimode and single-mode optical fibers, Coupling into and out of fibers, attenuation, group-velocity dispersion, optical nonlinearities, polarization-mode dispersion.dispersion shifted and polarization maintaining fiber

Module II

Optical sources and transmitters: Optical sources, Physics of light emission and amplification in semiconductors, -direct and indirect band gap materials-LED structures- quantum efficiency- modulation. Laser diodes- rate equations- diode structure- single mode laser-modulation- temperature effects- quantum cascade lasers-vertical cavity surface emitting lasers- modal noise- partition noise- reflection noise. Light coupling-source to fiber coupling.Photo detectors-PIN, APD, Photo detector noise - response time- structure of detectors- receiver units.

Module III

Components of fiber optic networks: – couplers - splitters- semiconductor optical amplifiers- Erbium doped fiber amplifiers- wavelength division multiplexers/ demultiplexers. Filters- isolators-circulators-optical switches- Wavelength converters- Fiber gratings tunable sources-tunable filters.

Module IV

Dispersion in optical communication systems, Dispersion in single-mode and multimode fibers, Dispersion-induced pulse broadening in single-mode fiber, coherent & non coherent detection, channel capacity, various limits of transmission rate- Optical link design, Power and noise budget, Jitter and rise time budgets.

References:

1. Gerd Kaiser , *Optical fiber communication*, McGraw Hill ,4/e, (2007), ISBN 9780070648104
2. John M. Senior, *Optical fiber Communication*, Pearson Education India, 3/e
3. John Gowar, *Optical communication systems*, Prentice Hall Inc, (1984)
4. Mynbaev and Scheiner, *Fiber optic communications technology*, Pearson Education, (2001)
5. Ray Tricker, *Optoelectronics and Fiber Optic Technology*, Elsevier India Pvt. Ltd, (2006)
6. Joachim Piprek, *Semiconductor Optoelectronic Devices*, Elsevier India Pvt. Ltd, (2005)
7. Govind P. Agrawal, *Fiber-Optic Communication Systems*, Wiley India, 3/e
8. Max Ming-Kang Liu, *Principles and applications of optical communications*, McGraw hill,1/e, (2010)
9. Kasap, *Optoelectronics and Photonics: Principles and Practices* ,Pearson Education , (2009) ,ISBN 978131726482

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1706F NANO ELECTRONICS

Course Objectives:

To understand the fundamentals physics behind Nano electronics and nano devices

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To under the quatum mechanics theory behind the nano electronics concept
2. To understand nano structures and quantum behaviours
3. To familiarise nao devies and systems

Module I

Introduction to nano Electronics, Top down and bottom-up approach- classical particles- waves quantum particles-Quantum mechanics of Electron – Time dependent shordinger equation - Probability density- Free and confined Electron- finite potential well- Electron in a periodic potential well- kronig and penny model- Band theory

Module II

The physics of low dimensional structures - basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells - -Tunnelling Junction- resonant tunnelling - coulomb blockade

Module III

Review of density of states-Semiconductor hector junction - Quantum well – Nano wires and quantum wires - Quantum dots and nanoparticles, Fabrication Techniques. Carrier transport in nano devices-Ballistic transport. Transport of spin- spintronic devices.

Module IV

Nanoelectonic devices and systems - MODFETS, heterojunction bipolar transistors, resonant tunnel effect, RTD, RTT, hot electron transistors, Carbon nanotube transistor, heterostructure semiconductor laser, quantum well laser, quantum dot LED, quantum dot laser, quantum well optical modulator, quantum well sub band photo detectors, nanoswitches

References:

1. G W Hanson ,*Fundamental of nano electronics* Pearson education ,(2009), ISBN 9788131726792
2. M Duart, R J Martin, F Agullo Rueda *Nano Technology for Micro electronics and optoElectronics*, Elsevier ,(2006)
3. J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda *Nanotechnology for Microelectronics and optoelectronics*, Elsevier, (2006).
4. W.R. Fahrner, *Nanotechnology and Nan electronics*, Springer, (2005)
5. Supriyo Dutta, *Quantum Transport- Atom to transistor*, Cambridge University Press, (2005).
6. K goser, P Glosekotter, J. Dienstuhl ,*Nano Electronics and Nano Systems*,Springer ,(2005)
7. J J Ramsden, *Nano-Technology An introduction* ,Elsevier ,(2011)
8. T Pradeep, *Nano : the essentials* McGraw Hill Education ,(2007)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

SEMESTER VIII

EC 15- 1801 ELECTRONIC PRODUCT DESIGN

Course Objectives:

To design an electronic product with industrial standards

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze the products existing in the market,
2. To convert a concept to an electronic product
3. To solve various practical issues like noises, thermal management and EMI
4. To understand the Industrial Design Process, IP Rights modelling of electronic components and PCB design

Module 1

Overview: - From Requirement to Product: Engineering design as real life problem solving- Requirement analysis of Electronic products- Formulation of product requirement specifications and target specifications.

The design process: Product conceptualization- Product architecture- Product synthesis- Portable Electronic Design Factors- Computer Aided Design. Product Life Cycle. Various dimensions of Electronic Product Design- Industrial design and Engineering design- Aesthetics and Ergonomics- Inputs, control and display interface.

Module II

Electronic interconnection and Packaging of components, Integrated circuits, Printed circuits and Functional products- Cables and connectors- Design Documentation, Engineering Documentation and Test Documentation –Component Specification/ Bill of materials. Enclosure sizing, requirement of enclosure and standards of enclosures. **Noise and thermal management**: Noise- Types of noise-Noise coupling mechanisms in Electronic Circuits- **EMI/EMC**, EMI standards and regulations, Grounding, cabling, Shielding, Guarding..

Module III

Thermal Considerations in Electronic Product Design: Heat generation and modes of heat transfer in Electronic Products- Selection/Design of Heat Sinks- Factors affecting the design of heat sinks and its cooling effectiveness-Assembly of components on heat sinks- Electrical analogue of thermal circuits- Enclosure design of Electronic Equipments and thermal considerations- Design guidelines for Ventilations- Forced cooling- Heat pipes for electronic cooling applications.

Basic Principles and Acquisition of Intellectual Property Rights: Philosophical Aspects of Intellectual Property Laws Basic Principles of Patent Law Patent Application procedure Drafting of a Patent Specification Understanding Copyright Law Basic Principles of Trade Mark Basic Principles of Design Rights, International Background of Intellectual Property Memory-Technology & devices -Flash memory-

Module IV

IPCB design: requirements in PCB Design- PCB Design elements- PCB design process- advantages of PCBs Design rules for analog, digital, high-frequency, power-electronic and MW PCBs-PCB design guidelines for EM compatibility.

Introduction to SPICE simulation of circuits- Circuit description- Modelling of active and passive circuit elements - DC, AC, Transient and Parametric circuit analysis.

Module V *(Tutorial Only-No questions from this module for End Semester Examination)*

Electronic Design Automation Tools: Introduction to PC based Electronic Design Automation Tools: Schematic Capture, Circuit Simulation, Layout Design etc. features like EMI analysis, Thermal analysis, 3d visualization etc. of such packages with reference to EDA tools such as Orcad, EDWIN XP etc.

(As assignment, each student shall design and simulate an electronic product following the above syllabus using EDA tools.)

References:

1. R.G.Kaduskar, V.B Baru, *Electronic Product Design*, Wiley India, 2/e.
2. Karl T. Ulrich & Steven D. Eppinger, *Product Design and Development*, Tata McGraw Hill, (2004)
3. Thermal Design of Electronic *Equipment- Monogram by CEDT*, IISc., Bangalore.
4. Mohammed H. Rasheed, *Spice for circuits & Electronics using Pspice*, Prentice Hall India,3/e
5. V. Prasad Kodali, *Engineering Electromagnetic Compatibility-Principles, Measurements, and Technologies, S.* Chand & Company Ltd,(2000)
6. Walter C. Bosshart, *Printed Circuit Boards- Design and Technology*, Tata McGraw Hill, 1988
7. Kevin Otto, Kristin Wood, *Product Design- Techniques in Reverse Engineering and New Product Development*, Pearson Education, (2004)
8. Richard Stillwell, *Electronic Product Design for Automated Manufacturing*, Marcel Dekker Pub
9. Bert Haskell, *Portable Electronics Product Design and Development*, McGraw Hill, (2004)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1802 WIRELESS COMMUNICATION

Course Objectives::

To synthesize and analyze communication systems over a stochastic fading channel.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand wireless systems
2. To analyze the performance of multicarrier modulation
3. To understand adaptive modulation and adaptive MQAM
4. To understand diversity reception techniques.

Module I

Overview of Wireless Systems. Wireless spectrum, Signal Propagation, Path Loss Models and Shadowing, Combined Path Loss shadowing, Coverage Area, Statistical Fading Models, Narrowband Models, Signal Envelope Distribution, Fading Distributions and Duration. Markov Model. Wideband Fading. Doppler and Delay Spread, Wideband Channel Models.

Module II

Capacity of wireless channels- Fading Channels, Capacity of Flat and FS Fading Channels, Modulation schemes, Linear Modulation Performance in Fading, Performance in Fading and ISI. Diversity, receiver diversity, Transmit Diversity

Module III

Adaptive Modulation and Adaptive MQAM. Impact of Finite Constellations. MIMO and Space/Time Communications, MIMO Capacity, Beam forming, Diversity, Space time codes.

Module IV

Multi carrier modulation – OFDM- Multi user systems – multiple access-random access- multi used diversity.
Adhoc wireless networks – cross layer Design- Energy Constrained Networks.

References:

1. A. Goldsmith ,*Wireless Communication* , Cambridge ,(2011)
2. C Y Lee, *Mobile Communication Engineering* , TataMcGrawhill ,2/e ,(2008)
3. Theodore S. Rappaport, Simon: *Wireless communication principles and practice* ,Pearson Education,2/e
4. Haykin, Michael Mohar, *Modern wireless communication*, Pearson Education,(2008)
5. William Stallings, *Wireless communication and networks*, Pearson Education, (2006).
6. Molisch ,*Wireless communication* ,Wiley India ISBN 9788126510566
7. William C Y Lee: *Mobile cellular Telecommunications*, McGraw Hill, 2/e.
8. John P Proakis&Salehi ,*Digital Communication*, McGrawHill,5/e, (2008),ISBN 9780070591172
9. S R Saunders AA Zavala, *Antennas and propagation for Wireless Communication Systems*, Wiley India, 2/ e

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1803 COMPUTER COMMUNICATION AND NETWORKING

Course Objectives:

To appreciate the various data communication techniques and protocols along with advanced networking concepts

Course Objectives

On successful completion of teaching-learning and valuation activities, a student would be able

1. To demonstrate the knowledge and ability to independently understand basic computer network technologies
2. To identify the different types of network topologies and protocols
3. To enumerate the layers of OSI model and TCP/IP Protocols with its application.
4. To familiarize with network design and implementation of basic protocols of computer network

Module I

Communication Networks and Services: Network functions and network topology, basics of message switching, packet switching, circuit switching and cell switching. Application and Layered Architectures Layering architecture, the OSI reference model, unified view of layers, protocols and services, overview of TCP/IP architecture, TCP/IP protocol. digital Representation of Analog Signals, Line Coding, Modems and Digital Modulation, Circuit- Switching Networks, Multiplexing, SONET, Transport Networks, Circuit Switches, Signalling, Traffic and Overload Controls in Telephone Networks, Cellular Telephone Networks.

Module II

Peer-to-Peer Protocols and Data Link Layer, Peer-to-Peer Protocols, ARQ Protocols and Reliable Data Transfer Service. Derivation of Efficiency of ARQ Protocols. Data Link Controls, Framing, Point-to-Point Protocol, HDLC Data Link Control, Link Sharing Using Packet Multiplexers. Multiple access communications, local area networks (LAN) structure, the medium access control sub layer, the logical link control layer, random access, ALOHA, slotted ALOHA, CSMA, CSMA/CD, scheduling approaches to medium access control, reservation systems, polling, token passing rings, comparison of random access and scheduling medium access controls. IEEE LAN standards

Module III

Packet Switching Networks: Network services and internal network operation, packet network topology, connectionless packet switching, virtual circuit packet switching, routing in packet networks, routing algorithm classification, routing tables, hierarchical routing, link state versus distance vector routing, shortest path algorithms, Dijkstra's algorithm.

Module IV

TCP/IP : The Internet Protocol (IP), IP packet, IP addressing, subnet mask, classless inter domain routing (CIDR), address resolution, reverse address resolution, IP fragmentation and reassembly, User Date gram Protocol (UDP), Transmission Control Protocol (TCP), TCP Reliable stream service, TCP operation, Dynamic Host Configuration Protocol (DHCP), mobile IP, IPv6, internet routing protocols, distance vector multicast routing protocol. Integrated Services i, RSVP, Differentiated Services, Network Interconnection Models, MPLS, Real-Time Transport Protocol, Session Control Protocols

References:

1. Leon Garcia &Widjaja ,*Communication Networks* Tata McGraw Hill Publication, 2/e, ISBN 9780070595019
2. Andrew S. Tanenbaum, *Computer Networks*, Pearson education/ PHI Ltd., 4/e
3. Bertsekas and Gallagar, *Data Networks*, Prentice Hall India, 2/e.
4. James F. Kurose and Keith W. Ross, *Computer Networking – A Top-Down Approach Featuring the Internet*, Pearson Education, 2/e
5. F. Halsall, *Data Communication, Computer Networks and Open Systems*, Addison Wesley, 1996
6. S. Keshav, *An Engineering Approach to Computer Networking*, Pearson education, (2002)
7. Uyless Black, *Computer Networks – Protocols, Standards and Interfaces*, PHI Ltd, 1994
8. Behrouz A. Fourouzan, *Data Communications and Networking*, Tata McGraw Hill, 2/e
9. Anurag Kumar, D. Manjunath, Joy Kuri, *Communication Networking : An Analytical Approach*, Elsevier, (2005)
10. William Stallings, *Wireless Communications & Networks*, Prentice Hall, (2001)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 18L1 SEMINAR

Course Objectives:

To encourage and motivate the students to read and collect recent and relevant information from their area of interest confined to the relevant discipline from technical publications including peer reviewed journals, conferences, books, project reports, etc., prepare a report based on a central theme and present it before a peer audience

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To Identify and familiarize with some of the good publications and journals in their field of study.
2. To Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and reference identifying their intended meaning and style.
3. To Understand effective use of tools of presentation, generate confidence in presenting a report before an audience and improve their skills in the same.
4. To Develop skills like time management, leadership quality and rapport with an audience

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Electronics & Communication Engineering. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks, technical reports and URLs. The references shall be incorporated in the report following IEEE standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 30 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

EC 15- 18L2 PROJECT PHASE 2

Course Objectives:

To enable students to apply any piece of theory and experiments which they have learned to a specific problem related to industry / research which is identified with the help of a guide in Phase I and solve it

Course Outcomes:

On successful completion, a student would be able

1. Realize various steps involved in conducting a project work, like literature survey, methodology adopted – field study / survey / experiments / numerical work, analysis of the data to arrive at final results and conclusions, etc.
2. Initiate a habit of proper report writing with all of its major components, proper style of writing and preparation of a distinct abstract and carved out conclusions.
3. Conceive the pros and cons of working in a team and the wonderful results which could evolve through team-work.
4. Present and defend self-prepared and corrected report (with the help of project guide) of a self-created work to a peer audienceTo analyze and formulate a socially relevant problem

Each batch of students shall develop the project designed during the VII semester. The implementation phase shall proceed as follows:

- For hardware projects, practical verification of the design, PCB design, fabrication, design analysis and testing shall be done
- For software projects, a proper front end (GUI) if applicable shall be designed. A detailed algorithm level implementation, test data selection, validation, analysis of outputs and necessary trial run shall be done
- Integration of hardware and software, if applicable, shall be carried out.
- A detailed project report in the prescribed format shall be submitted at the end of the semester. All test results and relevant design and engineering documentation shall be included in the report.
- The work shall be reviewed and evaluated periodically

A committee consisting of the Project Coordinator (appointed by the Head of the Department / Division), project guide and at least one senior faculty member will carry out the assessment based on at least one interim review and a final review just before the submission of the project report.

The final evaluation of the project shall include

- Presentation of the work,
- Oral examination ,
- Demonstration of the project against design specifications
- Complete project report

Guidelines for evaluation:

i.	Regularity and progress of work	40%
ii.	Work knowledge and Involvement	40%
iii.	End semester presentation and oral examination	40%
iv.	Level of completion and demonstration of functionality/specifications	40%
v.	Project Report – Presentation style and content	40%
	Total	200 marks

Note: Points (i) and (ii) to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. (iii)-(v) to be evaluated by the final evaluation team.

EC 15- 18L3 COMPREHENSIVE VIVA VOCE

Course Objectives:

To test the student's learning and understanding of the theory and applications of the various concepts taught during the entire course of their program and to prepare the students to face interviews in both the academic and industrial sectors

Course Outcomes:

On successful completion, a student would be able to

1. To refresh all the subjects covered during the programme
2. To gain good knowledge of theory and practice
3. To develop oral communication skills and positive attitude
4. To face technical interviews with confidence

Each student is required to appear for a viva-voce examination at the end of the complete course work. The examination panel shall comprise of Head of Division or his/her nominee and one senior faculty of the Division and an external expert appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the program of study and practical/analysis skills in the field of Electronics and Communication

LIST OF ELECTIVES

EC 15- 1804A ASIC DESIGN

Course Objectives:

To design an ASIC, its testing and fault diagnosis.

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the types of ASICs , construction of ASIC
2. To analyse floor planning, Placement and Routing algorithms
3. To explore the need and importance of testing and fault diagnosis.

Module I

Introduction to ASICs: - Types of ASICs - Design flow

ASIC construction: Physical Design-Partitioning methods-simple partitioning- constructive partitioning - Interactive partitioning -KL algorithm- Ratio Cut algorithm- simulated annealing

Module II

Floor planning: Goals and Objectives- Floor planning tools- channel definition- I/O and Power planning- clock planning.

Placement: placement term and definitions -goals and objectives- placement algorithm- iterative placement improvement- placement using simulated annealing-time driven placement methods

Module III

Routing: Global routing-goals and objectives- global routing methods- global routing between blocks and inside flexible blocks- Detailed routing- measurement of channel density- left edge algorithm-constrains and routing graphs- area routing algorithm- multi level routing. Special routing: Clock routing- power routing- circuit extraction – DRC.

Module IV

Testing: Importance- BST cell- Boundary scan Controller-BIST-LFSR- signature analysis – MISR-Test vector-test flow.

Faults: Fault models, physical faults, Stuck at fault model, Logical faults, Fault collapsing, Fault simulation – serial fault simulation, parallel fault simulation, concurrent fault simulation, nondeterministic fault simulation, ATPG-D- Calculus, Basic ATPG algorithm, PODEM algorithm, controllability, observability

References:

1. M.J.S .Smith, *Application Specific Integrated Circuits*, Pearson Education ,(2006), ISBN:978-81-7758-408-0
2. Andrew Brown, *VLSI Circuits and Systems in Silicon*, McGraw Hill.
3. Dhiraj K. Pradhan, *Fault tolerant Computer system design*, PH, 2/e, (2003),I SBN:0-13-057887-8

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1804B RADAR AND NAVIGATION

Course Objectives:

To explore basic aspect of modern radar system and understand satellite communication and microwave radio communication system

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To provide good understanding of radar system , radar signal processing, radar target tracking and ENS
2. To understand different types of radar receivers
3. To enhance the knowledge of microwave radio communication
4. To understand principles of satellite communication.

Module I

Introduction to RADAR: General form of RADAR range equation – block diagram of simple pulsed RADAR and determination of range - maximum Unambiguous range, Radar resolution cell volume, pulse repetition frequency , relevance of Cosecant squared radiation pattern for RADAR antennas - RADAR displays - synthetic and Raw displays, Radar Types based on frequency, Waveform, prf, applications. Probability of detection and false alarm - integration of RADAR pulses-RADAR cross section of various targets.

Module II

Radar Systems: Doppler frequency shift and determination of velocity –Block diagram and working principle of CW Doppler RADAR, FMCW Radar and Pulsed Doppler RADAR. MTI Radar block diagram and use of Delay line cancellers- Blind speed-Digital MTI processing- Tracking Radar: Types Monopulse tracking-Amplitude comparison monopulse system in one/ two coordinates (block diagram)-phase comparison monopulse, Sequential lobing, Conical scan tracking Radar –tracking in range- comparison between Monopulse and conical scan tracking RADARs.

Module III

Radar Receivers: Block diagram of super heterodyne receiver- Detection of Radar signals in noise –Matched filter criterion- detection criterion – Extraction of information and waveform design. **Special purpose radars**: Synthetic Aperture Radar- Height finder- 3D radars -Radar Beacons- Radar Jamming. **Microwave Radio communication** – block schematics of Terminal transmitters and receivers -Salient features, radio repeaters, microwave radio stations, Line of sight path characteristics, Free space loss, Path clearance, Fade margin, Microwave Radio system gain, Receiver threshold, CNR and SNR, Noise figure.

Module IV

Satellite Communication: Communication satellites –sub systems of Space-craft - payload – repeater, antenna, control systems. Orbits- Orbital parameters, *Apogee&Perigee*, period, velocity, coverage angle and slant angle, geostationary orbits look angle, near-geostationary constellations, launching orbits. Elements of digital satellite communication systems, Digital baseband signals, Digital modulation techniques, Satellite digital link design, inter modulation noise and inter satellite links. Principle of Global Positioning Systems – Instrument landing system

References:

1. Merrill I. Skolnik, Introduction to Radar Systems, 3/e, McGraw Hill, (2006).
2. Dennis Roddy, Satellite Communications, Prentice Hall Inc., 4/e,ISBN:978-00-700-778-50
3. Byron Edde, Radar Principles,Technology,Applications,Pearson Education1/e,1993.
4. Mark A Richards, Fundamentals of Radar Signal Processing, Mc Graw Hill ,(2005).
5. J. C. Toomay, Paul Hannen, *Principles of RADAR*, PHI, 3 /e, (2010).
6. Wayne Tomasi, *Electronic Communications Systems, Fundamentals through advanced*, Pearson Education 5/e,(2008)
7. Harvey Lehpamer, *Microwave Transmission Networks,* Planning, Design and Deployment, TMH,2/e, (2010)
8. Tri T Ha, *Digital Satellite Communication*, Tata McGraw Hill Publishers,/e, (2009).
9. G S N Raju, *Radar Engineering and Fundamentals of Navigational aids*, I K Publishers.
10. W.L. Pritchard, HG Suyderhoud and RANelson, *Satellite Communication Systems Engineering*, Pearson education, 2/e, 2012
11. S. K. Raman, *Fundamentals of Satellite Communication*, 1/e, Pearson , (2011)
12. Anil.K.Maini,Varsha Agrawal, *Satellite Communications*,Wiley publications,(2011)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15- 1804C MECHATRONICS

Course Objectives:

To get the concept of numerical control of actuators and sensors and the associated design challenges

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyze different systems and their response
2. To understand various actuation systems
3. To learn the concept of Numerical Control systems
4. To understand MEMS, PIDs,PLC etc and their selection criteria

Module I

Introduction to Mechatronics - Elements of Mechatronic Systems. Mechatronics in manufacturing - Mechatronics in products - Scope of Mechatronics.

Mathematical modelling of Engineering Systems: System Building blocks for Mechanical, Electrical, Fluid and Thermal systems.

General Engineering System Modelling: Rotational - Translational, Electromechanical, Hydraulic_ Mechanical systems - System Transfer Function - Dynamic response of systems for standard test signals (Detailed mathematical analysis not required).

Module II

Actuation Systems: Pneumatic & Hydraulic Systems: Process Control Valves, Directional and Pressure Control valves, Linear and Rotary actuators.**Mechanical Actuation Systems:** Translational and Rotational motions, Kinematic Chains, Cams, Gear Trains, Ratchet and Pawl, Belt and Chain drives, Bearings.**Electrical Actuation Systems:** Mechanical and Solid State Relays, Solenoids, DC & AC motors, Servo & Stepper motors- feedback devices - encoders - pulse digitizers - resolvers - inductosyn – tachometers.

Module III

Fundamentals of numerical control - advantages of NC systems - classification of NC systems - point to point and contouring systems - NC and CNC - incremental and absolute systems - open loop and closed loop systems -features of NC machine tools - fundamentals of machining - design consideration of NC machine tools - methods of improving machine accuracy and productivity

Industrial robotics - basic concepts - robot anatomy - robotics and automation - specification of robots - resolution- repeatability and accuracy of manipulator - classification of robots.

Module IV

MEMS: Internal Structure, advantages, manufacturing, applications - Fibre Optic Devices in Mechatronics

Mechatronic System Controllers: ON/OFF, P, I, D, PI and PID Controllers, Digital controllers, Intelligent Controllers in Mechatronics.**Programmable Logic Controllers:** Structure, I/O processing, Programming, applications – Selection Criteria.

References:

1. Bolton. N, *Mechatronics- Electronic Control systems in Mechanical and Electrical Engineering*, Pearson Education,4/e, (2008)
2. Rolf Isermann, Mechatronic Systems: Fundamentals, Springer, (2005).
3. W. Bolton, Mechatronics, Pearson Education Limited, (2015).
4. M.D. Singh, J.G. Joshi, *Mechatronics*, Prentice Hall India, New Delhi, (2006)
5. Dradly. D.A, Dawson.D, Burd N.C and Loader A.J, *Mechatronics – Electronics in Products & Processes*, Chapmen & Hail, 1993.
6. HMT Limited, Mechatronics, Tata McGraw Hill, (1998).
7. James Harter, *Electromechanics- Principles concept and Devices*, Prentice Hall, (1995).
8. Michel P. Groover, *Industrial Robots-Technology, Programming and Applications*, McGraw Hill, (1986)
9. Yoram Koren & Ben Yuri, *Numerical Control of Machine Tools*, Khanna Publishers,(1984)
10. A.Smaili,F.Mrad,*Mechatronics-Integrated Technologies for Intelligent Machines*,Oxford,(2009)
11. Appukuttan .K.K, *Introduction To Mechatronics*, Oxford University Press,1/e, (2007)
12. David G Alciatore,Micheal ,*Introduction to Mechatronics and Measurement Systems*,TMH,3/e,(2007)
13. Nitaigour P Premchand,*Mechatronics-Principles,Concepts and Applications*,TMH,11/e,(2011)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-1804D BIO- INFORMATICS

Course Objectives:

To appreciate the diverse field of study and apply electronic engineering skill n the new discipline

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand basics of molecular biology and molecular structure predictions
2. To understand the concept of sequence alignment and its types
3. To familiarise Genomic Signal processing approach

Module I

Basic Concepts of Molecular Biology: Cells - Chromosomes, DNA, RNA, Proteins, Central dogma of molecular biology, Genomes and Genes - Genetic code, Transcription, Translation and Protein synthesis. Web based genomic and proteomic data bases: NCBI, GenBank

Module II

Sequence alignments – Dot plot-Pair-wise sequence alignments - local and global -Sequence similarity and distance measures - Smith-Waterman algorithm, Needleman-Wunch algorithm, Multiple sequence alignment –Sum-of-Pairs measure - Star and tree alignments – PAM and BLOSUM, Phylogenetic analysis

Module III

Informational view of Genomic data, Genomic Signal Processing, DNA Spectrograms, Identification of protein coding regions, Gene expression, Microarrays, Microarray image analysis

Module IV

Gene structure in Prokaryotes and Eukaryotes: Molecular Structure Prediction: Basic concepts and terminologies related to molecular structures, Basic molecular Visualization, RNA secondary structure prediction, Protein folding problem, Protein Threading, Protein Visualization, Introduction to Drug Discovery.

Case Study

Software Tools: Use of Tools for basic and specialized sequence processing such as: BLAST, FASTA, RasMol, Phylip, ClustalW

Textbooks:

1. Setubal & Meidanis, *Introduction to Computational Molecular Biology*, Thomson:Brooks/Cole, International Student Edition, (2003)
2. Claverie & Notredame, *Bioinformatics - A Beginners Guide*, Wiley-Dreamtech India Pvt Ltd, (2003).

References:

1. Lesk, *Introduction to Bioinformatics*, Oxford University Press, Indian Edition, (2003)
2. Higgins and Taylor, *Bioinformatics: Sequence, structure and databanks*, Oxford University Press, Indian Edition, (2003)
3. Bergeron, *Bioinformatics Computing*, Prentice hall of India, (2003)
4. Jiang, Xu and Zhang, *Current topics in Computational Molecular Biology*,AneBooks, NewDelhi, (2004)
5. S.C Rastogi &Namitha Mendiratta,*Bioinformatics method and application*
6. Dov Stekel, *Microarray Bioinformatics* ,Cambridge University Press

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I
Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-1804E MULTIMEDIA COMMUNICATION SYSTEMS

Course Objectives::

To get an idea about the various technique and standards used for multimedia communication

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the underlying concepts, principles, techniques related to video coding.
2. To learn basic techniques and international standards for image, video, and audio coding.
3. To familiarize with the international standards
4. To understand state-of-the-art compression technologies

Module I.

Introduction to Multimedia towards a definition, The elements of Multimedia, Multimedia today and tomorrow, Using Multimedia: applications ,benefits and problems, Multimedia Authoring and Tools, Multimedia Information

Representation, digitization principles, Text, Images, Audio, Fundamental Concepts in Video, Color in Image and Video, Basics of Digital Audio.

Module II

Multimedia Compression Techniques.

Basic Audio Compression Techniques- Quantization, Non-linear Quantization, Differential Encoding, Linear Prediction Coding-LPC, DPCM, DM, Adaptive DPCM.

Lossless Compression-Run Length Coding, Statistical Coding, Huffman Coding, Dictionary Coding, Arithmetic Coding. Lossy Compression-Transform coding, DFT, DCT, Harr Transform, KLT, Wavelet Transforms, Embedded Zero Tree Coder.

Module III

Multimedia Compression Standards.

JPEG Standards-Baseline JPEG, JPEG Models, JPEG (2000) Standards, JPEG-LS Standard, MPEG audio coders, Dolby audio coders. Basic Video Compression Principles, H.261, 263,264. MPEG Video Coding- MPEG-1, MPEG-2, MPEG-4, MPEG-7, MMDs, Applications Enabled by MPEG-7, MPEG-21 Digital Item Declaration.

Module IV

Communications Systems.

Multimedia Interchange-QMF, OMFI, MHEG. Multimedia Conferencing. HFC Network, Satellite Television

Networks, Terrestrial Television Networks, High-speed PSTN access technologies-ADSL, VDSL. High Definition Television, HDTV standards. Movie/ video on demand, Interactive Television, Kiosks, Content-Based Retrieval in Digital Libraries. Knowledge based Multimedia Systems, Intelligent multimedia System Design.

References:

1. Fred Halsall, *Multimedia Communications: Applications, Networks, Protocols and Standards*, , Pearson, (2011)
2. Li, Ze-Nian, Drew, Mark S, *Fundamentals Of Multimedia*, PHI, (2011)
3. Ralf Steinmetz, Klara Nahrstedt *Multimedia: Computing Communications & Applications* , Pearson, (2011)
4. Krishna Kumar D N, *Multimedia communication*, Pearson (2010).
5. John F. Koegel Buford, *Multimedia Systems*, Pearson, (2009).
6. J.R. Ohm. *Multimedia Communication Technology*, Springer International Edition, (2005).
7. Judith Jeffcoate, *Multimedia in Practice*, Pearson,(2009)
8. K.Sayood, Morgan Kauffman, *Introduction to Data Compression*, 2/e, (2000)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV

EC 15-1804F RF CIRCUIT DESIGN

Course Objectives:

To get an idea about the various technique used in RF design

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To understand the components used in RF circuits.
2. To understand actice RF components
3. To design RF amplifiers, Oscillatos , Mixers etc

Module I

Passive Components for RF: Behavior at High Frequencies: Wire, Resistors, Capacitors, Inductors, Toroids and their winding, Impedance Transformation, Coupling of resonant circuits.

Active RF components: RF diodes, RF transistors; The Transistor at Radio Frequencies: Equivalent Circuit, Y-Parameters, S-Parameters, and other relevant two-port parameters, RF Transistor Data Sheets.

Computer-Aided Design and Analysis Interconnection of networks Analysis techniques, Optimization Use of SPICE

(*Practical assignments using HSPICE is recommended*)

Module II

Microwave Printed Circuits & Microwave Solid State Devices: Bipolar Microwave Transistor, MESFET, MODFET/HEMT Microwave IC's, Microwave Diodes, and MODAMPs, Strip lines, Micro strips, Printed Microwave Components, Surface Acoustic Wave device. **Amplifiers:** High frequency Amplifier Design, Small Signal RF Amplifier Design- Biasing, Designs using Y and S Parameters, Broadband Amplifiers, Single Stage, Multistage designs. Gain and stability analysis using S parameters. Wide Bandwidth Design Fundamental limitations on matching Transmission line transformers. Use of feedback in RF amplifier design. Design for specified gain, bandwidth, and SWR.

Module III

RF Power Amplifiers: RF Power Transistor Characteristics, Biasing, Design, Matching to Coaxial Feed lines Large Signal Amplifiers Amplifier classes and efficiency Dynamic range Inter modulation distortion Third-order intercept Design of large signal linear amplifiers. Design of large-signal class-C amplifiers Design of switch-mode amplifiers. Power combiners ,Directional couplers Hybrids.

Module IV

Oscillators and Mixers: Basic oscillator model, Oscillator, Synthesizer, Phase-locked loop, Phase noise, PLL structures & Architectures. Direct Digital Synthesis, Mixer- basic concepts, single ended, single balanced and double balanced mixers. Software Radio and DSP in Radio Communication.

References:

1. Smith J, *Modern Communication Circuits*, McGraw Hill, (1986)
2. Bowick, *RF Circuit Design*, H W SAMS, (1994)
3. Chung & Levien, *Microwaves Made Simple: Principles & Applications*, ARTECH House, (1985)
4. M N Radmanesh, *RF and Microwave electronics illustrated*, Pearson Education, (2002)
5. R S Carson, *High Frequency Amplifiers* ,Wiley, (1982), 2nd ed..
6. G Vendelin, *Design of amplifiers and Oscillators by the S-parameter Method*, Wiley, (1982)
7. Reinhold Ludwig, Pavel Bretchko, *RF circuit Design: theory and practice*, PHI., (2000)
8. Herbert L Krauss, Charles W Bostian & Frederick H Raab, *Solid State Radio Engineering*,John Wiley & Sons, (1980)
9. Liao S.Y, *Microwave Devices & Circuits*, Prentice-Hall India Ltd , 3rd ed.
10. Meyr et al, *Digital Communication Receivers, Synchronisation, Channel Estimation & Signal Processing*, Wiley, (1997).
11. Jeffrey H. Reed, *Software Radio, a modern approach to Radio Engineering*, PHI., (2002)

Type of Questions for End Semester Examination

PART A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks)

PART B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I

Question nos. IV , Vwith sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV