BMS College of Engineering, Bangalore – 19

Autonomous College under VTU

Department of Electronics & Communication Engineering

3rd - 8th Semester Scheme and Syllabus

2014-15 Batch Onwards

INSTITUTE VISION

Promoting Prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

INSTITUTE MISSION

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society

PROGRAM VISION

To emerge as a Centre of Academic Excellence in Electronics, Communication and related domains through Knowledge acquisition, Knowledge dissemination and Knowledge Generation meeting global needs and standards

PROGRAM MISSION

Imparting Quality Education through state of the art curriculum, Conducive Learning Environment and Research with scope for continuous improvement leading to overall Professional Success

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1: Graduates will Professionally Progress in Electronics, Communication and related areas with an inclination towards Continuous Learning

PEO 2: Graduates will work in Diversified Teams of Multidisciplinary Environment

PEO 3: Graduates will exhibit good Inter-personal skills, adapt themselves for changes in Contemporary Technology

PROGRAM SPECIFIC OUTCOMES

The students will be able to -

1. Analyse and design electronic systems for signal processing and communication applications.
2. Demonstrate the Conceptual domain Knowledge with respect to Architecture, Design, Analysis and Engineering deployment in Data communication and Computer networking.
3. Identify and apply domain specific tools for design, analysis, synthesis and validation of VLSI and Communication systems.

PROGRAM OUTCOMES

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs given in the Table below, ensure that the POs are aligned to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA). These attributes are measured at the time of Graduation, and hence computed every year for the outgoing Batch. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum.

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Semester: III

Sl No	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1.	Advanced Engineering Mathematics	15MA3GCAEM	3	1	0	0	4	50	50	100
2.	Linear Circuit Analysis	15ES3GCLCA	3	1	0	0	4	50	50	100
3.	Analog Microelectronics	15ES3GCAME	3	0	1	2	6	50	50	100
4.	Digital Electronics	15ES3GCDEC	3	0	1	2	6	50	50	100
5.	Fields and Waves(EC & TC only)	15ES3GCFAW	3	1	0	0	4	50	50	100
6.	Simulation Laboratory-I	15EC3DLSL1	0	0	1	0	1	50	50	100
Total			15	3	3	4	25	300	300	600

Semester: IV

Sl No	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1.	Discrete Mathematics and Probability	15MA4GCDMP	3	1	0	0	4	50	50	100
2.	Verilog HDL Programming (Only EC)	15EC4DCHDL	3	0	1	0	4	50	50	100
3.	Analog Integrated Circuits	15ES4GCAIC	3	0	1	2	6	50	50	100
4.	Microcontrollers	15ES4GCMCS	3	0	1	2	6	50	50	100
5.	Signals and Systems	15ES4GCSAS	3	1	0	0	4	50	50	100
6.	Technical Writing and Documentation	15EC4DCTWD	0	0	1	0	1	50	50	100
Total			15	2	4	4	25	300	300	600

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Semester: V

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Department Elective-1	16EC5DEXXX	3	0	0	0	3	50	50	100
2	Communication Theory-1	16EC5DCCT1	3	0	1	2	6	50	50	100
3	Digital Signal Processing	16EC5DCDSP	3	0	1	2	6	50	50	100
4	Fundamentals of VLSI	16EC5DCFOV	3	0	0	0	3	50	50	100
5	Microwave Engineering	16EC5DCMWE	3	0	0	0	3	50	50	100
6	Control System	16EC5DCCSM	3	1	0	0	4	50	50	100
Total			18	1	2	4	25	300	300	600

Department Elective -1

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Image Processing	16EC5DE1IP	2	1	0	0	3	50	50	100
2	Advanced Digital Logic Design	16EC5DE1AL	2	1	0	0	3	50	50	100
3	EMI and EMC	16EC5DE1EI	2	0	1	0	3	50	50	100
4	OOPs using C++	16EC5DE1OP	2	1	0	0	3	50	50	100
5	Computer Architecture	16EC5DE1CA	3	0	0	0	3	50	50	100

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Semester: VI

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Department Elective-2	16EC6DEXXX	3	0	0	0	3	50	50	100
2	Cluster Elective-1	16EC6GEXXX	3	0	0	0	3	50	50	100
3	Communication Theory - 2	16EC6DCCT2	3	0	1	2	6	50	50	100
4	Mixed Signal Design	16EC6DCMSD	3	0	1	2	6	50	50	100
5	Computer Communication Networks	16EC6DCCCN	3	0	0	0	3	50	50	100
6	Antenna and Wave Propagation	16EC6DCAWP	3	1	0	0	4	50	50	100
Total			18	1	2	4	25	300	300	600

Department Elective -2

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Advanced Digital Logic Verification	16EC6DE2AV	2	1	0	0	3	50	50	100
2	Radar System	16EC6DE2RS	3	0	0	0	3	50	50	100
3	Operating System	16EC6DE2OS	2	1	0	0	3	50	50	100
4	Automotive Embedded System	16EC6DE2ES	3	0	0	0	3	50	50	100

Cluster Elective - 1

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Data Structures and Algorithm	16EC6GE1DA	2	1	0	0	3	50	50	100
2	Sensor Technology	16EC6GE1ST	3	0	0	0	3	50	50	100
3	VLSI Testing and Design for Testability	16EC6GE1VD	3	0	0	0	3	50	50	100
4	Physical Design	16EC6GE1PD	3	0	0	0	3	50	50	100
5	Probability and Random Process	16EC6GE1PR	3	0	0	0	3	50	50	100
6	Advanced Microcontrollers and Applications	16EC6GE1AM	2	1	0	0	3	50	50	100

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Semester: VII

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Data Communication Networks	16EC7DCDCN	3	0	1	1	5	50	50	100
2	Embedded System Design	16EC7DCESD	3	0	1	1	5	50	50	100
3	Power Electronics	16EC7DCPEL	2	0	1	0	3	50	50	100
4	Project for Community Service	16EC7DCPW1	0	0	3	0	3	50	50	100
5	Department Elective-3	16EC7DEXXX	3	0	0	0	3	50	50	100
6	Cluster Elective-2	16EC7GEXXX	3	0	0	0	3	50	50	100
7	Institution Elective-1	16EC7IEXXX	3	0	0	0	3	50	50	100
Total			17	0	6	2	25	350	350	700

Department Elective -3

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Computer Vision	16EC7DE3CV	2	1	0	0	3	50	50	100
2	Low Power VLSI	16EC7DE3LV	3	0	0	0	3	50	50	100
3	System on Chip	16EC7DE3SC	3	0	0	0	3	50	50	100
4	Network Security and Cryptography	16EC7DE3NS	3	0	0	0	3	50	50	100
5	Wireless Communication	16EC7DE3WC	3	0	0	0	3	50	50	100

Cluster Elective – 2

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Nano Electronics	16EC7GE2NE	3	0	0	0	3	50	50	100
2	Electronics and Packaging	16EC7GE2EP	3	0	0	0	3	50	50	100
3	Internet of Things	16EC7GE2IT	3	0	0	0	3	50	50	100
4	Multimedia Communication	16EC7GE2MC	3	0	0	0	3	50	50	100
5	Software Defined Radio	16EC7GE2SR	2	1	0	0	3	50	50	100
6	Wireless Sensor Networks	16EC7GE2SN	3	0	0	0	3	50	50	100

Institution Elective – 1

Semester: VII

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Fuzzy logic and Neural networks	16EC7IE1FN	3	0	0	0	3	50	50	100
2	Fundamentals of Mobile Communication	16EC7IE1MC	3	0	0	0	3	50	50	100
3	Electronic Engineering Materials	16EC7IE1EM	3	0	0	0	3	50	50	100

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Semester: VIII

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Major Project	16EC8DCMPJ	0	0	10	0	10	100	100	200
2	Internship/Technical Seminar	16EC8DCSMR	0	0	2	0	2	50	50	100
3	Electronics and Communication for sustainable Developments	16EC8DCECS	3	0	0	0	3	50	50	100
4	Intellectual Property Rights and Cyber Law	16HS8GCIPL	2	0	0	1	3	50	50	100
5	Project Management and Finance	16HS8GCPMF	2	0	0	1	3	50	50	100
6	Life Skills	16HS8IEXXX	0	0	1	0	1	50	50	100
7	Institution Elective-2	16EC8IEXXX	3	0	0	0	3	50	50	100
Total			10	0	13	2	25	400	400	800

Institution Elective – 2

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Engineering Economics	16EC8IE2EE	3	0	0	0	3	50	50	100
2	Automotive Electronics	16EC8IE2AE	3	0	0	0	3	50	50	100
3	Organizational Behaviour	16MD8IE2OB	3	0	0	0	3	50	50	100

MD – Multi Disciplinary

Life Skills:

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Yoga for Beginners	16HS8IEYGB	0	0	1	0	1	50	50	100
2	National Service Scheme(NSS)	16HS8IENSS	0	0	1	0	1	50	50	100
3	National Cadet Corps (NCC)	16HS8IENCC	0	0	1	0	1	50	50	100
4	Physical Education and Sports	16HS8IEPES	0	0	1	0	1	50	50	100
5	Civil Defence	16HS8IECDC	0	0	1	0	1	50	50	100
6	Cultural and Fine Arts	16HS8IECFA	0	0	1	0	1	50	50	100
7	Applied Psychology for Engineers	16HS8IEAPE	0	0	1	0	1	50	50	100
8	Comparative Science of Cultures	16HS8IECSC	0	0	1	0	1	50	50	100

Professional Skills:

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Intellectual Property Rights and Cyber Law	16HS8GCIPL	2	0	0	1	3	50	50	100

Managerial Skills:

Sl No.	Course Title	Course Code	Credits					CIE	SEE	Total
			L	T	P	S	Total			
1	Project Management and Finance	16HS8GCPMF	2	0	0	1	3	50	50	100

3^{rd} – 4^{th} Semester Syllabus

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COURSE CODE	**15MA3GCAEM**	**COURSE TITLE**	**Advanced Engineering Mathematics (Common To EC, TE, EE, IT, ML)**
CREDITS	**4**	**L-T-P-S**	**3-1-0-0**

CO Numbers	Course Outcomes
CO-1	Obtain numerical solution a system of algebraic equations, algebraic and transcendental equations and ordinary differential equations.
CO-2	Obtain numerical solution a system of algebraic equations, algebraic and transcendental equations and ordinary differential equations.
CO-3	Solve partial differential equations with appropriate boundary conditions using the method of separation of variables
CO-4	Construct analytic functions and simple conformal mappings
CO-5	Evaluate real and complex integrals using the calculus of residues

UNIT-I

MATRICES

Introduction: Elementary row transformations, Echelon form of a matrix, rank of a matrix by elementary row transformations. Consistency of system of linear equations and solution. Solution of a system of non-homogenous linear algebraic equations: Gauss elimination method, LU decomposition method, Gauss-Seidel method. Eigenvalues and eigenvectors of matrices. Reduction of a matrix to diagonal form. **7L+2T Hrs**

Suggested Reading: Inverse of a matrix using Gauss-Jordan method. Largest eigenvalue and corresponding eigenvector using Rayleigh power method.

UNIT-II

NUMERICAL METHODS

Solution of algebraic and transcendental equations: Newton-Raphson method. Finite Differences and interpolation: Forward differences, backward differences. Newton-Gregory forward interpolation formula, Newton-Gregory backward interpolation formula, Lagrange's

interpolation formula, Lagrange's inverse interpolation Numerical integration: Simpson's $1/3^{rd}$, $3/8^{th}$ rule, Weddle's rule. Numerical solution of ordinary differential equations: Euler's modified method, Runge-Kutta method of fourth order **8L+2T Hrs**

Suggested Reading: Milne's method to solve ordinary differential equations. Solution of simultaneous differential equations by Runge-Kutta fourth order method.

UNIT-III

PARTIAL DIFFERENTIAL EQUATIONS

Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- Solution of the linear equation P p + Q q = R (Lagrange's partial differential equation).

Applications: One-dimensional heat equation and wave equation (without proof), Transmission line-telegraph equations, various possible solutions of these by the method of separation of variables. **7L+3T Hrs**

Suggested Reading: Direct integration method, method of separation of variables, D'Alembert's solution of wave equation.

UNIT-IV

COMPLEX ANALYSIS -1:

Function of a complex variable, limits, continuity and differentiability of a complex valued function. Analytic functions, properties of analytic functions, Cauchy-Riemann equations in Cartesian and polar form, construction of analytic functions by Milne-Thomson method **9 Hrs**

UNIT-V

COMPLEX ANALYSIS-2

Complex integration: Line integral, Problems on line integral, Cauchy's theorem, Cauchy's integral formula.

Complex series: Taylor's series, Maclaurin's series and Laurent's series (without proof). Zeros, Poles and Residues: Residue theorem (without proof). Evaluation of real definite integrals using residues **7L+3T Hrs**

Suggested Reading: Power series, radius of convergence, Removable and essential singularities, improper real integrals with singular points on real axis

Applications: Use of harmonic function to a heat transfer problem. Analysing AC circuits, Current in a field- effect transistor

MATHEMATICS LAB

1. Solution of system of algebraic equations using Gauss Seidel method.

2. LU decomposition of matrices.
3. Eigenvalues and eigenvectors of matrices.
4. Largest eigenvalue, smallest eigenvalue and corresponding eigenvectors of a matrix.
5. Solution of algebraic and transcendental equations using Newton- Raphson method.
6. Numerical integration.
7. Numerical solution of ordinary differential equations

TEXT BOOKS:

1. Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers
2. Advanced Engineering Mathematics, 5th edition, 2011,by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.

REFERENCE BOOKS

1. Higher Engineering Mathematics, B.V. Ramana, 2007, Tata Mc. Graw Hill.
2. Advanced Engineering Mathematics, Erwin Kreyszig, 10^{th} edition Vol.1 and Vol.2, 2014, Wiley-India.
3. Numerical Methods for Scientific and Engineering Computation. M.K. Jain, S.R.K Iyengar, R.K. Jain, 6^{th} edition, 2010, New Age International (P) Limited Publishers

E-books

1. Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y
2. Advanced Engineering Mathematics, P. V. O'Neil, 5^{th} learning India Pvt. Ltd. Indian reprint, 2009, Cengage
3. http://ocw.mit.edu/courses/mathematics/ (online course material)

MOOCs

1. http://nptel.ac.in/courses.php?disciplineId=111
2. https://www.khanacademy.org/
3. https://www.class-central.com/subject/math (MOOCS)
4. E-learning: www.vtu.ac.in

ASSESSMENT:

1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. To set one question each from Units 1, 2, 4 and two questions from Unit 3 and Unit 5.

Questions for CIE (50%) and SEE(50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

- Remembering and understanding the course contents (weightage: 40%)
- Applying the knowledge acquired from the course (weightage: 35%)
- Designing and analyzing various engineering problems (weightage: 15%)
- Understanding of various system models (weightage: 10%)

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COURSE CODE	**15ES3GCDEC**	**COURSE TITLE**	**DIGITAL ELECTRONICS (Common to EC, TE, EE, IT, ML)**
CREDITS	**6**	**L-T-P-S**	**3-0-1-2**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of digital circuit concepts to optimize a digital circuit.	1	1
CO-2	Analyze digital circuits and arrive at suitable conclusions	2	
CO-3	Design a digital circuit for given problem statement by applying the digital circuit concepts	3	1
CO-4	Conduct experiments using digital ICs to demonstrate a given application / problem statement.	4, 10	1
CO-5	Work in a team to demonstrate an application of digital circuits by engaging in self-learning	4, 9, 10, 12	1, 3

UNIT - I

Introduction: Review of Boolean algebra, logic gates.

Simplification of Boolean functions: Three Variable K – Maps, Four Variable K – Maps, The Tabulation Method, Determination of Prime Implicants, Selection of prime implicants

Combinational Logic Circuits: Introduction, Carry Look Ahead Adder, Parallel Adder, Decimal Adder Code conversion, Magnitude Comparator, Decoders, Multiplexers, Read Only memories (ROM), Programmable Logic Arrays (PLAs) **8 Hrs**

UNIT - II

Flip-Flops:

The Basic Flip-flop circuit, Clocked Flip-flops, Triggering of Flip-flops: Master Slave Flip-Flops, Edge Triggered Flip Flops, Characteristic Equations. **7 Hrs**

UNIT - III

Sequential Logic Circuits:

Shift Registers, Ripple Counters, Design of Synchronous Counters **8 Hrs**

UNIT- IV

Sequential systems**:**

Analysis of Clocked Sequential circuits, State Reduction and Assignment, Design Procedure, Design with State Equations **7 Hrs**

UNIT-V

Logic Families: Characteristic of Digital ICs, Transistor – Transistor Logic, Complementary MOS (CMOS) Logic, Comparison of TTL and CMOS families **6 Hrs**

This course shall include assessments based on the QEEE Phase IV lecture on 'Nitty Gritty of Logic Gates to Processor Design' by Prof. Ashok Jhunjhunwala, IIT Madras (based on the topics Logic Gates to Execution Unit Design, ALU design)

Text books:

1. Digital Logic and Computer Design- M. Morris Mano, Prentice Hall – Pearson Education
2. Fundamental of Logic Design- Charles Roth Jr., Thomas Learning

Reference books:

1. Digital Principles and Design- Donald Givone, Tata McGraw Hill
2. Digital Logic Applications and principles- John Yarbrough, Pearson Education

EBooks

1. http://www.free-engineering-books.com/2014/11/digital-fundamentals-by-thomas- l-floyd.html
2. https://books.google.co.in/books/about/Fundamentals_of_Digital_Circuits.html?id=BOVkrtiLUcEC

MOOCs

1. http://freevideolectures.com/blog/2010/11/130-nptel-iit-online-courses/
2. http://freevideolectures.com/blog/2010/11/130-nptel-iit-online-courses/
3. www.Pyroelectrom.com/eu

4. Nptel.ac.in/courses/11710606
5. http://nptel.ac.in/courses/117105080
6. Digital Circuits and SystemsYoutube - S. Srinivasan, IITMadras
7. Digital Integrated Circuits Youtube - AmitavaDasgupta, IIT Madras

DIGITAL ELECTRONICS

15ES3GCDEC Laboratory

Experiment List

Sl.No	Title of the Experiments
1	Applications of IC 7483 (Adders, Subtractors and Comparators)
2	Multiplexers (using Gates and IC) and their applications
3	Decoders/DeMultiplexers (using Gates and IC) and their applications
4	BCD to Decimal decoder using 7-segment display
5	Verification of MSJK Flip-flop (using Gates and IC 7476)
6	Asynchronous counters (using ICs 7476,7490,7493)
7	Synchronous Counters (using ICs 7476, 74190/74192)
8	Shift registers and their applications (using ICs 7476, 7495)

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COURSE CODE	**15ES3GCAME**	**COURSE TITLE**	**ANALOG MICROELECTRONICS (Common to EC, TE, EE, IT, ML)**
CREDITS	**6**	**L-T-P-S**	**3-0-1-2**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of working principle of electronic devices to arrive at suitable conclusions for a given analog electronic circuits	1	1
CO-2	Analyze the given analog electronic circuit with a given specifications to compute required parameters	2	1
CO-3	Design analog electronic circuits for given problem statement by applying analog circuit concepts.	3	1
CO-4	Conduct experiments to demonstrate the application of analog electronic circuits using analog components.	4,9	1
CO-5	Work in a team to analyze and demonstrate an application using analog electronic components by engaging in self learning.	4,5,9,10,12	1

UNIT - I

Diodes: Introduction, Limiting and clamping circuits, Limiter circuits, The Clamped capacitor or DC restorer.

Bipolar Junction Transistor (BJTs): Introduction, Single stage BJT amplifiers the basic structure, characterizing BJT Amplifiers. The common emitter amplifier Frequency Response -The 3 frequency bands, the high frequency response, the low frequency response **7 Hrs**

UNIT - II

MOSFETS: Introduction, Device structure and physical operation, Device structure,

operation with no gate voltage, creating a channel for current flow, Applying a small VDs, Operation as VDs is increased Derivation of the id- V_{DS} relationship, The P-Channel MOSFET, Complementary MOS or CMOS, Operating the MOS transistor in the sub-threshold region. Current voltage characteristics-Circuit symbol, I_d- V_{ds} characteristics, Characteristics of the P channel MOSFET.

MOSFET Circuits at DC: The MOSFET as an amplifier and as a switch-Large signal operation, Graphical derivation of the transfer characteristic, operation as a switch, operation as a linear amplifier.

Biasing in MOS amplifier circuits: Biasing by fixing V_{GS}, Biasing by fixing Connecting a resistor in the source, Biasing using a drain to gate feedback resistor, biasing using a current source **8 Hrs**

UNIT -III

Small – signal operation and models of MOSFETs: The DC bias point, the signal current in the drain terminal ,the voltage gain, separating dc analysis and the signal analysis, small signal equivalent circuit models, the trans conductance g_m, the T equivalent circuit model.

Single stage MOS amplifiers: The basic structure, characterizing amplifiers, The CS amplifier, The CS amplifier with a source resistance.

IC Biasing: Current sources, current mirror and current steering circuits, the basic MOSFET current source, MOS current steering circuits Current mirror circuit with improved performance, The Wilson current mirror **7 Hrs**

UNIT - IV

Feedback: Introduction, the general feedback structure, some properties of negative feedback: Gain density, bandwidth extension, noise reduction, reduction in non-linear distortion, the four basic feedback topologies: Voltage amplifiers, current amplifiers, Trans conductance amplifiers, practical circuits for current series and voltage series feedback **7 Hrs**

UNIT - V

Power Amplifiers: Introduction, The classification of output stages, Class A output stage, transfer characteristic, signal W/Fs, power dissipation, power conversion efficiency, transformer coupled power amplifiers, class B transformer coupled amplifier.

Class B output stage: Circuit operation , transfer characteristic, power conversion efficiency, power dissipation, reducing crossover distortion, single supply operation Class AB output

stage Circuit operation, output resistance

Power BJTs: Junction temperature, thermal resistance, power dissipation versus temperature, transistor case and heat sink **7 Hrs**

Text Books:

1. Microelectronic Circuits-Theory and applications by Adel S. Sedraand Kenneth C.Smith, Fifth Edition , (Oxford International Student Edition)
2. Electronic Devices and Circuit Theory-Robert L.Boylestad and Louis Nashelsky (Pearson Education)

Reference Books:

1. Electronic Devices and Circuits- Millman and Halkias, TMH
2. Electronic Devices and Circuits- David A Bell - PHI 4th edition

On-line Reference:

1. www.pyroelectro.com/edu/analog
2. http://freevideolectures.com/Course/3020/Circuits-for-Analog-System-Design MOOCs
3. https://www.mooc-list.com/course/electronic-systems-and-digital-electronics-uninettuno?static=true
4. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/
5. Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware | Reviews and Ratings

ANALOG MICROELECTRONICS

15ES3GCAME

Laboratory Experiment List

Sl.No	Title of the Experiments
1	Diode and Transistor as a switch.
2	Zener diode characteristics and Zener as regulator.
3	Diode clipping circuits- Single/Double ended.
4	Diode clamping Circuits - positive clamping/negative clamping.
5	BJT as RC coupled amplifier.
6	BJT as RC phase shift oscillator.
7	Crystal Oscillator.
8	Power Amplifier.
9	Open ended experiments.

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COURSE CODE	**15ES3DCLCA**	**COURSE TITLE**	**LINEAR CIRCUIT ANALYSIS (Common to EC, TE, EE, IT, ML)**
CREDITS	**4**	**L-T-P-S**	**3-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the basic circuital laws and network theorems to linear circuits, and two port networks.	1	1
CO-2	Formulate tie–set and cut-set matrices for network topology and Analyze a linear circuit in time and frequency domain.	2	1
CO-3	Simulate a linear circuit using appropriate tool.	5	1

UNIT - I

Basic Concepts:

Practical sources, Source transformations, Network reduction using Star Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh. **5L+2T Hrs**

UNIT - II

Network Topology:

Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set, tie-set & cut-set schedules, Formulation of equilibrium equations, Principle of duality. Resonant Circuits: Series and parallel resonance, frequency response of series and Parallel circuits, Q factor, B and width **8L+3T Hrs**

UNIT - III

Network Theorems: Super position, Reciprocity, Millman's, Thevinin's and Norton's theorems; Maximum Power transfer theorem **7L+3T Hrs**

UNIT - IV

Transient behaviour and initial conditions: Behavior of circuit element sunders witching condition and their representation, evaluation of initial and final conditions in RL, RC and

RLC circuits R e v i e w of Laplace transforms, Laplace Transformation & Applications, wave form Synthesis, initial and final value theorems, step, ramp and impulse responses, convolution theorem, solution of simple R-L,R-C,R-L-C networks for AC and DC excitations using Laplace transforms. **10L+3T Hrs**

UNIT - V

Two port network parameters and State Variable analysis: Definition of z, y, hand transmission parameters, modelling with these parameters, relationship between parameters sets. Writing state equations and solution using Laplace transforms. **6L+1T Hrs**

Text Books:

1. "Network Analysis", M.E.VanValkenburg, PHI/Pearson Education, 3rd Edition. Reprint2002.
2. "Networks and systems", Roy Choudhury, 2nd edition, 2006 re- print, New Age International Publications
3. Theory and Problems of Electric Circuits (Schaum Series), 2nd Edition Mc GrawHill

Reference Books:

1. "Engineering Circuit Analysis", Hayt, Kemmerly and Durbin, TMH 6th 2002
2. "Network analysis and Synthesis", Franklin F.Kuo,Wiley Edition
3. "Analysis of Linear Systems", DavidK.Cheng, Narosa Publishing House,11th
4. "Circuits", Bruce Carlson, Thomson Learning, 2000.Reprint 2000 E-Books
5. Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur
6. Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi
7. www.electrodiction.com/circuit-theory

MOOCs:

1. http://elearning.vtu.ac.in/06ES34.html
2. https://www.coursera.org/course/circuits

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COURSE CODE	**15ES3GCFAW**	**COURSE TITLE**	**FIELDS AND WAVES (Common to TE and EC)**
CREDITS	**4**	**L-T-P-S**	**3-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concepts of static Electric & Magnetic fields to study Time-varying electro-magnetic field	1	1
CO-2	Analyze propagation of uniform plane waves in different media	2	1
CO-3	Self-learning through listening and comprehension of audio/video lectures related to electromagnetic fields and waves domain	12	1

UNIT - I

Introduction to electrostatics: Introduction to line integral, surface integral, volume integral of vectors, Coulomb's Law(vector form), Electric Field Intensity (vector form), Electric Flux Density (EFD), Gauss' Law and Divergence Theorem Energy and Potential: Energy spent in moving charge, Definition of Potential Difference (PD), PD due to Point Charge ,Energy Density Current and current density: Current and Current Density, Continuity of Current, Conductor, Dielectric materials, Properties, and Boundary Conditions, capacitance-parallel plate ,co-axial, spherical. **8L+2T Hrs**

UNIT - II

Introduction to Magnetostatics: Biot-Savart Law, Ampere's circuital law, curl, Magnetic Flux, Flux Density, Scalar and Vector Magnetic Potentials, Force on a moving charge, Force on different current element, Magnetic Boundary Condition. **6L+2T Hrs**

UNIT –III

Time varying fields and Maxwell's equations: Faraday's Law, Displacement Current, Maxwell's Equations in Point and Integral Form, retarded potentials **7L+3T Hrs**

UNIT - IV

Uniform plane waves: Wave equations, solution of wave equation, wave propagation through good dielectric, good conductor, skin effect, Poynting Theorem, wave polarization.

7L+3T Hrs

UNIT - V

Plane wave reflection and dispersion: Reflection of uniform plane waves at normal incidence, SWR ,Wave reflection from multiple interfaces, plane wave propagation in general directions, plane wave reflection at oblique incidence angles, total reflection and total transmission of obliquely incident waves, wave propagation in dispersive media, pulse broadening in dispersive media **8L+2T Hrs**

This course shall include an assessment based on the QEEE Phase IV on 'Electromagnetic Waves' taught by Prof.DeepaVenkatesh, IIT Madras

Text Books:

1. Engineering Electromagnetics, W H Hayt ,J A Buck,MJaleelAkhtar Tata McGraw-Hill, 8e Edition, 2014.
2. Electromagnetics, Schaum's Outline series Joseph A Ediminister Tata McGraw-Hill, revised second Edition, 2014.

Reference Books:

1. Electromagnetics with Applications, John Krauss and Daniel A Fleisch, McGraw-Hill, 5th Edition, 1999
2. Field and wave electromagnetic, David K Chary, Pearson Education Asia, Second Edition – 1989, Indian Reprint – 2001

On-line Reference:

1. http://nptel.ac.in/courses/108106073/
2. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/
3. Transmission%20Lines%20and%20EM%20Waves/Course%20Objective.htm

MOOCs:

1. http://emt-iiith.vlabs.ac.in/
2. http://emt-iiith.vlabs.ac.in/Experiment.php?code=C001 to C010
3. http://nptel.ac.in/courses/108106073/ 1 to 108106073/42

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COURSE CODE	**15EC3DLSL1**	**COURSE TITLE**	**SIMULATION LABORATORY–I (EC only)**
CREDITS	**1**	**L-T-P-S**	**0-0-1-0**

PART – A
(MATLAB)

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Make use of MATLAB features to represent data and model systems	1	3
CO-2	Examine simulated data in various formats for solving Engineering problems	2	3
CO-3	Model and simulate basic Engineering problem using MATLAB and SIMULINK	5,10	3

Experiments
PART A
(MATLAB)

1. Introduction: The MATLAB Environment, Data addressing, Language fundamentals, Operators, Functions & System objects, Data input & output, Matlab functions
2. Numerical Computation Matrix arithmetic. Equations & Expressions- Solve simultaneous and differential equations and visualize the same.
3. Data Analysis & visualization Graphical visualization, Plotting tools, Plotting multi graphs, multi curves, pie charts, bar graphs. Labeling and annotation Introduction to functions, function I/O, definitions of functions, scope, advantages, scripts, File I/O, MAT files, excel files, text files, binary files.
4. Signal generation and system analysis- Using MATLAB commands, Solution of mesh current and node voltage equations using matrix operations. Obtain the time response of first and second order systems and the domain specifications.

Realize a logical expression using Boolean algebra

PART B

(Simulink)

1. Create mathematical models of systems, Interact with MATLAB workspace and obtain the plots.
2. Use of Simulink tool box, steps involved in creating system models using the Simulink Library, solver selection, creating model hierarchy
3. Obtain the transient response of first order and second order systems. Transfer of variables between Simulink and MATLAB workspace and obtain their plots.
4. Modelling Mechanical /Electrical systems-such as Full wave rectifier design, Op Amp Configuration, Digital system etc. (not limited)

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COURSE CODE	**15MA4GCDMP**	**COURSE TITLE**	**DISCRETE MATHEMATICS AND PROBABILITY (Common to EC, TE, EE, IT, ML)**
CREDITS	**4**	**L-T-P-S**	**3-1-0-0**

CO-numbers	Course Outcomes
CO-1	Understand the notation of set theory, relations and functions.
CO-2	Construct a Hasse diagram for partial orderings, Use many terms associated with graphs and prove whether two graphs are isomorphic.
CO-3	Obtain the probability of an event using discrete and continuous distributions, including the n-step transition probability.
CO-4	Analyse and classify simple states current/transient
CO-5	Understand, derive and apply the properties of the M/M/m queuing model (properties like stationary probability, average waiting and system time, expected number of customers in the queue)

UNIT - I

SET THEORY AND RELATIONS:

Introduction to sets and subsets, operations on sets, laws of set theory. Duality, Principle of duality for the equality of sets Countable and uncountable sets. Addition Principle.Introduction to Relations Definition, Types of functions, operations on relations, matrix representation of relations, composition of relations, properties of relations, equivalence relations, partial orders, Hasse diagram. Posets-extremal elements on posets **9L+3T Hrs**

Suggested Reading: Some particular functions- Floor and ceiling functions, Projection, Unary and Binary operations.

UNIT – II

ALGEBRAIC STRUCTURES: Groups, properties of groups. Some particular groups-

The Klein 4-group, additive group of integers modulo n, multiplicative group of integers mod p, permutation groups. Subgroups, Cyclic groups, Coset decomposition of a group, homomorphism, isomorphism. **7L+3T Hrs**

Suggested Reading: Lagrange's theorem and its consequences.

UNIT - III

GRAPH THEORY:

Basic concepts: Types of graphs, order and size of a graph, in-degree and out-degree, connected and disconnected graphs, Eulerian graph, Hamiltonain graphs, subgraphs, dual graphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Trees: spanning tree, breadth first search. Minimal spanning tree: Kruskal's algorithm, Prim's algorithm, shortest path-Dijkstra's algorithm. **7L+2T Hrs**

Suggested Reading: Konigsberg bridge problem, Utility problem

UNIT- IV

Theoretical distributions: Poisson distribution, Normal distribution: Error function, Central limit theorem. Two dimensional random variables: Discrete random variable, Mathematical expectation, Covariance and Correlation. **6L+2T Hrs**

Suggested Reading: Exponential distribution, Uniform distribution. Continuous two dimensional random variables.

UNIT - V

MARKOV CHAIN AND QUEUING THEORY

Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chains. Queuing models: Concept of Queue, M/M/1 queuing systems. **7L+2T Hrs**

Suggested Reading: Power supply model, Economic cost profit model

Mathematics Lab:

1. Probability distributions
2. Minimal spanning tree- Kruskal's algorithm, Prim's algorithm.
3. Shortest Path- Dijkstra's algorithm

Text Books:

1. Discrete Mathematical Structures, Dr. DSC, 4th edition, 2011-12, Prism Engineering Education Series.
2. Engineering Mathematics, B.S. Grewal, 43rd edition, 2013, Khanna Publishers.

3. Discrete Mathematics, Seymour Lipschutz. M. Lipson, 2005, Tata McGraw Hill.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, 2007, Tata Mc. Graw Hill.
2. Discrete Mathematics, J K Sharma, 3rd edition, 2013, Macmillan India Ltd.
3. Queuing Theory and Telecommunications, Networks and applications, Giovanni Giambene, 2005, Springer
4. Data Networks, Dimitri Bertsekas, Robert Gallager, 2nd edition, 1992, Prentice India
5. Schaum's Outline of Probability and Statistics, John J Schiller, Murray R Speigel, 4th edition, 2013, Schaum's Outlines

E books

1. Discrete Mathematics for Computer Science, Gary Haggard, John Schlipf, Sue Whitesides, Thomson Brooks/Cole, 2006
2. http://www.khanacademy.org/math/probability/random-variablestopic/random_variables_prob_dist/v/random-variables
3. http://ocw.mit.edu/courses/mathematics/ (online course material)

MOOCs

1. www.nptelvideos.in/2012/11/discrete-mathematical-structures.html
2. www.cs.berkeley.edu/~daw/teaching/cs70-s05
3. https://www.khanacademy.org/

Assessment

1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. To set one question each from Units 1, 4, 5 and two questions from Unit 2 and Unit 3.

Questions for CIE (50%) and SEE(50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

- Remembering and understanding the course contents (weightage: 40%)
- Applying the knowledge acquired from the course (weightage: 35%)
- Designing and analyzing various engineering problems (weightage: 15%)
- Understanding of various system models (weightage: 10%)

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COURSE CODE	**15EC4DCHDL**	**COURSE TITLE**	**Verilog HDL Programming (Only EC)**
CREDITS	**4**	**L-T-P-S**	**3-0-1-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of HDL for modeling and functional verification of digital circuits.	1	3
CO-2	Analyze digital circuits using suitable Verilog HDL modeling	2	3
CO-3	Design and synthesize a digital circuit for complex systems using Verilog HDL and state machines	3	3
CO-4	Program and synthesize a given application / problem statement using EDA tools	4, 5,10	3

UNIT – I

Overview of Digital Design with Verilog HDL:

Evolution of computer aided digital design, Emergence of HDLs, Typical design flow, importance of HDLs, Verilog HDL and Design. Methodologies, modules, instances, components of simulation, example, basic concepts.

Modules and ports: Modules, ports, Rules, Hierarchical Names. Gate Level modeling and Data flow modeling: Gate Types, Gate Delays, Examples, and Continuous assignment, Delays, Expressions, Operators, Operands, Operator Types and Examples. **8 Hrs**

UNIT - II

Behavioural Modelling: Structured procedure, procedural assignments, timing control, conditional statements, multi way branching, loops, sequential and parallel blocks, generate blocks, Examples.

Tasks and Functions: Difference between task and functions, Tasks, functions, automatic functions, Constant function, signed function. **7 Hrs**

UNIT - III

Logic synthesis with Verilog HDL:

Logic synthesis, Verilog HDL Synthesis, Interpretation of Verilog Constructs, Synthesis Design flow, examples, verification of the gate level netlist, modeling tips for logic synthesis.

Timing and delays: Types of delay models, modeling, timing checks and delay back annotation **7 Hrs**

UNIT – IV

FPGA based systems:

Introduction, basic concepts, Digital design with FPGAs, FPGA based system design. FPGA Fabrics: FPGA architectures, SRAM based FPGAs, Chip I/O and Circuit design of FPGA fabrics, Architecture of FPGA fabrics, SPARTAN III and above **7 Hrs**

UNIT – V

Synchronous sequential circuits:

Moore and Mealy machines, definition of state machines, state machine as sequence controller, Design of state machines, state table, state assignment, transition excitation table, logic realization, Design example- Serial adder **7 Hrs**

Text Books:

1. Sameer Palnitkar, "Verilog HDL-a guide to digital design and synthesis 2nd edition, Pearson Edition 2003.
2. Wayne Wolf, "FPGA based system design", Reprint 2005, Pearson Education

Reference Books:

1. Stephan Brown and Zvonk Vranesic, "Fundamentals of digital logic with Verilog design", 2nd edition MGH, 2008

EBooks

1. http://access.ee.ntu.edu.tw/course/dsd_99second/2011_lecture/W2_HDL_
2. Fundamentals_2011-03-02.pdf
3. http://www.ics.uci.edu/~alexv/154/VHDL-Cookbook.pdf
4. http://ece.niu.edu.tw/~chu/download/fpga/verilog.pdf

MOOCs

1. Electronic Design Automation http://nptel.ac.in/courses/106105083/

2. Digital system design with PLDs and FPGAshttp://nptel.ac.in/courses/117108040/ Fundamentals of HDL (Lecture #008)
3. https://www.youtube.com/watch?v=rdAPXzxeaxs&index=8&list=PLE3BC3EBC9CE15FB0

Verilog HDL Programming

15EC4DCHDL

Laboratory Experiment List

Sl. No	Title of the Experiments
1	Realization of logic gates and half adder
2	Implementation of MUX and DEMUX
3	Implementation of Decoder and Encoder
4	Implementation of Binary to Gray and Gray to Binary
5	Implement Comparator using different types of descriptions
6	Implement full adder using three descriptions
7	Implementation of 8 - BIT ALU
8	Realization of SR, D, JK & T flip-flops.
9	Implementation a 4-bit (BCD/ Binary) Up/Down counter
10	Implementation of Sequence Generator
11	Seven-Segment display interface
12	Open Ended Experiments

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COURSE CODE	**15ES4GCAIC**	**COURSE TITLE**	**ANALOG INTEGRATED CIRCUITS (Common to EC, TE, EE, IT, ML)**
CREDITS	**6**	**L-T-P-S**	**3-0-1-2**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of network theorems to analog integrated circuits	1	-
CO-2	Analyze analog integrated circuits to obtain the response at different points that meet desired specifications.	2	-
CO-3	Design an analog circuit for given problem statement by applying the analog integrated circuit concepts	3	1
CO-4	Conduct experiments using analog ICs to demonstrate a given application / problem statement.	4, 10	1
CO-5	Work in a team to demonstrate an application of analog integrated circuits by engaging in self-learning	4, 5, 9, 10,12	1,3

UNIT- I

Operational Amplifier Characteristics:

Introduction, DC Characteristics, AC Characteristics, Analysis of data sheets of an OP-AMP Operational Amplifier Applications: Review of basic Opamp applications, Instrumental Amplifier, V to I and I to V converter, Op-amp circuits using Diodes – Half wave rectifier, Full wave rectifier, Sample and hold circuit, Multiplier and Divider. **8 Hrs**

UNIT- II

Comparators and Waveform Generators:

Introduction, comparator, Regenerative comparator (Schmitt Trigger), Square wave generator (Astable Multivibrator), Monostable Multivibrator, Triangular wave generator. (RC and wein bridge oscillators only) **7 Hrs**

UNIT- III

Voltage Regulators: Introduction, Series op-amp regulator, IC Voltage regulators, 723 General purpose Regulator, Switching Regulator.

Active Filters: Introduction, RC Active Filters, First order low pass filter, second order active filter, Higher order low pass filter, High pass active filter, All pass filter-phase shift lead and lag circuit **7 Hrs**

UNIT- IV

Timers: Introduction to 555 timer, Description of Functional diagram, monostable operation, Astable operation. Phase locked loops: Introduction, Basic principles, phase detector/comparator, voltage controlled oscillator (VCO) **7 Hrs**

UNIT - V

D-A and A-D Converters: Introduction, Basic DAC Techniques- Weighted Resistor DAC, R-2R Ladder DAC. A-D Converters: Direct type ADCs- The parallel Comparator (Flash) A/D converter, Successive Approximation Converter, DAC/ADC Specification, Sigma – delta ADC **7 Hrs**

Text Book:

1. " Linear Integrated Circuits", D.RoyChoudhury&ShailB.Jain (New age Publication)
2. Op-Amps and Linear Integrated Circuits- Ramakanth A.Gayakwad, 4th ed,PHI

Reference Books:

1. " Linear Integrated Circuits", S. Salivahanan & V.S.Kanchana Bhaaskaran (Tata McGraw- Hill Publication)
2. " Opamps and Linear ICs",David A.Bell(Prentice-Hall Publications)

E Books

1. http://freevideolectures.com/Course/2321/Electronics-for-Analog-Signal-Processing-I
2. http://freevideolectures.com/Course/2322/Electronics-for-Analog-Signal-Processing-I

MOOCs

1. http://ocw.tudelft.nl/courses/microelectronics/analog-integrated-circuit-design/course-home/

2. Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware | Reviews and Ratings
3. http://www.pannam.com/blog/free-resources-to-learn-electrical-engineering/

ANALOG INTEGRATED CIRCUITS

15ES4GCAIC Laboratory

Experiments List

Sl.No	Title of the Experiments
1	Inverting and non- inverting amplifier, voltage follower
2	Inverting and non- inverting summing Amplifier
3	Differentiator and integrator
4	Precision half wave and full wave rectifier
5	Zero crossing detector and Schmitt trigger
6	Weinbridge Oscillator
7	First order active low pass filter
8	First order active high pass filter
9	555 as astable multivibrator
10	555 as monostable multivibrator
11	IC 723 as low voltage and high voltage regulators
12	D to A convertor
13	A to D convertor
14	Clipping Circuits
15	Clamping Circuits

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COURSE CODE	**15ES4GCMCS**	**COURSE TITLE**	**MICROCONTROLLERS (Common to EC, TE, EE, IT, ML)**
CREDITS	**6**	**L-T-P-S**	**3-0-1-2**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the programming concepts to provide solution to a given problem using embedded 'C'/assembly program	1	-
CO-2	Analyse the given data to program the device for time critical application	2	1
CO-3 CO-4	Design a system for control application using 8051 to perform multiple tasks	3	1
	Use simulator to debug and execute assembly and embedded C code.	4,5	1
CO-5	Engage in self-study to design a system to demonstrate the applications of microcontroller for health, safety, environment and society.	6,9,10,12	1

UNIT - I

INTRODUCTION TO MICROCOMPUTER AND MICROCONTROLLER: Introduction to Microprocessors, Internal organization of computer-Bus Structures, Harvard & Von- Neumann CPU architecture, The 8051 Architecture: Introduction, 8051 Microcontroller Hardware, Input / Output Pins, External Memory Interface. **7 Hrs**

UNIT - II

MICROCONTROLLER PROGRAMMING:

Instruction set architecture-RISC & CISC CPU Architectures, Pipelining, Execution of an instruction, Addressing Modes and Instruction set. Example Demonstration using 8051 instruction set, Data transfer instructions, Arithmetic instructions, Logical instructions, branching and Subroutines, Example programs. **8 Hrs**

UNIT - III

CONCEPTS OF EMBEDDED 'C' PROGRAMMING:

Data types, examples in 8051 C, program structures, logical operations, Memory and I/O access, Programming peripherals (Examples: Timer / Counter), Programming serial communication (serial data input/output) - example programs using 8051 **8 Hrs**

UNIT - IV

INTERRUPTS AND INTERRUPT PROGRAMMING:

Concept of Interrupts, Interrupts in 8051. Programming Timer Interrupts, Programming External Hardware Interrupts, Programming Serial Communication Interrupts **7 Hrs**

UNIT - V

Interfacing 8051 to LCD, DAC, ADC Stepper motor interfacing. Applications of microcontrollers **6 Hrs**

LABORATORY EXPERIMENTS:

Part A: Data Transfer, Logical-Byte/Bit manipulations, Jump and Subroutine Calls using Assembly language, counters and delay generation using timers, Embedded C programs

Part B: Interfacing: LCD Display, Stepper motor control, logical interface, 7 segment interface, DAC and keyboard.

Text Books:

1. "The 8051 Microcontroller Architecture, Programming & Applications", Kenneth J. Ayala 2e, Thomson Learning 2005
2. "The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006

Reference Books:

1. 'Computer Organization and Architecture', Carl Hamacher, McGrawHill, 5th Edition
2. http://cnx.org/contents/dadb4fd5-8390-4323-a056-f6381587e89a@1/ Microcontroller%288051%29-Lab

E Books

1. nptel.ac.in/courses/Webcourse-contents/IIT.../microcontrollers
2. http://freevideolectures.com/Course/3018/Microprocessors-and-Microcontrollers

MOOCs

1. Embedded Systems - Shape the World- https://www.edx.org/course/embedded-systems-shape-world-utaustinx-ut-6-02x
2. Electronic Interfaces: Bridging the Physical and Digital Worlds- https://www.edx.org/course/electronic-interfaces-bridging-physical-uc-berkeleyx-ee40lx-0

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COURSE CODE	**15ES4GCSAS**	**COURSE TITLE**	**SIGNALS AND SYSTEMS**
CREDITS	**4**	**L-T-P-S**	**3-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply various properties of transform techniques to solve the continuous and discrete Linear Time Invariant Systems	1	1
CO-2	Analyze various methods to categorize the LTI Systems and identify solutions for mathematical representation of systems.	2	1,2
CO-3	Self-learning on enhanced topics of signals and systems through online course	12	1,2

UNIT - I

INTRODUCTION: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as Interconnections of operations, properties of systems **10 Hrs**

UNIT- II

TIME-DOMAIN REPRESENTATIONS FOR LTI SYSTEMS: Convolution, impulse response representation, Convolution Sum and Convolution Integral, Properties of impulse response representation, Differential and difference equation Representations, Block diagram representations **10 Hrs**

UNIT – III

FOURIER SERIES: Introduction, Discrete time and continuous time Fourier series (derivation of trigonometric Fourier series representation are excluded), Properties of Fourier series (No proof), Applications of Fourier series. Sampling Theorem and Reconstruction. **8 Hrs**

UNIT - IV

FOURIER TRANSFORM: Discrete and continuous Fourier transforms & their properties (With proof). Fourier transform representation of periodic signals, Applications of Fourier transform, Frequency response of LTI systems. Laplace Transform and its Applications. **10 Hrs**

UNIT - V

Z-TRANSFORMS: Introduction, Z – transform, properties of ROC & Z – transforms, Inverse Z–transforms, unilateral Z- Transform, analysis of LTI Systems and application to Solve Difference equations. **10 Hrs**

Text Books:

1. Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons, 2001.Reprint 2002
2. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002

Reference Books:

1. H. P Hsu, R. Ranjan, "Signals and Systems", Scham?s outlines, TMH, 2006
2. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005
3. Ganesh Rao and SatishTunga, "Signals and Systems", Sanguine Technical Publishers, 2004

E Books

1. NPTEL lecture Video on Signals and Systems by Prof. S.C.Dutta Roy, http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.html
2. NPTEL lecture Video on Signals and Systems by Prof. T.K. Basu, IIT Kharagpur. http://www.nptel.ac.in/courses/108105065/

MOOCs

1. https://www.edx.org/course/signals-systems-part-1-iitbombayx-ee210-1x-0
2. https://www.edx.org/course/signals-systems-part-2-iitbombayx-ee210-2x-0

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COURSE CODE	15EC4DCTWD	**COURSE TITLE**	**Technical Writing and Documentation**
CREDITS	**1**	**L-T-P-S**	**0-0-1-0**

COs	Course Outcomes	POs	PSOs
CO-1	Identify and understand the primary genres of technical writing, including, project reports, project proposals, technical descriptions (manuals), product documents, user manual, release notes, Technical paper, recommendation reports, letters, memos, resumes and cover letters.	10, 11	1
CO-2	Exposure to documentation deliverables	8, 10, 11	1
CO-3	Writing and documenting using industry standard tools	5	1

Concepts of Technical Writing and Documentation:

Documentation Standards, Documentation development life cycle, documents comparison tool, Industry standard Technical writing tools and benefit, Single sourcing and variance output, Content management system, Evolution of online help systems.

Documentation Deliverables: Project Reports, Project Proposals, Installation manual, Technical Manual, Product manual, Troubleshooting guides, User Manual, Quick Reference guides, Programmer's reference guides, Release Notes, Recommendation reports, catalogues, brochures, white papers, Technical papers, Technical graphics. Graphs exercises, Diagrams exercise, write presentation, resumes, covering letters and Email etiquette

Tools for Technical Writing:

LATEX, MS Word, MS Excel, Power Point, Adobe Frame maker, Page maker, Photoshop, HTML/DHTML/XML (Flash), Adobe Robo Help Acrobat Reader, MS Visio, Snagit

Reference Book(S):

1. Raman, Meenakshi and Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press, 2nd Edition, 2011.
2. Sharma Sangeeta and Binod Mishra, Communication Skills for Engineers and Scientist, Pearson Education, 2009
3. Kumar, Sharma and Pushp Lata, Communication Skills, New Delhi: Oxford University Press, 2012
4. Gerson, Sheron J and Steven M. Gerson, Technical Writing, 3rd Pearson, 2000.

Methodology

1. 2 days workshop on Technical Writing and Documentation by Industry experts
2. In house lecture series and interactive session
3. Continuous Evaluation through hands on assignment

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MANDATORY MATHEMATICS COURSES FOR LATERAL ENTRY STUDENTS

COURSE CODE	**15MA3IMMAT**	**COURSE TITLE**	**Mathematics-I**
CREDITS	**0**	**L-T-P-S**	**0-0-0-0**

COs	Course Outcomes
CO-1	Understand the basic concepts of differentiation and integration.
CO-2	Apply the concepts of polar curves and multivariate calculus.
CO-3	Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.
CO-4	Apply techniques of vector calculus to engineering problems
CO-5	Comprehend the generalization of vector calculus in curvilinear coordinate system.

UNIT - I

DIFFERENTIAL AND INTEGRAL CALCULUS:

List of standard derivatives including hyperbolic functions, rules of differentiation. Differentiation of product of two functions using Leibnitz rule (direct problems). Taylor's and Maclaurin's series expansion for functions of single variable. List of standard integrals, integration by parts. Definite integrals – problems **9 Hrs**

UNIT - II

POLAR COORDINATES AND PARTIAL DERIVATIVES:

Polar curves: Polar coordinates, angle between radius vector and tangent, angle between two polar curves. Partial differentiation. Total differentiation-Composite and Implicit functions. Taylor's and Maclaurin's series expansion for functions of two variables. Jacobians and their properties (without proof) – Problems **10 Hrs**

UNIT - III

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Introduction to first order differential equations. Linear equation and its solution. Bernoulli's equation and its solution. Exact differential equation and its solution. Orthogonal Trajectories **8 Hrs**

UNIT - IV

SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS: Ordinary differential equations with constant coefficients: Homogeneous differential equations, non-homogeneous differential equations – Particular integral for functions of the type f (x) = e^{ax}, sin(ax), cos(ax), x^n, e^{ax}sin(bx), e^{ax}cos(bx). Method of variation of parameters. Cauchy's and Legendre differential equations

7L+2T Hrs

UNIT - V

VECTOR CALCULUS AND ORTHOGONAL CURVILINEAR COORDINATES (OCC): Recapitulation of scalars, vectors and operation on scalars and vectors. Scalar and vector point functions. Del operator, gradient-directional derivative, divergence, curl and Laplacian operator. Vector identities (without proof). Cylindrical and Spherical polar coordinate systems. Expressing a vector point function in cylindrical and spherical systems. Expressions for gradient, divergence, curl and Laplacian in OCC

6L+2T Hrs

Text books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, and Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
2. Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.

Reference Books:

1. Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers
2. Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.

Ebooks

1. Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-

xB8dEC&redir_esc=y.

2. Advanced Engineering Mathematics, P. V. O'Neil, 5th learning India Pvt. Ltd. Indian reprint, 2009, Cengage learning India Pvt. Ltd.
3. http://ocw.mit.edu/courses/mathematics/ (online course material)

MOOCs

1. https:// www.khanacademy.org/Math
2. https:// www.class-central.com/subject/math (MOOCS)
3. E-learning: www.vtu.ac.in

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COURSE CODE	**15MA4IMMAT**	**COURSE TITLE**	Mathematics-II
CREDITS	**0**	**L-T-P-S**	**0-0-0-0**

COs	Course Outcomes
CO-1	Use Laplace transforms to solve differential equations
CO-2	Apply double integrals to compute areas.
CO-3	Learn to use triple integrals in computing volumes.
CO-4	Use Gamma and Beta functions to evaluate integrals.
CO-5	Ability to understand the use of integral calculus in scalar and vector fields.

UNIT - I

LAPLACE TRANSFORMS:

Laplace transforms of standard functions. Properties and problems. Laplace Transform of Periodic functions with plotting. Unit step function. **6L+2T Hrs**

UNIT - II

INVERSE LAPLACE TRANSFORMS:

Inverse Laplace transforms of standard functions. Properties and problems. Solution of ODE-Initial and Boundary value Problems. **7L+2T Hrs**

UNIT - III

DOUBLE INTEGRAL:

Evaluation of double integral. Change of order of integration. Change of variables to polar coordinates. Application: Area. **8L+3T Hrs**

UNIT - IV

TRIPLE INTEGRALS AND IMPROPER INTEGRALS:

Evaluation of triple integral. Application: Volume. Gamma and Beta functions-definition Relation between Gamma and Beta functions. Properties and Problems. **6L+2T Hrs**

UNIT - V

VECTOR INTEGRATION:

Line integral. Green's theorem. Stokes' theorem. Gauss divergence theorem. **6L+2T Hrs**

Text Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
2. Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd

Reference Books:

1. (1) Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y
2. Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.
3. http://ocw.mit.edu/courses/mathematics/ (online course material)

MOOCs

1. https:// www.khanacademy.org/Math
2. https:// www.class-central.com/subject/math (MOOCS)
3. E-learning: www.vtu.ac.in

5^{th} – 6^{th} Semester Syllabus

Program Core Course Syllabus

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COURSE CODE	**16EC5DCCT1**	**COURSE TITLE**	**COMMUNICATION THEORY -1**
CREDITS	**6**	**L-T-P-S**	**3-0-1-2**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply various concepts of theorems and Transforms for computing parameters of Communication systems	1	1,2
CO-2	Analyze performance of different types of Analog modulation Techniques for a given set of parameters	2	1,2
CO-3	Design Analog Communication subsystems for given set of specifications	3	1,2
CO-4	Simulate and conduct experiments on different types of Analog communication subsystems	4, 5	1,2,3
CO-5	Involve in independent/team learning, Communicate effectively and engage in life-long learning	9, 10,12	1,2,3

UNIT- I

Random variables, Gaussian distribution, random processes, Stationarity, Mean, Correlation and Covariance functions, Transmission of random signals through linear systems. NOISE: Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Narrow bandwidth. **7 Hrs**

UNIT- II

Amplitude Modulation (AM), DSBSC- time-domain and Frequency domain representation, Generation and Detection. Quadrature carrier multiplexing, Noise in AM receivers- AM and DSBSC. **7 Hrs**

UNIT- III

Hilbert transform, properties of Hilbert transform, Pre-envelope, Canonical representation of band pass signals Single side band modulation: Frequency domain description, Generation and Demodulation, noise in SSB receiver.

VESTIGIAL SIDE BAND MODULTION (VSB): Time and Frequency domain description, Generation and detection. Frequency translation, Frequency division multiplexing. **7 Hrs**

UNIT- IV

Angle Modulation - Basic concepts, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves. Generation of FM waves: Indirect FM, Direct FM. Demodulation of FM waves: Balanced frequency discriminator, Zero-crossing detector, Phase-locked loop, FM stereo multiplexing, noise in FM receivers, FM threshold effect, Pre-emphasis and De-emphasis in FM. **8 Hrs**

UNIT- V

Digital Communication: Basic operations in Digital Communications, Sampling Theorem, Quadrature Sampling of Band pass signals, Practical aspects of sampling and signal recovery, Pulse amplitude Modulation and TDM. **7 Hrs**

List of Experiments:

1. Conduction of 2^{nd} order filters.
2. Conduction of mixer.
3. Generation and detection of AM, DSBSC waves.
4. FM wave generation.
5. Generation and detection of PAM.
6. TDM and Demultiplexing.
7. Verification of sampling theorem.

Text Books:

1. S.Haykins, Communication Systems (4/e), Wiley, 2001.

2. S.Haykins, An Introduction to Analog and Digial Communications, Wiley, 2003.

Reference Books:

1. John G Proakis, Masoud Salehi, Communication Systems Engineering, (2/e), Person, 2015.
2. K Sam Shanmugam, Digital and Analog Communication Systems, Wiley, 1994
3. http://nptel.ac.in/courses/117102059/1.

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COURSE CODE	**16EC5DCDSP**	**COURSE TITLE**	**DIGITAL SIGNAL PROCESSING**
CREDITS	**6**	**L-T-P-S**	**3-0-1-2**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concepts of transform techniques in realizing Discrete time signal and Digital filters	1	1
CO-2	Analyze various transform techniques for discrete time signals and various methods to design digital Filter	2	1
CO-3	Design of Analog and Digital Filters for given specifications.	3	1
CO-4	Simulation and verification of various transform techniques and filter Design	4, 5	1,3
CO-5	Engage in self-study to design and demonstrate an application of digital signal processing	4,5, 9, 10, 12	1, 3

UNIT- I

Introduction to DSP, Frequency-domain Sampling (Sampling of DTFT), DFT and its Inverse, DFT as a Linear Transformation (Matrix formulation), Properties of DFT: Periodicity, Linearity, Circular Time shifting, Circular Frequency Shifting, Circular Time Reversal, Conjugation and Conjugate Symmetry (Symmetry properties), Duality, Circular Convolution (Multiplication of two DFTs), Circular correlation, Multiplication(or Modulation) property, Parseval's Relation. **8 Hrs**

UNIT- II

Linear convolution using Circular Convolution, Filtering of long data sequences using DFT: Overlap save method, overlap Add method, Relation between DFT and other transforms. Computational complexity of Direct Computation of DFT **7 Hrs**

UNIT- III

DIT-FFT algorithm, DIF-FFT Algorithm, Comparison between DIT and DIF Algorithms, Inverse DFT using FFT Algorithms, Linear Filtering Approach for Computing DFT: Goertzel Algorithm, Chirp-Z Transform . **7 Hrs**

UNIT- IV

Design of Analog Filters: Analog Butterworth Filters, Analog Chebyshev Filter, Frequency transformation in Analog domain, Frequency transformation in Digital domain. Design of IIR Filters from Analog Filter: Impulse Invariant Method, Bilinear Transformation. Realization of IIR Filters: Block diagram and Signal flow Graps representation, Direct-Form I Structure, Direct Form-II Structure, Cascade form and Parallel form. **7 Hrs**

UNIT- V

Properties of FIR Digital Filters, Design of FIR Filters using Windows: rectangular, triangular, Hamming, Hanning , Blackman window, Kaiser Window. Design of FIR Filters using frequency Sampling Method Realization of Finite Impulse Response (FIR) systems: Direct Form, Linear Phase Form Gibbs phenomenon (qualitative discussion only), comparison between IIR and FIR filters **7 Hrs**

Lab Experiments:

Display of basic elementary signals, sampling theorem, basic operations on sequences (shifting, folding, time scaling and multiplication), linear and circular convolution, cross and auto correlation, linear convolution and correction using FFT algorithm, FFT of Sequence, FIR Filter design-LP, HP, BP and Notch filter, FIR filter design using Hamming and Kaiser window for the given order and cut-off frequency, Design of IIR FILTER-LP,HP (using both hardware and software)

Text Books:

1. Discrete-Time Signal Processing (Second Edition), Alan V. Oppenheim, Ronald W. Schafer, and John R. Buck, Pearson Education India
2. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press, 2015

Reference Books:

1. Digital Signal Processing, A computer based approach, Sanjit K Mitra, Tata McGrawHill, Third Edition,

2. Digital Signal Processing, Principles, Algorithms and Applications, John G. Proakis, Dimitris K Manolakis,,Pearson education/PHI, (4th Edition)
3. Fundamentals of Digital Signal Processing, Lonnie Ludeman, John Wiley & Sons; st Wiley International 1 Edition, 1988.
4. Understanding Digital Signal Processing, Richard G. Lyons Prentice Hall, March 25, 2nd Edition 2004
5. Digital Signal Processing: Fundamentals and Applications,LiTan,Academic st Press,6. 1 edition 2007
6. Schaum's Outline of Digital Signal Processing, Monson Hayes, McGraw- Hill, 1 edition, 1998.

E-books:

1. http://freevideolectures.com/Course/2339/Digital-Signal-Processing-IITKharagpur
2. http://freevideolectures.com/Course/2317/Digital-Signal-Processing-IIT-Delhi

MOOCs:

1. https://www.coursera.org/course/dsp
2. https://www.edx.org/course/discrete-time-signal-processing-mitx-6-341x-0

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COURSE CODE	**16EC5DCFOV**	**COURSE TITLE**	**FUNDAMENTALS OF VLSI**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	To Apply the knowledge of CMOS technology to construct basic and advanced CMOS logic circuit like memory & array subsystems	1	1
CO-2	Analyse the ideal & non ideal IV effects of MOSFET and DC transfer characteristics CMOS circuit	2	1
CO-3	Design of CMOS based combinational and sequential circuits for given specification	3	1

UNIT- I

VLSI design flow: Specification, Design entry, Functional simulation, planning placement and routing, timing simulation.

MOS Transistor: Introduction, Ideal I-V characteristics, C-V Characteristics, Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, Non ideal I-V Effects, Mobility Degradation and Velocity Saturation, Channel Length Modulation, Threshold Voltage Effects, Junction Leakage, Body effect, Tunneling. **7 Hrs**

UNIT- II

CMOS Processing Technology: CMOS Technologies, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide (SiO2), Isolation, Gate Oxide, Gate and Source/Drain Formations, Contacts and Metallization, Passivation, Metrology, Layout design rules, CMOS Process enhancements. **7 Hrs**

UNIT- III

DC Transfer Characteristics: Static CMOS Inverter DC Characteristics, Beta Ratio Effect, Noise Margin, Pass Transistor DC Characteristics.

Combinational Circuit Design: CMOS Logic, Inverter, NAND Gate, NOR Gate CMOS, Logic Gates, The Compound Gates, Pass Transistors and Transmission Gates, Tristate buffer, Multiplexers. **7 Hrs**

UNIT- IV

Sequential MOS logic circuitry: Behavior of Bistable element, SR Latch Circuitry, Clocked latch and Flip Flop Circuitry, C-MOS D-Latch and Edge Triggered Flip-Flop.

Sequencing Static Circuits: Sequencing Methods, Max-Delay Constraints, Min-Delay Constraints, Time Borrowing, Clock Skew **7 Hrs**

UNIT- V

Array Sub system: SRAM: Memory cell Read/Write operation, Decoder, Bit-line conditioning and Column Circuitry, Multi-Ported SRAM and Register Files, Large SRAMs.

DRAM: Subarray Architectures, Column Circuitry, Embedded DRAM.

Read-Only Memory: Programmable ROMs, NAND ROMs. **8 Hrs**

Text Books:

1. Neil H.E. Weste, David Harris, Ayan Banerjee,"CMOS VLSI Design",Pearson Education,3rd Edition, 2006,ISBN: 0321149017

Reference Books:

1. Sung MO Kang, Yousf Leblebici,"CMOS Digital Integrated Circuits"; Tata McGrawHill, 3rd Edition, ISBN: 0-7923-7246-8
2. Douglas.A.Pucknell, Kamaran Eshraghian, "Basic VLSI Design",PHI,3rd Edition 2010,ISBN: 0-321-26977-2
3. John P. Uyemura,"Introduction to VLSI Circuits & Systems",Wiley India Edition, 2007, ISBN: 978-81-265-0915-7;

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COURSE CODE	**16EC5DCMWE**	**COURSE TITLE**	**MICROWAVE ENGINEERING**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply concepts of Fields and Networks to study working principles of specific microwave active/passive devices, transmission lines/microwave devices	1	2
CO-2	Analyze microwave networks and components using S-parameters	2	1
CO-3	Gain knowledge on effect of microwaves on human body , impact of the professional engineering solutions on environment and society and the consequent responsibilities relevant to an EC engineer	6, 7, 10	2

UNIT- I

Introduction: History of Microwaves, Microwave Frequency bands. Properties and applications of Microwaves. Concept of Mode - Characteristics of TEM, TE and TM Modes. Losses associated with microwave transmission. Concept of Impedance in Microwave transmission.

Transmission line theory: Introduction, Transmission line equations, Characteristic and input Impedances, reflection and transmission coefficients, standing waves and SWR, Mismatch losses in transmission lines, Smith chart, Application of smith chart.

Microwave transmission lines (Qualitative analysis only): Co axial line, Planar transmission lines, Strip lines, Micro strip lines, slot lines and Coplanar lines **10 Hrs**

UNIT- II

Microwave network theory: Introduction, Symmetrical Z and Y parameters, for reciprocal Networks, S matrix representation of multi-port networks- Properties of S parameters, S –

parameters of a Two – port network with mismatched load, Comparison b/n [S], [Z], and [Y] matrices, Relations of Z, Y, ABCD parameters with S-Parameters. **6 Hrs**

UNIT- III

Passive Devices: Introduction, Coaxial cables, connectors and adapters, Wave guide sections, matched terminations, Wave guide corners, bends, Twists, Coaxial line to waveguide adapters, Attenuators, Phase shifters, Waveguide Tees, Magic tees, circulators and isolators, directional couplers- Bethe-hole coupler, Multi-hole directional coupler(Qualitative analysis Only). **6 Hrs**

UNIT- IV

Active Devices: Introduction, Schottky diode, PIN diode, Transfer electron devices – GUNN diodes, Avalanche transit time devices- IMPATT Diodes, TRAPATT Diodes, BARITT Diodes, Parametric amplifiers (Qualitative analysis Only). Microwave tubes: Klystron, TWT, Magnetron **8 Hrs**

UNIT- V

Modern Trends in Microwaves Engineering: Effect of Microwaves on human body. Medical and Civil applications of microwaves. Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC). Monolithic Microwave IC fabrication. RFMEMS for microwave components. Microwave Imaging **6 Hrs**

Text Books:

1. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2001.

Reference Books:

1. Microwave Engineering – David M Pozar, John Wiley, 2e, 2004.
2. Microwave Devices and circuits- Liao / Pearson Education.
3. Rizzi P.A., "Microwave Engineering, Passive Circuits Hall of India
4. M.Kulkarni., "Microwave devices and Radar Engg."Umesh Publications
5. Chatterji R., Microwave Engineering, Special topics, East West Press

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COURSE CODE	**16EC5DCCSM**	**COURSE TITLE**	**CONTROL SYSTEM**
CREDITS	**4**	**L-T-P-S**	**3-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Understand Basic control systems and applying different techniques to reduce system and determine stability.	1	1
CO-2	Analyzing system performance and stability using different approaches.	2	1
CO-3	Evaluation of system performance by varying system parameters of the control systems.	3	1
CO-4	Create, Apply and analyze control system problems using MATLAB or Simulink tool	5, 10	1

UNIT- I

Introduction: Examples of Control Systems, open loop v/s Closed loop Systems, Classifications of Control Systems.

Mathematical Modeling of Linear Systems: Transfer functions determination of Mechanical and electrical systems (analogous systems) using various approaches: block diagram, Signal Flow Graph, state space modeling (include DC motor control and PID controller).

12L+4T Hrs

UNIT- II

Time response analysis of control systems: Step response of first order, second order systems, response specification, steady state error and error constants. **6L+3T Hrs**

UNIT- III

Stability analysis: Concept of stability, RH criterion, applications of RH criterion with limitations, Polar plots, concept of Nyquist plot. **5L+2T Hrs**

UNIT- IV

Root locus technique: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot, effect of adding poles and zeros, lead and lag compensation based on root locus technique. **8L+2T Hrs**

UNIT- V

Frequency response analysis: Bode plots, Relative stability, Frequency domain specifications.

5L+1T Hrs

Text Books:

1. Control Engineering by Nagrath & Gopal, New Age International Publishers
2. Control Engineering An introduction with the use of MATLAB Derek P.Atheron
3. Control Engineering by Norman S. Nice Sixth edition, John Wiley & Sons, Inc.

Reference Books:

1. Modern control Engineering - Ogata, Prentice Hall
2. Automatic Control Systems - B.C Kuo, John Wiley and Sons

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COURSE CODE	**16EC6DCCT2**	**COURSE TITLE**	**COMMUNICATION THEORY - 2**
CREDITS	**6**	**L-T-P-S**	**3-0-1-2**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of various signal processing and coding techniques for effective communication in digital systems	1	1
CO-2	Analyze the performance of a given digital communication system	2	1
CO-3	Design a digital communication system for a given set of specifications.	3	1
CO-4	Conduct experiments / simulate to demonstrate a given application / problem statement in digital communication	4, 5, 9 10	1,3
CO-5	Engage in self-learning of advanced concepts and application of Digital Communication	4, 9, 10, 12	1,3

UNIT- I

Introduction to DCS, Pulse code modulation, generation and detection of PCM, need for Robust quantization-companding, differential PCM; Delta modulation, Adaptive delta modulation; Signal-to-Noise Ratio calculations, TDM-PCM, T1 and E1 digital Hierarchy. Line codes, ISI in band limited channels, Zero-ISI condition- the Nyquist criterion, Solution for zero ISI, Raised cosine filters, Duo binary encoding. **8 Hrs**

UNIT- II

Optimum Receiver for AWGN channel, Matched filter and Correlation type receivers, Digital Modulations- Generation and detection of ASK, BPSK and BFSK, QPSK and DPSK. Signal space constellation, Computation of probability of bit error for BPSK, BFSK. Performance

analysis of all the schemes in terms of probability of bit error, BW and Power and their Comparison. Introduction to OFDM **9 Hrs**

UNIT- III

Need for Spread Spectrum Modulation, PN sequence and its properties, Direct sequence SS system- DS/BPSK Transmitter & Receiver, Processing gain, Jamming margin, Frequency hop SS system- FH-FSK transmitter and Receiver, Fast and slow hop. Application of DS SS and FHSS for multiuser environment – CDMA, Multipath fading. Introduction to diversity technique **5 Hrs**

UNIT- IV

Measurement of Information; Entropy and information rate, communication channels, Shannon's Channel Capacity theorem and its trade off.

Source encoding: Properties of codes, Shannon Fano Encoding Algorithm, Huffman's coding algorithm. **7 Hrs**

UNIT- V

Channel coding: Linear Block codes, Error Detecting and Correcting capability, Binary Cyclic Codes, algebraic structure, Encoding using shift registers, Syndrome calculation

Convolutional Encoding: Convolutional Encoder Representation in time and transform domain. Tree, trellis and state representation **7 Hrs**

List of Hardware and Software Experiments

1. Design TDM circuitry to demonstrate TDM of two band limited signals.
2. Design and demonstrate PSK generation and detection.
3. Design and demonstrate ASK generation & Detection.
4. Design and demonstrate FSK generation & Detection.
5. Demonstrate and analyse ISI from eye pattern.
6. Demonstrate and analyse PCM coding and decoding.
7. Demonstrate and analyse performance of Digital communication transmission and reception with and without channel coding.
8. Demonstration and analysis of Spread spectrum for CDMA.

Text Books:

1. Digtal Communications By Simon Haykins –John Wiley 2003
2. Digital communications - Bernard Sklar: Pearson education 2007

Reference Books:

1. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007
2. Concepts of Information theory and coding, P.S. Satyanarayana, DYNARAM 2005

E-books:

1. Digital communications ny John Barry and Lee, Springer
2. NPTEL lecture series : Prof Bikas Kumar Dey, IIT Bombay.

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COURSE CODE	**16EC6DCMSD**	**COURSE TITLE**	**MIXED SIGNAL DESIGN**
CREDITS	**6**	**L-T-P-S**	**3-0-1-2**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of basic CMOS technology to understand and explain the concepts of analog integrated circuits and mixed signal circuits	1	1 ,3
CO-2	Analyze CMOS based Analog, ADC and DAC circuits	2	1, 3
CO-3	Design analog CMOS integrated circuits and mixed signal circuits	3	1 ,3
CO-4	Conduct experiments on Analog and mixed signal CMOS circuits using modern EDA tools	4,5	1, 3
CO-5	Engage in self learning to design and demonstrate an application using CMOS based mixed signal circuits	4, 5, 9, 10, 12	1, 3

UNIT- I

Review of MOS Single-stage Amplifiers, Differential Amplifiers: basic differential pair (quantitative, qualitative analysis) half circuit concept, common mode response, current mirrors(only passive current mirror). **8 Hrs**

UNIT- II

Operational Amplifiers: General considerations, One-Stage Op amps, Two-Stage Op amps, Gain Boosting, Input Range Limitations. **7 Hrs**

UNIT- III

Oscillators and Phase Locked Loops: VCO, Mathematical Model of VCO, Simple PLL, Charge pump PLL. **7 Hrs**

UNIT- IV

Data Converter Fundamentals: Analog versus Discrete Time Signals, Converting Analog Signals to Digital Signals, Sample-and-Hold characteristics, Digital-to-Analog Converter specifications, Analog-to-Digital Converter specifications, Mixed-Signal layout issues.

7 Hrs

UNIT- V

DAC Architectures: Digital Input Code, Resistor String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, Pipeline DAC.

ADC Architectures: Flash ADC, Two-Step Flash ADC, Pipeline ADC, Integrating ADCs, Successive Approximation ADC, Oversampling ADC. **7 Hrs**

Text books:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Mc GrawHill Edition, 2002,ISBN: 0-07-238032-2
2. R. Jacob Baker, Harry W. Li and David E. Boyce, "CMOS Circuit Design, Layout and Simulation", IEEE Press, 2002, ISBN: 81-203-1682-7

Reference Books:

1. Behzad Razavi: "Fundamentals of Microelectronics", 1st edition, Wiley, 2008, ISBN: 978-0-471-47846-1

Lab Experiments:

All experiments must be implemented using Industry standard EDA tools

1. Design the analog circuits using MOS transistors:
    a. Draw the schematic and verify the following
        (i) DC Analysis
        (ii) AC Analysis
        (iii)Transient Analysis
    b. Draw the Layout and verify the DRC, ERC
    c. Check for LVS.
2. Design a two stage op-amp with given specification using given differential amplifier, Common Source and Common Drain amplifier in library and complete the design flow mentioned below:
    a. Draw the schematic and verify the following
        (i) DC Analysis

(ii) AC Analysis

(iii) Transient Analysis

b. Draw the Layout and verify the DRC, ERC

c. Check for frequency response, slew rate, offset effects and Noise.

3. Design a simple ADC/DAC and measure the data conversion time.
4. To measure INL and DNL of converter.

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COURSE CODE	**16EC6DCCCN**	**COURSE TITLE**	**COMPUTER COMMUNICATION NETWORKS**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concepts of Computer Networks and Networks Models for Data Communication.	1	1,2
CO-2	Analyze networking architecture and infrastructure for wired and wireless link.	2	1,2
CO-3	Skill to substantiate design and performance issues in LANs for a given specification.	3	1,2
CO-4	Ability to submit a report on the impact/growth of wired and wireless network for societal and sustained development.	7, 10	1,2

UNIT - I

Introduction to Building a Network, Applications, Requirements, Network Models, Data and signals, Digital transmission, analog Transmission, Multiplexing and Spreading **6 Hrs**

UNIT- II

Transmission Media, Switching, Telephone Networks and Cable networks for data transmission **6 Hrs**

UNIT- III

Error detection and Correction, Data link control **10 Hrs**

UNIT- IV

Multiple Access, Wired LANs, Wireless LAN **8 Hrs**

UNIT - V

Connecting LANs, Back bone Networks, Virtual LANs, Virtual Circuit Networks (ATM and Frame Relay) **6 Hrs**

Text Books:

1. Data Communication and Networking, Farouzan, Mc Graw Hill Education.
2. Computer Networks, Andrew S.Tanenbaum
3. Computer Networks, a systems approach, Larry L. Peterson and Bruce S. Davie,Morgan Kauffman Publication, 2011.
4. http://nptel.ac.in/video.php?subjectId=106105081
5. http://freevideolectures.com/Course/2278/Data-Communication

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COURSE CODE	**16EC6DCAWP**	**COURSE TITLE**	**ANTENNA AND WAVE PROPAGATION**
CREDITS	**4**	**L-T-P-S**	**3-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concepts & properties of Electro-Magnetism to obtain parameters of antennas and Wave Propagation	1	2
CO-2	Analyze different types of antennas, characteristics of radio-waves and their propagation in the atmosphere	2	2
CO-3	Effectively prepare and present a seminar/case study on assigned topics related to Advanced topics/Safety measures/antenna design as an individual/team	5, 6, 10	2

UNIT- I

Antenna Basics: Physical concept of radiation, near and far field regions, basic antenna parameters: radiation patterns, beam area, radiation Intensity, beam efficiency, reciprocity, directivity and gain, antenna apertures, effective height, bandwidth, radiation efficiency, radio communication Link, antenna temperature and antenna field zones. Short electric dipole, fields of a short dipole, radiation resistance of dipole, Half wave dipole antenna, folded dipole antennas **7L+3T Hrs**

UNIT- II

Point Sources & their arrays: Arrays, Point source, Power theorem and its application, Examples of power patterns, Field patterns, Phase patterns, Array of isotropic point sources-different cases, non-isotropic sources, principle of pattern multiplication, linear arrays of n elements of equal amplitude & spacing, broad side, end fire arrays, radiation pattern, directivity, beam width and null directions, array factor, Directions of maxima, Linear broadside arrays with non-uniform amplitude distributions-general condition. Phased arrays.

8L+2T Hrs

UNIT- III

Loop, Slot, Patch and Horn Antenna: Introduction, small loop, far fields of small loop, far field patterns of circular Loop, radiation resistance, directivity, slot antenna, Babinet's Principle and complementary antennas, patch antennas, horn antennas, rectangular horn antenna **7L+2T Hrs**

UNIT- IV

Antenna types: Helical antenna, YagiUda array, parabolic reflectors, Log periodic antenna, Antenna design considerations for satellite communication, Antennas for mobile communications systems: Mobile Terminal antennas, Base station antennas, Introduction to MIMO **7L+2T Hrs**

UNIT- V

Radio Wave Propagation: Introduction, ground wave propagation, free space propagation, Ground reflection, surface wave, diffraction Troposphere wave propagation Tropospheric scatter, ionosphere propagation, electrical properties of the ionosphere, effects of Earth's magnetic field. **7L+3T Hrs**

Text Books:

1. John D Kraus R J Marhefka and Ahmed S Khan "ANTENNAS For all applications", Tata McGraw Hiill India, 2006, Third Edition.
2. Constantine A Balanis "ANTENNA THEORY" John Wiley & Sons, 2004, Second Edition
3. Simon R Saunders and Alejandro Aragon-Zavala Antennas and Propagation for Wireless Communication systems, Wiley-India,2nd Edition
4. Antennas and Wave Propagation by A R Harish & M Sachidananda, Oxford University Press 2007, Seventh impression 2011

Department Elective Course Syllabus

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DEPARTMENTAL ELECTIVE- 1 **SEMESTER 5**

COURSE CODE	**16EC5DE1IP**	**COURSE TITLE**	**IMAGE PROCESSING**
CREDITS	**3**	**L-T-P-S**	**2-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply enhancement and restoration techniques to 2D images in spatial and frequency domain for required visualization.	1	1
CO-2	Analyze and represent an image using transform techniques in different domains.	2	1
CO-3	Interpret image in various data formats by applying image transformation / processing techniques for different applications.	4	1

UNIT-I

Introduction to Image Processing: Introduction, Fundamental steps in DIP, Components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Arithmetic and Logical operations on images, Fundamentals of color image processing, Color models, Conversion of color models from one form to other form. **5L+3T Hrs**

UNIT- II

Image Enhancement in Spatial Domain: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Local enhancement, Spatial filters: Smoothing filters, Order statistics filter, Sharpening filters, Frequency domain filters: smoothing and sharpening filters. **4L+2T Hrs**

UNIT- III

Image Restoration**:** Image degradation/restoration model, Inverse filter, Pseudo Inverse

filter, Noise models, Estimating the degradation function, inverse filtering, Wiener filter, Constrained Least squares filter. **5L+2T Hrs**

UNIT- IV

Morphological Image Processing: Preliminaries, Dilation and erosion, opening and closing, Basic morphological operations: Boundary extraction, Region filling, extraction of connected components, convex hull, thinning, thickening, skeleton, pruning. **5L+3T Hrs**

UNIT- V

Image Transforms: Two-dimensional orthogonal unitary transforms, Properties of Unitary Transforms, Discrete Cosine Transform, Haar Transform , Hadamard Transform and wavelet transforms with application examples. **5L+2T Hrs**

Text Book:

1. Digital Image Processing by Rafael C. Gonzalez & Richard E. Woods, Third Edition, Pearson education, 2009.

Reference Book:

1. Digital Image Processing by S.Jayaraman, S.Esakkirajan, T.Veerakumar, TMH, 2009.

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DEPARTMENTAL ELECTIVE-1 **SEMESTER 5**

COURSE CODE	**16EC5DE1AL**	**COURSE TITLE**	**ADVANCED DIGITAL LOGIC DESIGN**
CREDITS	**3**	**L-T-P-S**	**2-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concepts of Digital design to create digital building blocks using Verilog.	1	3
CO-2	Analyze the RTL timing to report violations and synthesize to generate gate level netlist.	2	3
CO-3	Design of RTL using finite state machines along with design optimization.	3	3
CO-4	Simulate and debug the design using test benches and analyze the synthesis timing and power reports.	4,5,9, 10	3

UNIT- I

Logic Design Using Verilog: Moore's law, Technology Scaling, Die size growth, Frequency, Power dissipation, Power density, Challenges in digital design, Design metrics, and Cost of Integrated circuits, Digital Combinational & Sequential circuits. Lexical Conventions, Data Types, Levels of Abstraction, Modules, Nets, Values, Comments, arrays in Verilog, Expressions, Operators, Operands, Arrays, memories, Strings, Delays, parameterized designs, Procedural blocks, Blocking and Non-Blocking Assignment, looping, flow Control, Task, Function, basic test bench generation and Simulation, Verilog modeling of combinational and sequential logic **6L+4T Hrs**

UNIT- II

Principles of RTL Design: Verilog Coding Concepts, Verilog coding guide lines: Combinational, Sequential, FSM. General Guidelines, Synthesizable Verilog Constructs, Sensitivity List, Verilog Events, RTL Design Challenges **6L+2T Hrs**

UNIT - III

Introduction to Timing concepts: Setup and hold times. Setup and hold time equalities and inequalities, timing paths. Static timing delay calculation for basic flip flop & sequential circuits, Clock Domain Crossing. **4L+2T Hrs**

UNIT- IV

Synthesis, Libraries and Technology Mapping: Introduction to synthesis, logical synthesis of basic combinational and sequential circuits, Synthesis Methodologies, Pre and post synthesis mismatch, Translation, mapping and optimization. Overview of Libraries, design constraints, importance of wire load models **4L+2T Hrs**

UNIT- V

Design and simulation of Finite state Machines: FSM Design – overlapping and non-overlapping Mealy and Moore state machine design **4L+2T Hrs**

Reference Books:

1. Digital Design by Morris Mano M, 4th Edition
2. Verilog HDL: A Guide to Digital Design and Synthesis by Samir Palnitkar, 2nd Edition
3. Verilog HDL Synthesis A Practical Primer by J. Bhasker
4. Fundamentals of Digital Circuits by A. Anand Kumar, 2nd Edition
5. Principles of VLSI RTL Design: A Practical Guide by Sanjay Churiwala, Sapan Garg, 2011

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DEPARTMENTAL ELECTIVE-1 **SEMESTER 5**

COURSE CODE	**16EC5DE1EI**	**COURSE TITLE**	**EMI AND EMC**
CREDITS	**3**	**L-T-P-S**	**2-0-1-0**

CO-numbers	**Course Outcomes**	**POs**	**PSOs**
CO-1	Apply the knowledge of EMI/EMC in prototyping an electronic system design	1	2
CO-2	Ability to analyse/apply reasoning through knowledge acquisition with regard to Noise Coupling, Noise reduction, EMI suppression	2,6	2
CO-3	Understand the impact of EMI compliance, IEEE EMI Standards and measurements, which is important in Electronic system design in modern era with an example of SMPS.	7	2

UNIT- I

Introduction of EMC, Electromagnetic environment, History, concept, Natural and intentional source of EMI, EMC in Commercial, automobile, defence and Aviation product. Introduction to radiated and conducted emissions testing and limits. Electromagnetic field theory - Description of electromagnetic disturbances, classification based on frequency, transmission and character. Unintentional antennas; Near field vs Far field. **5 Hrs**

UNIT- II

Noise Coupling Mechanisms: Conductive coupling, capacitive coupling and Inductive coupling, electromagnetic coupling. Types of EMI Intra and Inter .Current loops, Differential mode and common mode noise in digital circuits, Decoupling capacitor – selection, values & resonant frequencies, Decoupling capacitor placements & routing;-Demonstration – Dielectrics, Vias placement, Return paths. **5 Hrs**

UNIT- III

Techniques to Optimize power delivery network , grounding, shielding, bonding, reducing internal EMI, EMI Filter design. Insertion loss versus frequency of EMI filter. Cable radiation and interference. EM coupling wiring layout and PCB design considerations, shielding-coaxial cables, shielding of equipment, EMC suppression cable, EMC gaskets, Isolation transformer. **5 Hrs**

UNIT- IV

Introduction to signal integrity and EMI, Impedance mismatches, reflections, vias and manufacturing effects, Termination methods and routing topologies, Crosstalk and guarding, causes of EMI from high speed digital circuits., SMPS design for low conducted emissions, need for Shielding. **5 Hrs**

UNIT- V

Introduction to IEEE Standards - EMC compliance, testing of Electrical/ Electronic product for Conducted and Radiated emission, Conducted and Radiated immunity parameters as Per standards. EMI measuring instruments, spectrum analyser, LISN, Current probe, EMC Antenna, anechoic chambers, Field Probe. **4 Hrs**

Reference Books:

1. Electromagnetic Compatibility Design Guide", Tecknit.
2. Noise Reduction Techniques In Electronic System: H.W.Ott.
3. New Dimensions in Shielding, Robert B. Cowdell, IEEE transactions on Electromagnetic Compatibility, 1968 March.
4. EMI Standards : Prasad Kadali.

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DEPARTMENTAL ELECTIVE-1 **SEMESTER 5**

COURSE CODE	**16EC5DE1OP**	**COURSE TITLE**	**OOPS USING C++**
CREDITS	**3**	**L-T-P-S**	**2-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply knowledge of object-oriented concepts to implement a given problem statement.	1	2
CO-2	Design and analyze solution to a given problem using C++.	2	2
CO-3	Simulate and document the given application using Object Oriented approach.	3, 4, 5	2

UNIT- I

Migration to CPP syntax from C - Benefits and applications beginning with C++: Definition, application, structure of C++ program, compiling and linking Tokens, expressions and control structures: Tokens, keywords, identifiers and constants, data types, symbolic constants, variables, operators, manipulators, control statements and loops. OOP Concepts, Program construction, directives, pre-processor directives, header files and library files. **5L+2T Hrs**

UNIT- II

Functions in C++: Function prototype, argument passing, recursion, inline functions, friend and virtual functions Classes and objects: Class definition and declaration, member functions, static data members and member functions, arrays of objects, returning objects. **5L+2T Hrs**

UNIT- III

OOPS concepts: Constructors, parameterized constructors, multiple constructors in a class, copy constructor, dynamic constructors, destructors, Operator overloading: Overloading unary and binary operators, overloading using friends, rules for overloading. Inheritance: Single and multiple inheritances, public, private and protected inheritance. Pointers to objects, this pointer, pointers to derived classes, virtual functions. **8L+4T Hrs**

UNIT - IV

Templates and exceptions: Class templates, function templates, overloading template functions, member function templates and non-type template arguments. Exception handling: Basics, throwing and catching mechanisms, re-throwing an exception, specifying exceptions.

4L+2T Hrs

UNIT - V

Other aspects: Pointers to objects, this pointer, pointers to derived classes, virtual functions. Managing console I/O operations: C++ streams, C++ stream classes, I/O operations, managing O/P with manipulators, classes for file stream operations, opening and closing a file, detecting end of file, more about open():file modes. **4L+2T Hrs**

Text Books:

1. "Object oriented Programming with C++", E Balagurusamy, TMH Publications, 4th Edition
2. Object oriented Programming in turbo C++, Robert Lafore, GALGOTIA Publications

Reference Books:

1. Let Us C++, Yashavanth P. Kanetkar, BPB Publications
2. Programming With C++-Schaum's series, TMH Publications
3. Programming With C++, Schaum's series, TMH Publications

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DEPARTMENTAL ELECTIVE-1 **SEMESTER 5**

COURSE CODE	**16EC5DE1CA**	**COURSE TITLE**	**COMPUTER ARCHITECTURE**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of the hardware and software systems of computer to develop efficient coding for sequential and pipeline architectures.	1	2
CO-2	Analyze various aspects of code optimization, storage technologies and impact of cache memory on the program performance on modern processors.	2	2
CO-3	Analyze the exceptional control flow of program and the compilation process to create executable object files.	2	2
CO-4	Communicate on advanced system engineering trends with effective presentations and report writing skills, following professional ethics.	8, 10	2

UNIT- I

Fundamentals of Computer Systems: Hardware organization of a system, Caches and storage devices, Operating system manages the hardware: processes, threads, virtual memory and file system, Concurrency and parallelism, Importance of abstractions in a computer system.**5 Hrs**

UNIT- II

Processor Architecture: Y86 instruction set architecture: instructions, instruction encoding, CISC & RISC instruction set, Y86 exceptions, Y86 programs, Sequential Y86 implementations, General principles of pipelining, pipelined Y86 implementation. **8 Hrs**

UNIT- III

Optimizing Program Performance: Capabilities and limitations of optimizing compilers, Expressing Program Performance, program example, Eliminating loop inefficiencies and

memory references, Reducing procedure calls, Understanding modern processors, Loop unrolling, Enhancing parallelism. **8 Hrs**

UNIT- IV

The Memory Hierarchy: Storage Technologies, Locality, Memory Hierarchy, Cache Memories, Virtual Memory and Virtual Machines, Writing Cache Friendly Code, The impact of Cache on Program Performance. **7 Hrs**

UNIT- V

Running Programs on a System: Compiler Drivers, Static Linking, Object Files, Relocation, Loading Executable Object Files.

Exceptional Control Flow: Exceptions, Processes, System Call Error Handling, Process Control. **8 Hrs**

Text Books:

1. Computer Systems: A Programmer's Perspective by Randal E Bryant, David R O' Hallaron, 2nd edition, Prentice Hall.
2. Computer Architecture- A Quantitative Approach by John L Hennessey & David A Patterson, 4th Edition, Elsevier.

Reference Books:

1. Computer Organization and Architecture, Stallings W, Prentice Hall, 6th edition, 2003.
2. Computer Architecture: From Microprocessors to Super Computers by Behrooz Parhami, Oxford University press 2010, https://www.ece.ucsb.edu.
3. Computer Architecture and Organisation: From Software to Hardware, by Manoj Frankline, University of Maryland, 2007

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DEPARTMENTAL ELECTIVE-2 **SEMESTER 6**

COURSE CODE	**16EC6DE2AV**	**COURSE TITLE**	**ADVANCED DIGITAL LOGIC VERIFICATION**
CREDITS	**3**	**L-T-P-S**	**2-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of OOPs concepts, system Verilog constructs and data types to create verification environment	1	3
CO-2	Analyze coverage driven verification for given design under test(DUT)	2	3
CO-3	Design solutions to obtain 100% code coverage and functional coverage by determining the set of input constraints and assertions in test benches.	3	3
CO-4	Simulate the layered test bench architecture using system Verilog and analyze coverage reports	4,5,9, 10	3

UNIT-I

Verification Concepts: Concepts of verification, importance of verification, Stimulus vs Verification, functional verification, test bench generation, functional verification approaches, typical verification flow, stimulus generation, direct testing, Coverage: Code and Functional coverage, coverage plan. **4L+2T Hrs**

UNIT-II

System Verilog – 1: System Verilog constructs - Data types: two-state data, strings, arrays: queues, dynamic and associative arrays, Structs, enumerated types. Program blocks, module, interfaces, clocking blocks, modports. **6L+2T Hrs**

UNIT-III

System Verilog – 2 : SV Classes: Language evolution, Classes and objects, Class Variables and Methods, Class instantiation, Inheritance, and encapsulation, Polymorphism.

Randomization:Directed Vs Random Testing. Randomization:Constraint Driven

Randomization. **6L+2T Hrs**

UNIT-IV

System Verilog – 3: Assertions: Introduction to Assertion based verification, Immediate and concurrent assertions. **4L+2T Hrs**

UNIT-V

System Verilog – 4: Coverage driven verification: Motivation, Types of coverage, Cover Group, Cover Point, Cross Coverage, Concepts of Binning and event sampling, Layered Test Bench Architecture. **4L+ 4T Hrs**

References:

1. Janick Bergeron, Writing Testbenches Using SystemVerilog
2. Chris Spear, SystemVerilog for Verification
3. Janick Bergeron, Eduard Cerny, Alan Hunter, and Andy Nightingale, Verification Methodology Manual for SystemVerilog

Tools:

1. NC Verilog, NC Sim for System Verilog

Reference Websites:

www.asic-world.com

www.testbench.in

http://www.vlsi-expert.com/2011/03/static-timing-analysis-sta-basic-timing.html

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DEPARTMENTAL ELECTIVE-2 **SEMESTER 6**

COURSE CODE	**16EC6DE2RS**	**COURSE TITLE**	**RADAR SYSTEM**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concepts of Signal Processing, Communication & Antennas to obtain the parameters of Radar Systems	1	2
CO-2	Analyze the performance of different types of Radar System for a given condition/application	2	2

UNIT-I

Introduction, Maximum unambiguous range, Radar Waveforms, simple form of Radar equation, Block diagram, application and types of radars **6 Hrs**

UNIT-II

Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative analysis only) **7 Hrs**

UNIT-III

CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Measurement Errors, Multiple Frequency CW Radar **7 Hrs**

UNIT-IV

MTI and Pulse Doppler Radar: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters.

MTI Radar Parameters, Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler Radar. **8 Hrs**

UNIT-V

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse. Target Reflection Characteristics and Angular Accuracy. Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers **8 Hrs**

Text Books:

1. Merrill I. Skolink, Introduction to Radar Systems, (3/e), Tata MG Graw Hill, 2001
2. Merrill I. Skolink, Introduction to Radar Systems, (2/e), Tata MG Graw Hill, 2013
3. http://www.nptel.ac.in/syllabus/101108056/

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DEPARTMENTAL ELECTIVE-2 **SEMESTER 6**

COURSE CODE	**16EC6DE2OS**	**COURSE TITLE**	**OPERATING SYSTEM**
CREDITS	**3**	**L-T-P-S**	**2-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of different classes and structure of operating system and requirement of system protection.	1	1,2
CO-2	Analyze the scheduling, page replacement policies for the process requirement, memory management in an operating system	1,2	1,2
CO-3	Analyze the device management and identify need for operating systems in the field of communication and computer networks and pursue life-long learning in it.	1,2	1,2

UNIT-I

Introduction and overview of operating systems: Abstract views of an Operating system, Computing environment and nature of computations Classes of operating systems: O.S and the computer system, Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, distributed operating systems ,modern operating system, Operation of an O.S, Structure of an operating system, Operating system with monolithic structure, layered design of operating system, Virtual machine operating systems, Kernel based operating systems. **8L+4T Hrs**

UNIT-II

Process management: processes and threads: processes and Program, implementing processes, threads. Process synchronization, race conditions, critical sections, control synchronization and invisible operations, synchronization approaches, semaphores.

Scheduling: Preliminaries, Non-preemptive Scheduling Policies, Preemptive Scheduling Policies, Scheduling practice, Real Time Scheduling. **5L+3T Hrs**

UNIT-III

Memory management: Static and Dynamic memory allocation, Memory allocation to a process, Reuse of memory, Contiguous memory allocation, Non-contiguous memory allocation, Paging, Segmentation **5L+1T Hrs**

UNIT-IV

Interrupt handlers, Device drivers, Device independent I/O software, user space I/O software **3L+1T Hrs**

UNIT-V

Distributed operating system: features of distributed operating system, nodes of distributed operating system, integrating operation nodes of a distributed operating system, reliable inter process communication, distributed computation paradigm. **3L+3T Hrs**

Text Books:

1. "Operating Systems - A Concept based Approach", D. M. Dhamdhare, TMH,
2. "modern operating systems" , Andrew S Tanenbaum, Herbert Boss 4th edition,

Reference Books:

1. Operating Systems Concepts, Silberschatz and Galvin, John Wiley, 7th Edition, 2001.
2. Operating System – Internals and Design Systems, Willaim Stalling, Pearson Education, 4th Ed, 2006

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DEPARTMENTAL ELECTIVE-2 **SEMESTER 6**

COURSE CODE	**16EC6DE2ES**	**COURSE TITLE**	**AUTOMOTIVE EMBEDDED SYSTEM**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	**Course Outcomes**	**POs**	**PSOs**
CO-1	Apply the knowledge of sensors, control theory, instrumentation and AUTOSAR to develop automotive embedded sub systems	1	2
CO-2	Analyze model based design approach in realizing automotive subsystems	2	2
CO-3	Design automotive subsystems for specified applications using model based or/and conventional approach	3	1,2

UNIT-I

Automotive Architecture: Need for Electronics in Automotive, Introduction to ECUs, Vehicle Functional Domains and their requirements-General Context, Functional Domains, Standardized Components, Models, and Processes, Intelligent Vehicle Technologies- Road Transport and Its Evolution, New Technologies, Dependability Issues, Fully Autonomous Car. **6 Hrs**

UNIT-II

The systems approach to control and instrumentation: Concept of a system, block diagram representation of a system, electronic system performance, instruments, basic measurement system, signal processing, control systems: P,PI, PID controllers.

Model Based Design approach: Definition, driving force for MBD, benefits of MBD, contextual requirements of MBD, MBD technology. **6 Hrs**

UNIT-III

Case studies of MBD (Block diagram approach only). Electronics engine Control: Motivation for electronic engine control, concept of electronic engine control system, electronic fuel

control system: configuration and control sequence, electronic ignition, automatic cruise control, antilock braking system (ABS), electronic suspension system, electronic steering control. **9 Hrs**

UNIT-IV

Sensors: Air flow rate sensor, engine crankshaft angular position sensor, magnetic reluctance position sensor, engine speed sensor, hall-effect sensor, throttle angle sensor, typical coolant sensor, exhaust gas oxygen sensor. **6 Hrs**

UNIT-V

A Review of Embedded Automotive Protocols: Different Networks for Different Requirements, Event-Triggered versus Time-Triggered, LIN, CAN, MOST, FlexRay, Middleware Layer: Rationale for a Middleware, Main Objectives of AUTOSAR, Layered Software Architecture, BSW and RTE, Virtual function bus, AUTOSAR in Practice: Demonstration of AUTOSAR-Compliant ECUs. **9 Hrs**

Text books:

1. "Automotive Embedded Systems Handbook", Nicolas Navet, Industrial Information Technology Series, CRC press.
2. Understanding automotive electronics, William B.Ribbens, Elsevier.

Cluster Elective Course

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CLUSTER ELECTIVE-1 **SEMESTER 6**

COURSE CODE	**16EC6GE1DA**	**COURSE TITLE**	**DATA STRUCTURES AND ALGORITHM**
CREDITS	**3**	**L-T-P-S**	**2-1-0-0**

CO-numbers	**Course Outcomes**	**POs**	**PSOs**
CO-1	Apply programming concepts to realize various data structures	1	2
CO-2	Analyze the suitability of a given data structure for a given application	2	2
CO-3	Develop a data structure for a given application/s	3,5,10	2

UNIT I

Introduction: Data Representation, Introduction, Linear lists, Formula-based representation linked representation, Indirect addressing, simulating pointers. **5L+ 1T Hrs**

UNIT II

Arrays and Matrics: Arrays, Matrices, Special matrices, spare matrices. **5L+1T Hrs**

UNIT III

Stacks: The abstract data types, Derived classed and inheritance, Formula-based representation, Linked representation, Applications. **5L+2T Hrs**

UNIT IV

Queues: The abstract data types, Derived classes and inheritance, Formula based representation, Linked representation, Applications. **5L+2T Hrs**

UNIT V

Hashing and Trees: Dictionaries, Linear representation, Hash table representation. Trees, Binary trees, Properties and representation of binary trees, Common binary tree operations, Binary tree traversal the ADT binary tree, Heaps – Min and Max, insertion into heaps, Binary Search Trees, AVL trees. **4L+6T Hrs**

Reference books:

1. Data structures, Algorithms, and applications in C++ - Sartaj Sahni, McGraw Hill.2000.

2. Data structures, Algorithms, and applications, Vaidyanathan

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CLUSTER ELECTIVE-1 **SEMESTER 6**

COURSE CODE	**16EC6GE1ST**	**COURSE TITLE**	**SENSOR TECHNOLOGY**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	**Course Outcomes**	**POs**	**PSOs**
CO-1	Apply the concepts of physics to understand the principle of sensing physical parameters	1	1
CO-2	Analyze the working of analog and digital transducers in engineering applications	2	1

UNIT-I

Sensor Characteristics: Transfer function, span, accuracy, calibration, hysteresis, non-linearity, saturation, dead band, resolution, special properties, output impedance, excitation, dynamic characteristics, environmental factors, reliability, application characteristics, and uncertainty. **6 Hrs**

UNIT-II

Physical principles of sensing: Electric charges, fields and potentials, capacitance, magnetism, induction, resistance, piezoelectric effect, pyro-electric effect, hall effect, Peltier effect and seebeck effect, sound waves, temp and thermal props of mats, heat transfer, light, dynamic models of sensor elements. **8 Hrs**

UNIT-III

Sensors for embedded systems application_1: Photoelectric sensors, detection methods, proximity sensors: Inductive and capacitive, limit switches, LED, microwave sensors, laser sensors, bar code identification systems, OCRs, position sensors. **8 Hrs**

UNIT-IV

Sensors for embedded systems application_2: Displacement and level sensors, velocity and acceleration sensors, force, strain and tactile sensors, pressure sensors. **8 Hrs**

UNIT-V

Digital transducers and applications: Adv of digit ran, shaft encoders, optical encoders, digital tachometer, Hall effect sensors, linear encoders, Moire Fringe displacement sensors, binary transducers. **6 Hrs**

Text Books:

1. Handbook of modern sensors: Physics, designs, applications by JACOB FRADEN, 3rd edition, Springer.
2. Sensors Handbook by Sabrie Soloman, 2nd edition, Mc Graw Hill.
3. Sensors and Actuators control systems Instrumentation by Clarence W de Silva, CRC Press.

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CLUSTER ELECTIVE-1 **SEMESTER 6**

COURSE CODE	**16EC6GE1VD**	**COURSE TITLE**	**VLSI TESTING AND DESIGN FOR TESTABILITY**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Description	POs	PSOs
CO-1	Apply the concept of faults and failure models to generate the number of fault models & Automatic Test Pattern Generator (ATPG) for the given design under test (DUT)	1	3
CO-2	Analyze and identify the given fault in given CUT(can be logic circuit or memory) and conclude the solution to test these faults	2	3
CO-3	Ability to generate the Automatic Test Pattern Generator (ATPG) with different techniques using CAD tool.	5	3

UNIT-I

Introduction: Testing Philosophy, Role of testing, Digital and Analog VLSI Testing. How to Test chips- types of Testing, Automatic Test equipment (ATE), Electrical parametric testing, Yield, Defects, Errors and Faults **4 Hrs**

UNIT-II

Fundamentals of VLSI testing: Fault models, Fault equivalence, Fault collapsing, Automatic test pattern generation: Path sensitization technique, Boolean difference, D-algorithm, PODEM algorithm, IddQ testing, Delay fault testing. Example problems. CAD tool usage for ATPG **10 Hrs**

UNIT-III

Design for testability: Controllability and observability, Scan design and scan based testing, Level sensitive scan Design (LSSD), Test interface and boundary scan. **8 Hrs**

UNIT-IV

Memory testing: Memory fault models, Test algorithms for RAMs, Detection of pattern sensitive faults Example problems **6 Hrs**

UNIT-V

Built in self-test (BIST): BIST process, BIST implementation, BIST pattern generation methods, output response analysis **8 Hrs**

Text Book:

1. Parag.K.Lala, Digital Circuit Testing and Testability, Academic press

Reference Books:

1. M. L. Bushnell and V.D. Agrawal, Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits, Springer, 2005
2. Neil Weste and K. Eshragian, "Principles of CMOS VLSI Design: A System Perspective", Third Edition, Pearson Education (Asia) Pvt. Ltd, 2006.

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CLUSTER ELECTIVE-1 **SEMESTER 6**

COURSE CODE	**16EC6GE1PD**	**COURSE TITLE**	**PHYSICAL DESIGN**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the advanced concepts of modern VLSI system design flow including standard cells, cell libraries, IPs etc in physical design	1	3
CO-2	Analyze the power planning, floor planning through partitioning the system into sub blocks.	2	3
CO-3	Design solutions to fix timing violations after clock tree synthesis and routing	3	3
CO-4	Simulate and analyze various timing, area and power reports after physical back end flow	4,5,9, 10	3

UNIT-I

Libraries: Standard cells, Transistor sizing, input-output pads, ESD and its sources, Library characterization, Timing models: Delay model, NLDM, Polynomial Delay model, Current source model. **8 Hrs**

UNIT-II

Partitioning and Floor planning: Approximation of Hyper Graphs with Graphs, Kernighan-Lin Heuristic Ratio cut partition, Fiduccia & Mattheyses, Technology File, Circuit Description Design Constraints, Design planning, Pad placement, power planning, Macro placement, Clock planning. **7 Hrs**

UNIT-III

Placement: Global Placement, detail placement, clock tree synthesis, power analysis **7 Hrs**

UNIT-IV

Routing (clock, power/ground, signal nets): Special routing, Global routing, Detailed routing,

Extraction. **7 Hrs**

UNIT-V

Verification: Functional Verification, Timing verification (STA), Physical Verification, SI analysis, Power Analysis **7 Hrs**

Text Book:

1. Khosrow Golshan, "Physical Design Essentials-An ASIC Design Implementation Perspective", 2007 Springer Science+Business, Media.

Reference books:

1. F. Nekoogar. Timing Verification of Application-Specific Integrated Circuits (ASICs).Prentice Hall PTR, 1999.
2. Sarafzadeh, C.K. Wong, "An Introduction to VLSI Physical Design", McGraw Hill International Edition 1995.
3. Preas M. Lorenzatti, "Physical Design and Automation of VLSI systems", The Benjamin Cummins Publishers, 1998.

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CLUSTER ELECTIVE-1 **SEMESTER 6**

COURSE CODE	**16EC6GE1PR**	**COURSE TITLE**	**PROBABILITY AND RANDOM PROCESS**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Understand and apply the underlying concepts of probability, random variables and stochastic processes	1	1
CO-2	Develop an analytical problem solving approach for real life problems using the theoretical concepts	3	1
CO-3	Nurture teamwork skills by working on problem assignments in groups throughout the semester	9	1

UNIT-I

Introduction to Probability theory: Experiments and Sample space, Events, Probability definition and Axioms, Joint and conditional probabilities, Baye's theorem- Independent events, Bernoulli Trials. **8 Hrs**

UNIT-II

Random variables, Distribution functions, Density functions: CDF, PDF, Gaussian random variable, Binomial, Poisson, Uniform, Exponential and Rayleigh types of random variable, Probability Mass Function. **7 Hrs**

UNIT-III

Operation on a single random variable: Expectation, EV of random variables, EV of functions of random variables, Moments, Central moments, Conditional expected values

7 Hrs

UNIT-IV

Random processes. Stationarity and ergodicity. Strict sense and wide sense stationary processes. Mean, Correlation and Covariance functions. **7 Hrs**

UNIT-V

Spectral properties of random processes – power spectral density and its properties, relation with autocorrelation, cross PSD and cross correlation **7 Hrs**

Text Books:

1. Peyton Z. Peebles, "Probability, Random variables and random signal principles", TMH, 4th edition, 2015.
2. S.Haykin, An Introduction to Analog and Digial Communications, Wiley, 2003
3. http://nptel.ac.in/courses/117105085/

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CLUSTER ELECTIVE-1 **SEMESTER 6**

COURSE CODE	**16EC6GE1AM**	**COURSE TITLE**	**ADVANCED MICROCONTROLLERS AND APPLICATIONS**
CREDITS	**3**	**L-T-P-S**	**2-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the acquired knowledge on ARM7 and ARM Cortex m3 architecture, their features and instruction set in programming the ARM processor.	1	1,2
CO-2	Analyze the architectural features of ARM7 and Cortex M3, concepts on system software and communication protocols to design ARM based embedded applications.	2	1,2
CO-3	Design and develop ARM based embedded applications.	3,5,9,10	3

UNIT-I

Migration from 8051 to 32bit cores, RISC design and ARM Design Approach, Advantages of ARM, ARM Organization, Registers, Pipeline, Exceptions & Interrupts, Introduction to Cortex M3 Processor & its applications. **5L+2T Hrs**

UNIT-II

Cortex M3 Architecture and Registers, Operation Modes, Thumb2 Technology & Instruction Set Architecture, Exceptions & Nested Vector Interrupt Controller, Memory Systems: Bit banding. **6L+3T Hrs**

UNIT-III

Cortex M3 Programming: A typical development flow, Using C, CMSIS, Using Assembly, Exception Programming. **5L+3T Hrs**

UNIT-IV

Introduction to Firmware, Boot-loader and Embedded Operating Systems, MPU & MMU, Working With I2C, SPI, CAN & USB protocols. **4L+2T Hrs**

UNIT-V

Applications of ARM Cortex M3: Robotics & Motion Control, WSN, IoT, ARM Cortex for DSP applications. **4L+2T Hrs**

Text books:

1. The Definitive Guide to ARM Cortex M3, 2nd Edition by Joseph Yiu.
2. ARM System Developer's Guide By Andrew N Sloss, Dominic Symes, Chris Wright

Reference books:

1. ARM System-On-Chip Architecture By Steve Furber, Addison Wesley, Pearson Education, 2nd edition
2. Jagger (Ed) ARM architectural reference manual, Prentice Hall

7^{th} – 8^{th} Semester Syllabus

Program Core Course Syllabus

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COURSE CODE	16EC7DCDCN	**COURSE TITLE**	Data Communication Networks
CREDITS	**5**	**L-T-P-S**	**3-0-1-1**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concepts of Networks layer protocols to deliver packets across Multiple Networks (links).	1	1,2
CO-2	Analyze issues of routing and congestion mechanism for independent and internetworking networks for wired and wireless link.	2	1,2
CO-3	Design, calculate, and apply subnet masks and routing addresses to fulfill networking requirements.	3	1,2
CO-4	Create Network for given specification and conduct experiments within a simulated networking environment.	4,5	1,2
CO-5	Involve in independent learning on contemporary issues in networking technologies, Communicate effectively and prepare a report.	9, 10	1,2

UNIT - I

Network Layer, Logical Addressing, Internet protocol, Address Mapping **7 Hrs**

UNIT - II

Routing , RIP, OSPF, BGP, Multicast **8 Hrs**

UNIT - III

End to End Protocols, Congestion Control and Resource Allocation, Quality of Service **8 Hrs**

UNIT - IV

Multimedia, Network Security **7 Hrs**

UNIT - V

Traditional Application, Multimedia Application, Infrastructure Services, Overlay Networks **6 Hrs**

Text Books:

1. Data Communication and Networking ,Farouzan, Mc Graw Hill Education.
2. Computer Networks, Andrew S.Tanenbaum
3. Computer Networks , A Systems Approach, Larry L. Peterson and Bruce S. Davie,Morgan Kauffman Publication, 2011.

http://nptel.ac.in/video.php?subjectId=106105081

http://freevideolectures.com/Course/2278/Data-Communication

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COURSE CODE	16EC7DCESD	**COURSE TITLE**	Embedded System Design
CREDITS	**5**	**L-T-P-S**	**3-0-1-1**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	**Apply** the embedded system models, features of processors, memory and I/O systems in developing embedded System.	1	1,2
CO-2	**Analyze** the embedded OS functionality and device drivers used in multitasking embedded applications.	2	1,2
CO-3	**Design** embedded applications using given specifications and concepts of development process.	3	1,2
CO-4	**Demonstrate** practical experiments on developing embedded systems.	4,5	2
CO-5	Engage in **self learning** in analyzing and carrying out embedded projects.	4, 5, 9, 10, 12	2

UNIT- I

A System Engineering Approach to Embedded Systems Design: Introduction to Embedded Systems Architecture, The Embedded Systems Models, Embedded Hardware building blocks, Reading a Schematic. **5 Hrs**

UNIT - II

Embedded Processors & Memory: ISA Architecture Models: Application specific, Internal Processor Design, Processor Performance, Reading Processor's Datasheet, ROM, RAM, Cache Memory, Cache mapping techniques, Memory Management of External Memory, Board Memory and Performance **6 Hrs**

UNIT - III

Board I/O & Buses: Managing Data: Serial vs. Parallel I/O, Interfacing the I/O Components, I/O and Performance, Bus Arbitration and Timing, I2C, SPI, USB, CAN & PCI protocols, integrating the Bus with Other Board Components, Bus Performance. **7 Hrs**

UNIT - IV

Embedded Software: Device Drivers: Device Drivers for Interrupt-Handling, Memory Device Drivers, On-board Bus Device Drivers, Board I/O Driver.

Embedded Operating Systems: Multitasking and Process Management, Memory Management, I/O and File System Management, OS Standards Example: POSIX, OS Performance Guidelines, OSs and Board Support Packages (BSPs). **10 Hrs**

UNIT - V

Middleware and Application Software: Introduction to Middleware, Applications with Examples, Application Layer Software Examples.

Implementing the Design: Main Software Utility Tool: Writing Code in an Editor or IDE, Interpreters, Compilers, and Linkers, Debugging Tools, System Boot-Up. **8 Hrs**

Text Book:

1. Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers, Tammy Noergaard

Reference Books:

1. Computer Organization and Embedded Systems. 6th Edition. By Carl Hamacher and Zvonko Vranesic and Safwat Zaky and Naraig Manjikian
2. Embedded system Design –Steve Heath , second edition
3. James K Peckol, "Embedded Systems – A contemporary Design Tool", John Weily, 2008.

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COURSE CODE	**16EC7DCPEL**	**COURSE TITLE**	**Power Electronics**
CREDITS	**3**	**L-T-P-S**	**2-0-1-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply basic circuit theory concepts to solve Power and control circuits in power electronics domain	1	1
CO-2	**Identify** and A**nalyze** power electronics circuits for a given task/application and draw valid conclusions with suitable assumptions	2	1
CO-3	D**esign** solutions to meet the given specifications of controlled rectifiers, dc-dc converters, inverters and few basic triggering circuits	3	1
CO-4	C**onduct experiments** & carry out data interpretation on power electronic circuits with valid conclusions and **individually / in a team** to prepare a report and make an effective **presentation**.	4, 9, 10	1

UNIT - I

Introduction, Applications of power electronics, Power semiconductor device (SCR, IGBT, TRIAC & DIAC), Types of power electronics circuits **4 Hrs**

UNIT - II

INTRODUCTION TO THYRISTORS: Two transistor model, Turn-on Methods, Dynamic Turn-on and turn-off characteristics, Gate characteristics, Gate trigger circuits, di / dt and dv/dt protection **5 Hrs**

UNIT - III

CONTROLLED RECTIFIERS: Introduction, Principles of phase controlled converter operation, 1 Φ semi converters, 1 Φ fully controlled converters, Dual converters, (all converters with R & RL load). Design examples. **4 Hrs**

UNIT - IV

DC-DC CONVERTERS: Introduction, principles of step down (buck) and step up (boost) choppers(R-load only), performance parameters. Switched mode regulators: buck regulator, boost regulator, Buck boost regulator **6 Hrs**

UNIT - V

INVERTORS: Introduction, Principles of operation, Performance parameters, 1 Φ bridge inverter, current source invertors, Variable DC link inverter. **5 Hrs**

List of Experiments:

1. Static Characteristics of an SCR
2. Static Characteristics of DIAC
3. Static Characteristics of TRIAC
4. Static characteristics of IGBT
5. UJT firing circuit for HWR and FWR circuits.
6. Single phase Fully Controlled Bridge Converter with R and R-L loads.
7. Voltage (Impulse) commutated chopper both constant frequency and variable frequency operations.
8. Parallel / series inverter

Text Books:

1. "Power Electronics" - M. H. Rashid 2 edition, PHI / Pearson publisher 2004.
2. "Power Electronics" - M. D. Singh and Kanchandani K.B. TMH publisher, 2 Ed. 2007.
3. "Power Electronics"- Ned Mohan, Wiley Publication

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COURSE CODE	**16EC8DCECS**	**COURSE TITLE**	**Electronics and Communication for sustainable Developments**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concepts of Electronics and Communication Engineering to solve societal issues	1	1, 2, 3
CO-2	Review and analyse the performance of the Electronic system for the specific societal issues.	2	1,2, 3
CO-3	Able to identify and develop process that meets specified needs with appropriate considerations for environment	3	1,2, 3
CO-4	Understand the impact of Electronics & communication Engineering for the sustainable development	7	1,2, 3

UNIT - I

Agriculture: A Review of Applications for sensor networks in Smart Agriculture, Wireless sensor networks with dynamic nodes for water and crop health management **7Hrs**

UNIT - II

Environment: Scaling Smart Environments, Localization of a wireless sensor network for environment monitoring using likelihood Estimation with negative Constraints, Reconfigurable Intelligent Space and the mobile module for Flexible Smart Space **7Hrs**

UNIT - III

Energy: Sensor Networks for Energy Sustainability in Buildings, Wireless Sensor and Actor Networks for monitoring and Controlling Energy use in Smart grid, Mobile monitoring application to support sustainable behaviour change toward healthy lifestyle **8Hrs**

UNIT - IV

Healthcare: Sensor networks in healthcare, Use of Body Sensor networks in Clinical settings and Medical Research **7 Hrs**

UNIT - V

Transportation: Social sensor networks for Transportation Management in smart cities, Applying RFID Techniques for the Next generation automotive services **7 Hrs**

Reference Book:

1. Sensor Networks for Sustainable Development, Mohammad Ilyas, Sami S. Alwakeel, Mohammed M. Alwakeel, el-Hadi M. Aggoune, June 25, 2014 by CRC Press, Reference - 568 Pages - 239 B/W Illustrations, ISBN 9781466582064 - CAT# K18915

Department Elective Course Syllabus

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COURSE CODE	**16EC7DE3CV**	**COURSE TITLE**	**Computer Vision**
CREDITS	**3**	**L-T-P-S**	**2-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	**Apply** various segmentation, feature extraction and representation techniques for a give pattern analysis problem	1	1
CO-2	**Analyse** various pattern recognition and classification schemes to perform a specific computer vision task	2	1
CO-3	**Design** 3D visualization models to process a 3D object and perform a specific computer vision task	3	1

UNIT - I

Pattern Analysis: Clustering: K-Means, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models **5L +2T Hrs**

UNIT - II

Feature extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH **5L+3T Hrs**

UNIT - III

Shape representation and segmentation: Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors **5L+3T Hrs**

UNIT - IV

3D Image Visualization: Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images. **5L+2T Hrs**

UNIT - V

Modern Trends: Biometrics – fingerprint, face, iris, digital signature; super resolution, Introduction to Augmented Reality **4L+2T Hrs**

Text Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

Reference Books:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

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COURSE CODE	**16EC7DE3LV**	**COURSE TITLE**	**Low Power VLSI**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concept of power analysis in simulators at different levels of design abstraction.	1	3
CO-2	Analyze power dissipation using mathematical and probabilistic approach in digital logic cells and compare the various clock tree synthesis methods. The	2	3
CO-3	Determine various circuit techniques for low power logic cells.	3	3

UNIT - I

Basics of MOS circuits: MOS Transistor structure and device modeling, MOS Inverters, MOS Combinational Circuits - Different Logic Families **6 Hrs**

UNIT - II

Sources of Power dissipation: Dynamic Power Dissipation -Short Circuit Power, Switching Power, Glitching Power, Static Power Dissipation, Degrees of Freedom **6 Hrs**

UNIT - III

Supply Voltage Scaling Approaches: Device feature size scaling Multi-Vdd Circuits Architectural level approaches: Parallelism, Pipelining Voltage scaling using high-level transformations Dynamic voltage scaling Power Management **8 Hrs**

UNIT - IV

Switched Capacitance Minimization Approaches: Hardware Software Tradeoff Bus Encoding Two’s complements v/s Sign Magnitude Architectural optimization Clock Gating Logic styles.

Leakage Power minimization Approaches: Variable-threshold-voltage CMOS (VTCMOS) approach Multi-threshold-voltage CMOS (MTCMOS) approach Power gating Transistor stacking Dual-Vt assignment approach (DTCMOS) **10 Hrs**

UNIT - V

Special Topics: Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design, CAD tools for low power synthesis **6 Hrs**

Text Books:

1. Sung Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata Mcgrag Hill.

2. Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).

3. A. Bellamour, and M. I. Elmasri, Low Power VLSI CMOS Circuit Design, Kluwer Academic Press, 1995.

4. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.

Reference Books:

1. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley-Inter science, 2000.

NPTEL http://nptel.iitm.ac.in Computer Science and Engineering, Department of Computer Science and Engineering, IIT Kharagpur

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COURSE CODE	**16EC7DE3SC**	**COURSE TITLE**	**System on Chip**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply concepts of Moores law, CMOS scaling to understand the System on Chip with its need, evolution, challenges, goals, superiority over system on board & stacked ICs in package.	1	3
CO-2	Analyze Typical goals in SoC design and also inter connect architecture	2	3
CO-3	Design solutions for issues at system level, and issues of Hardware-Software co design	3	3

UNIT - I

Motivation for SoC Design: Review of Moores law, and CMOS scaling. Benefits of system-on-chip integration in terms of cost, power, and performance. Comparison on System-on-Board, System-on-Chip, and System-in-Package **7 Hrs**

UNIT - II

Typical goals in SoC design: Cost reduction, power reduction, design effort reduction, performance maximization. Productivity gap issues and the ways to improve the gap – IP based design and design reuse. **7 Hrs**

UNIT - III

System On Chip Design Process: A canonical SoC Design, SoC Design flow, waterfall vs spiral, top down vs bottom up, Specification requirement, Types of Specification, System Design Process, System level design issues, Soft IP vs Hard IP, IP verification and Integration. **7 Hrs**

UNIT - IV

Hardware-Software co design: Design for timing closure, Logic design issues, Verification strategy, On chip buses and interfaces, Low Power, Hardware Accelerators in Soc. **8Hrs**

UNIT-V

Interconnect architectures for SoC: Bus architecture and its limitations. Network on Chip (NOC) topologies. Mesh-based NoC. Routing in an NoC. Packet switching and wormhole routing **7 Hrs**

Text Books:

1. Michael Keating, Pierre Bricaud, "Reuse Methodology Manual for System on Chip designs", Kluwer Accademic Publishers, 2nd edition, 2008.
2. Sudeep Pasricha and Nikil Dutt,"On-Chip Communication Architectures: System on Chip Interconnect", Morgan Kaufmann Publishers © 2008

Reference Books:

1. Rao R. Tummala, Madhavan Swaminathan, "Introduction to system on package sop-Miniaturization of the Entire System", McGraw-Hill, 2008.

E-books

MOOCs

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COURSE CODE	**16EC7DE3NS**	**COURSE TITLE**	**Network Security and Cryptography**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of encryption and security techniques along with cyber forensics to fulfil the societal needs	1	2
CO-2	Analyse the different types of encipherment techniques along with key exchange mechanisms.	2	1, 2

UNIT - I

Introduction, Services, mechanisms and attacks, The OSI security Architecture, A model for network security, A model for network security, Symmetric Ciphers: Symmetric Cipher model, Symmetric Ciphers: Symmetric Cipher model, Substitution techniques Transposition technique **7 Hrs**

UNIT - II

Simplified DES, Simplified DES, Data encryption Standard, mode of Block cipher operation, Principles of public key cryptosystems, Principles of public key cryptosystems, The RSA algorithm, Diffe-Hellman key exchange **8 Hrs**

UNIT - III

Authentication functions, Digital Signatures, Digital Signature standard, Electronic Mail Security: Pretty Good Privacy, web security: Web Security Consideration, Secure Electronic Transaction **7 Hrs**

UNIT- IV

Intruders, Intruder detection, Password management, Viruses and related threats, Viruses and related threats, Firewalls design principles **7 Hrs**

UNIT - V

CYBER CRIME AND CYBER FORENSICS: Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crimes, Introduction to Digital Forensics, Forensic Software and Hardware, Network Forensics, Introduction to Cyber Crime Investigation **7 Hrs**

Text Books:

1. Cryptography and Network Security- Principles and Practice: William Stallings, Third Edition
2. Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004.

Reference Books:

1. Understanding Forensics in IT ", NIIT Ltd, 2005.
2. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations",Cengage Learning, New Delhi, 2009.
3. Fundamentals of Network Security-Eric Maiwald, 2009 Edition, Information Security Series
4. Network Security-Private Communication in a public World:Charlie Kaufman, Radia Perlman, Mike Speciner, Second Edition

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COURSE CODE	**16EC7DE3WC**	**COURSE TITLE**	**Wireless Communication**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO1	Acquire Knowledge of techniques, algorithms and schemes in wireless communication, Apply this for effective wireless communication	1	2, 3
CO2	Analyse the performance of wireless communication system	2	2, 3
CO3	Investigate on methodologies for improving effective wireless communications	4	2, 3
CO4	Use Modern tools to simulate and analyse a given problem statement in wireless communication	5,10	2, 3

UNIT - I

Introduction to Wireless communication, Application and requirements of wireless services, The Cellular concept: System design fundamentals: Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Trunking and Grade of service, Improving coverage and capacity in cellular system. **8 Hrs**

UNIT - II

Mobile radio propagation: Introduction to Radio wave propagation, free-space propagation model, Ground Reflection model, Diffraction, Scattering.(Qualitative Analysis only). Small scale fading- small-scale multipath propagation, Impulse response model of a multipath channel, small scale multipath measurements, Parameters of mobile multipath channels, Types of small scale fading, Empirical models for Indoor and outdoor propagation (Okumura, Okumura Hata, Cost-Hata, Walfisch-Ikegami). **8 Hrs**

UNIT - III

Equalization and Diversity: Fundamentals of Equalization, Equalizers in communication receiver, Algorithms for Adaptive Equalization, Diversity techniques; Space Diversity, Time Diversity, Polarization Diversity, Frequency Diversity , RAKE receivers.(Qualitative Analysis only) **7 Hrs**

UNIT - IV

Wireless Technologies: Bluetooth, WLAN, 2G, 3G, Global System for Mobile communication: System overview- GSM Architecture, GSM MS block description, The air interface, Logical and physical channels, Establishing a communication and handoff. **7 Hrs**

UNIT- V

UMTS: System overview, Channels, Transmission mechanism, Handover and power control. Interconnectivity between 2G and 3G systems **6 Hrs**

Text books:

1. Wireless Communication- Principles and Practice, Theodre S Rappaport, Second Edition
2. Wireless Communication- Andreas F Molish, Wiley Student, Second Edition

Nptel lectures:

1. Wireless Communications by Dr.Ranjan Bose, Department of Electrical Engineering, IIT Delhi.
2. Principles of Modern CDMA/ MIMO/ OFDM Wireless by Prof Aditya Jaganthanan, IIT Kanpur

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COURSE CODE	**16EC7GE2NE**	**COURSE TITLE**	**Nano Electronics**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of semiconductors and Nano materials for Nanoelectronic Architectures	1	1
CO-2	Analyze the principles of Spintronics and applications through Research articles	2	1
CO-3	Design of Fe –memories and identification hazardous gases and solvents	3	1

UNIT - I

Overview of basic Nano electronics: Recent past, the present and its challenges, Future of Nano electronics **5 Hrs**

UNIT - II

Nanocomputer architectures: Introduction to Nanocomputers, Nanocomputer Architecture, Quantum DOT cellular Automata (QCA), QCA circuits, Single electron circuits, molecular circuits, Logic switches – Interface engineering – Properties (Self-organization, Size-dependent) – Limitations **9 Hrs**

UNIT - III

Nanoelectronic Architectures: Nanofabrication – Nano patterning of Metallic / Semiconducting nanostructures (e-beam/X-ray, Optical lithography, STM/AFM- SEM & Soft-lithography) – Nano phase materials – Self-assembled Inorganic/Organic layers **9 Hrs**

UNIT - IV

Spintronics: Introduction, Generation of Spin Polarization Theories of spin Injection, spin relaxation and spin dephasing, Spintronic devices and applications, spin diodes, spin transistors. **6 Hrs**

UNIT - V

Memory Devices And Sensors: Memory devices and sensors – Nano ferroelectrics – Ferroelectric random access memory –Fe-RAM circuit design – calorimetric -sensors – electrochemical cells – resistive semiconductor gas sensors –electronic noses – identification of hazardous solvents and gases . **7 Hrs**

Text books:

1. Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices: Karl Goser, JanDienstuhl and others.
2. Nano Electronics and Information Technology: Rainer Waser

Reference Books:

1. Concepts in Spintronics – Sadamichi Maekawa
2. Spin Electronics – David Awschalom

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COURSE CODE	16EC7GE2EP	**COURSE TITLE**	Electronics and Packaging
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of semiconductors for Microelectronics system packaging.	1	1
CO-2	Analyze the Different types of packaging methodologies like Multichip modules (MCM)-types,System-in package (SIP), Packaging roadmaps, Hybrid circuits.	2	1
CO-3	Design considerations in systems packaging and Design issues related to Surface Mount Technology	3	1

UNIT - I

Overview of electronic systems packaging: Introduction and Objectives of the course, Definition of a system and history of Semiconductors, Products and levels of packaging, Packaging aspects of handheld products, Definition of PWB. **7 Hrs**

UNIT - II

Semiconductor Packaging Overview: Basics of Semiconductor and Process flowchart Wafer fabrication, inspection and testing Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding. **7 Hrs**

UNIT - III

Semiconductor Packages: Why packaging? & Single chip packages or modules (SCM), Commonly used packages and advanced packages, Materials in packages, Advances packages Thermal mismatch in packages, Current trends in packaging, Multichip modules (MCM)-types; System-in package (SIP), Packaging roadmaps, Hybrid circuits. **8 Hrs**

UNIT - IV

Electrical Design considerations in systems packaging: Electrical Issues – Resistive Parasitic, Capacitive and Inductive Parasitic, Layout guidelines and the Reflection problem, Interconnection. **6 Hrs**

UNIT - V

Surface Mount Technology: SMD benefits, Design issues, Introduction to soldering, Reflow and Wave Soldering methods to attach SMDs ,Solders, Wetting of solders; Flux and its Properties , Defects in wave soldering Vapour phase soldering, BGA soldering and DE soldering /Repair, SMT failures. **8 Hrs**

Text Books:

1. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw Hill, NY, 2001.

Reference Books:

1. William D. Brown, Advanced Electronic Packaging, IEEE Press, 1999.
2. Web-based Current literature.

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COURSE CODE	**16EC7GE2IT**	**COURSE TITLE**	**Internet of Things**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the Knowledge of architecture, algorithms and schemes in Internet of things from a global context	1	2, 3
CO-2	Analyze the data base using efficient Algorithms	2	2, 3
CO-3	Design protocols and test on scenarios for improving effective implementation of IOT	4,10	2, 3
CO-4	Implement IOT applications and open source platform for data analytics	5,10	2, 3

UNIT-I

Internet of Things: Challenges and Opportunities, Exploring Major Architectural Aspects of the Web of Things. Embedded Web Technologies for the Internet of Things, High-Level Internet of Things Applications Development Using Wireless Sensor Networks **7 Hrs**

UNIT-II

Overview of End to End wireless communications (layers, evolution, including IP based networks), Intro to standard forums (IETF, 3GPP), roles of each with examples, Introduction to 2G and 3G network, core, call flows, architecture. Introduction to 4G, evolution from 3G, current status. Introduction to Cellular IoT standards (LTE-M, LTE-NB, EC-GPRS, Clean Slate IOT etc) **7 Hrs**

UNIT-III

M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics

M2M to IoT -An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. **8 Hrs**

UNIT-IV

IOT use case: representing usecase, design, test scenarios. Introduction to Raspberry Pi (to be done by BMS faculty). GUI design for Device/Sensor management and analytics, GUI testing, automation. Communication Protocol design (One or more of the wireless Protocols): call flows, information elements, protocol testing, library design for encoding/decoding.Database design for storing senor information: sql vs. nosql, graph db, correlation, queries, report.

IoT Architecture-State of the Art Reference Model-Introduction **7 Hrs**

UNIT-V

Sensor programming (Based on Pi framework): activating, init, extracting data, controlling. GUI programming: hands on with stub based backend. Protocol abstractions: stub based programs on protocol testing (client server based), with open source SW. Introduction to testing methods, metrics, integration testing, sub-system testing. **7 Hrs**

Text Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Internet of Things Challenges and Opportunities, Subhas Chandra Mukhopadhyay Springer International Publishing, 2014.

Reference Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Ebooks:

1. https://www.youtube.com/watch?v=co2MLqkJVXs
2. https://www.youtube.com/watch?v=9znRbMTimvc

BMS College of Engineering, Bangalore – 19

Autonomous College under VTU

COURSE CODE	**16EC7GE2MC**	**COURSE TITLE**	**Multimedia Communication**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the basic communication knowledge on multimedia with applications	1	1, 2
CO-2	Analyze various data compression techniques and algorithms for audio and video systems	2	1, 2
CO-3	Explore different multimedia concepts applied to internet	6	1, 2

UNIT- I

Information Representation Multimedia information representation: Introduction, Digitization Principles, Representation of Text, Images, Audio & Video; Multimedia applications: Media composition, Media communication, Media entertainment **7 Hrs**

UNIT- II

Compression Techniques Various Compression Principles; Text Compression: Static Huffman Coding, Dynamic Huffman Coding, Arithmetic Coding, Lempel-ziv Coding; Image Compression: Graphics Interchange Format, Tagged Image File Format, Digitized Document, Digitized Pictures, JPEG2000. **7 Hrs**

UNIT- III

Audio compression: Adaptive differential PCM, Code excited LPC, MPEG audio coders, Dolby audio coders; Video Compression: Basic principles, Video compression standard h.263, MPEG-4. Embedded Wavelet coding: Zero tree approach, SPIHT algorithm, EBCOT algorithm **8 Hrs**

UNIT- IV

Internetworking QoS: Admission Control, Integrated & Differentiated Services, RSVP; Internet Applications: DNS, Name Structure and Administration, DNS Resource Records;

Electronic Mail Message Structure, Content Transfer, Basic Concept of Internet Telephony, World Wide Web. **7 Hrs**

UNIT- V

Broadband Internet, Broadband ATM Networks, Entertainment Networks, High-Speed Modems; Multimedia over Wireless Channel, Communication Protocols for Multimedia Applications; Streaming Protocol: Progressive, Adaptive, On-Demand, Real-Time Transport Protocol; **7 Hrs**

Text Books:

1. F. Halsall, "Multimedia communications: Applications, Networks, protocols and standards", Pearson Education Ltd. 2001
2. R. Stein Metz and K. Nahrstedt, "Multimedia: Computing, Communications & Applications", Pearson Education, Inc
3. www.nptel.ac.in/courses/117105083

BMS College of Engineering, Bangalore – 19

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COURSE CODE	**16EC7GE2SR**	**COURSE TITLE**	**Software Defined Radio**
CREDITS	**3**	**L-T-P-S**	**2-1-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO1	Acquire knowledge on SDR, design principles, challenges and issues in SDR. Apply this for digital communication system	1	2, 3
CO2	Analyse the Performance of RF Receiver Design	2	2, 3
CO3	Investigate and identify Digital Hardware Choices Key Hardware Elements, DSP Processors, FPGA, through case study of different SDR platforms.	4,5	2, 3

UNIT- I

Introduction to SDR, Application of SDR in advanced communication systems, challenges and issues regarding the implementation of SDR, Adaptive wireless communication systems Spectrum efficiency and soft spectrum usage, Spectrum sensing , design principles of SDR

(5L + 2T) Hrs

UNIT- II

Challenge of Receiver Design, RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Importance of the Components to Overall Performance, Transmitter Architectures and Their Issues, Noise and Distortion in the RF Chain

(5L + 2T) Hrs

UNIT- III

ADC and DAC design challenges, Direct Digital Synthesis with Analog Signal Synthesis, Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious Components due to Periodic Jitter, Bandpass Signal Generation, Performance of Direct Digital Synthesis Systems, Hybrid DDS-PLL Systems, Applications of direct Digital Synthesis (5L + 3T) Hrs

UNIT- IV

Digital Hardware Choices Introduction, Key Hardware Elements, DSP Processors, FPGA, Trade-offs in using DSPs FPGAs and ASICs, Power Management Issues, Combinations of DSPs , FPGAs and ASICs **(4L + 2T) Hrs**

UNIT- V

Introduction to cognitive radio, case study of different SDR platforms. Hands on demos / on SDR platform to conduct digital communication experiments.

Case studies

1. Application of SDR in advanced communication systems
2. Challenges and issues regarding the implementation of SDR
3. Adaptive wireless communication systems
4. Different SDR architectures
6. Emerging standards – 3G, LTE, 802.11n, WiFi , TVWS **(5L +3T) Hrs**

Text Books:

1. Software Radio: A Modern Approach to Radio Engineering By Jeffrey H. Reed Pearson Education Low Price Edition
2. Telecommunication Breakdown by C. Richard Johnson Jr., William A. Sethares, 2003, Prentice Hall.
3. Multi-carrier and Spread Spectrum Systems, K. Fazel, S. Kaiser, John Wiley and Sons, Ltd. Publication, 2010

E-books

1. e-learning: sdrforum.org
2. Tools/Hardware for case study suggested: MATLAB/GNU Radio – SDR platforms suggested -HACK RF / WARP V3/ RTL SDR

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COURSE CODE	**16EC7GE2SN**	**COURSE TITLE**	**Wireless Sensor Networks**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the Concepts of Sensor Networks for Data Communication.	1	1,2
CO-2	Analyze Sensor Node and Network architecture and infrastructure.	2	1,2
CO-3	Design Energy Efficient MAC protocols for a given specification.	3	1,2
CO-4	Ability to Perform node level simulation in a simulation Environment and submit report.	5, 10	1,2

UNIT - I

OVERVIEW OF WIRELESS SENSOR NETWORKS Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks **5 Hrs**

UNIT - II

ARCHITECTURES: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts **10 Hrs**

UNIT - III

NETWORKING SENSORS: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC. The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing **10 Hrs**

UNIT - IV

INFRASTRUCTURE ESTABLISHMENT: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control **6 Hrs**

UNIT – V

SENSOR NETWORK PLATFORMS AND TOOLS: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming **5 Hrs**

Text books:

1. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007

References books:

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks- Technology, Protocols, And Applications", John Wiley, 2007
2. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003

Institution Elective Course Syllabus

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COURSE CODE	**16EC7IE1FN**	**COURSE TITLE**	**Fuzzy logic and Neural networks**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the concepts of Neuro-science, Mathematics and Computer Engineering knowledge to perform intelligent task	1	1
CO-2	Analyze performance of Fuzzy neural system for given parameters	2	1

UNIT - I

Brain Style Metaphor: Adaptive system and Neural networks, The nature of computation in the human brain, A historical tour of brain science, Inspiration for neural networks, Classical AI and Neural networks, Natural computing for intelligent information processing, soft computing and computational intelligence, application domains of computational intelligence, the human brain, Biological neurons. **7 Hrs**

UNIT - II

Feedforward Neural Networks and Supervised Learning, Artificial Neurons, neural networks and architecture: neuron abstraction, Neuron Signal Functions, Mathematical preliminaries, Neural- networks defined, architectures: Feedforward and feedback, salient properties and application domains of neural networks. **8 Hrs**

UNIT - III

Geometry of Binary Threshold Neurons and their networks : Pattern recognition and data classification , Convex Sets , conex Hulls and linear separability, space of Boolean functions, binary neurons and Pattern Dichotomizers, non-linearity separable problems, capacity of a simple Threshold logic neuron Revisiting the XOR problem, multilayer networks. **7Hrs**

UNIT - IV

Fuzzy sets, fuzzy Systems and applications: Need for numeric and linguistic processing, Fuzzy uncertainty and linguistic variable, fuzzy set, membership functions, geometry of fuzzy sets, simple operations on fuzzy sets **7 Hrs**

UNIT - V

Fuzzy rules for Approximate reasoning, rule composition and defuzzification, Fuzzy engineering, applications, Neural networks. Soft computing goes Hybrid: neural networks and fuzzy logic, Neuro-fuzzy Evolutionary integration. **7 Hrs**

Text book:

1. "Neural networks", a classroom approach by Satish kumar, 2nd edition, Mc Graw Hill Eduction, 2014

Reference books:

1. A brief introduction to Neural networks by David Kriesel
2. Fuzzy logic with engineering Applications by Timothy J.Ross , second edition

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COURSE CODE	**16EC7IE1MC**	**COURSE TITLE**	**Fundamentals of Mobile Communication**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Acquire the knowledge of mobile communications fundamental and standards, GSM, GPRS and 3G systems. And apply this concepts in solving fundamental traffic problems	1	2
CO-2	Investigate on m commerce life cycle, financial services, entertainment services, - content development and distribution and caching, through literature survey and use cases	4	2

UNIT- I

Introduction to mobile communication , spectrum allocation, services and range of operation. Wireless 2G,3G, 4G networks, WLL, WLAN, Bluetooth, PAN. **7 Hrs**

UNIT- II

Cellular Concepts , Frequency reuse, channel assignment stategies, call establishment, handoff mechanism, trunking concepts, cell splitting, sell sectoring **7 Hrs**

UNIT- III

GSM architecture , frequency allocation, channels in GSM, handoff mechanisms, security mechanism, EDGE and GPRS features , data services **7 Hrs**

UNIT- IV

Emerging telecommunication technologies :Wireless LAN – Wi-Fi, Wireless broadband-, UMTS architecture , channels, services, handoff mechanisms, Mobile IP architecture, IMS – IP multimedia subsystem **8 Hrs**

UNIT- V

Mcommerce-framework, different players, lifecycle, Different Mobile commerce applications and services, content development and distribution, technologies- -LAN, 3G,

4G, Implementation challenges in m commerce, m –commerce futuristic services **7 Hrs**

Text Books:

1. Theodore Rappaport "wireless Communications , Principle and practise" Prentice hall 2005
2. Yi Bing Lin, Imrich Chlamatac , "Wireless and Mobile Network Architecture", John Wiley 2001
3. Brian Mennecke, Troy J. Strader, "Mobile Commerce: Technology, Theory and Applications", IdeaGroupPublishing,
4. Mobile Commerce Applications , Upkar Vrshney, A tutorial at IEEE internationa; conference on wireless communicaions.

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COURSE CODE	**16EC7IE1EM**	**COURSE TITLE**	**Electronic Engineering Materials**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

COs	Course Outcomes	POs	PSOs
CO-1	Apply concepts of physics and chemistry to identify the application of materials in various engineering domains	1	2
CO-2	Analyze the various material preparation and characterization techniques available and hence infer on the selection of a method to suit requirements	2	2
CO-3	Conduct survey on recent application of materials and write a report/survey paper while following professional ethics	8,10, 12	2

UNIT - I

Introduction: Classification of engineering materials, levels of structure, structure-property relationships in materials, units, constants and conversion factors, basic thermodynamic functions, statistical nature of entropy, kinetics of thermally activated processes, Novel materials for sensing applications **6 Hrs**

UNIT - II

Electrical properties of materials: Electrical conduction, conductivity, conduction in terms of band and atomic bonding models, electron mobility, electrical resistivity of metals, electrical chars of commercial alloys, semi conductivity, temp dependence of carrier concentration, factors that affect carrier mobility, Hall effect, dielectric behaviour, types of polarization, frequency dependence of the dielectric constant, Ferro electricity, piezoelectricity **12 Hrs**

UNIT - III

Optical properties: Basic concepts, Absorption process, Tauc relation to calculate band gap of materials, Refractive index. Applications of optical properties: photoconductivity, fluorescence and luminescence **6 Hrs**

UNIT - IV

Fabrication methods: Thermal Evaporation, e-beam evaporation, sputtering: DC, RF, magnetron sputtering, spin coating, CVD techniques **6 Hrs**

UNIT - V

Characterization of materials: XRD, SEM, AFM, TEM, Van der Pauw method of resistance measurement **6 Hrs**

Text Books:

1. Material Science and Engineering - A first course V. Raghavan. PHI fifth edition 2012

2. Material Science and Engineering, William D. Callister Wiley India (P) Ltd. 2007

3. A review of Material Science M.Ohring

4. Solid State Physics Omar Ali

References:

Journals on material science:

Elsevier, Sensors and actuators, sensors, Advanced materials, ACM,Wiley, Nature

MOOCs

NPTEL lectures on basic material science

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COURSE CODE	**16EC8IE2EE**	**COURSE TITLE**	**Engineering Economics**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of concepts and principles of Economics for effective functioning of a firm/organization under different market conditions	1	1
CO-2	Analyse the various marketing and Financial management strategies adopted by various organization	2	2

UNIT - I

Introduction to Economics; Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics Theory of Demand & Supply; meaning, determinants, law of demand, law of supply, equilibrium between demand & supply Elasticity; elasticity of demand, price elasticity, income elasticity, cross elasticity. Theory of production; production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital & entrepreneur), Law of variable proportions & law of returns to scale Cost; meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis; meaning, explanation, numerical **8 Hrs**

UNIT - II

Markets; meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly) National Income; meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP,NDP, Personal income, disposal income. Basic economic problems; Poverty-meaning, absolute & relative poverty, causes, measures to reduce Unemployment: meaning, types, causes, remedies Inflation; meaning, types, causes, measures to control **7 Hrs**

UNIT - III

Money; meaning, functions, types, Monetary policy- meaning, objectives, tools, fiscal policy-meaning, objectives, tools Banking; meaning, types, functions, Central Bank- RBI; its functions, concepts; CRR, bank rate, repo rate, reverse repo rate, SLR. Introduction to Management; Definitions, Nature, scope Management & administration, skill, types and roles of managers Management Principles; Scientific principles, Administrative principles, Maslow's Hierarchy of needs theory **7 Hrs**

UNIT - IV

Functions of Management; Planning, Organizing, Staffing, Directing, Controlling (meaning, nature and importance) Organizational Structures; meaning, principles of organization, types-formal and informal, line, line & staff, matrix, hybrid (explanation with merits and demerits), span of control, departmentalization. Introduction to Marketing management; Marketing Mix, concepts of marketing, demand forecasting and methods, market segmentation Introduction to Finance Management; meaning, scope, sources, functions **7 Hrs**

UNIT - V

Introduction to Production Management; definitions, objectives, functions, plant layout-types & factors affecting it, plant location- factors affecting it. Introduction to Human Resource Management; definitions, objectives of manpower planning, process, sources of recruitment, process of selection. Corporate Social Responsibility; meaning, importance Business Ethics; meaning, importance **7 Hrs**

Textbooks:

1. Engineering Economics, R.Paneerselvam, PHI publication

Reference Books:

1. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.
2. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
3. Principles and Practices of Management by L.M.Prasad
4. Principles of Management by Tripathy and Reddy
5. Modern Economic Theory, By Dr. K. K. Dewett & M. H. Navalur, S. Chand Publications

Ebooks:

1. https://www.youtube.com/watch?v=Pr9Rti69QZM

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COURSE CODE	**16EC8IE2AE**	**COURSE TITLE**	**Automotive Electronics**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the knowledge of engineering and science to analyze the performance of Electronic Engine Control, working of sensors and actuators	1	1
CO-2	Analyze the vehicle level Electronic Control for automotive subsystems.	2	1
CO-3	Gain insight about building future automotive subsystems that contributes to the safety and health of the society using block diagram approach	6	1

UNIT- I

Automotive Fundamentals Overview: Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System, Battery, Starting System. **7 Hrs**

UNIT- II

Electronics Fundamentals: Semiconductor Devices, Operational Amplifiers, Analog Computers, Digital Circuits, Logic Circuits (Combinational and Sequential), Integrated Circuits, Microprocessor. **7 Hrs**

UNIT- III

Electronic Engine Control: Motivation for Electronic Engine Control, Concept of an Electronic Engine Control Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System. **7 Hrs**

UNIT- IV

Sensors: Oxygen (O2/EGO) Sensors, Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall

effect Position Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor - Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle sensor

Actuators: Fuel Metering Actuator, Fuel Injector, Ignition Actuator and EGR Actuator

8 Hrs

UNIT- V

Vehicle Motion Control: Electronic suspension system, Antilock Brake System (ABS), Electronic Steering Control

Future Automotive Electronic Systems: Alternative Fuel Engines, Electrical and Hybrid vehicles. Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation, Advance Driver Information System

7 Hrs

Text Books:

1. William B. Ribbens: Understanding Automotive Electronics, 6th Edition, SAMS/Elsevier Publishing

E-books:

1. www.engineering108.com/.../Automobile.../Understanding-Automotive-Electronics-e...
2. www.sciencedirect.com/science/book/9780750675994

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Autonomous College under VTU

COURSE CODE	**16MD8IE2OB**	**COURSE TITLE**	**Organizational Behaviour**
CREDITS	**3**	**L-T-P-S**	**3-0-0-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Understanding Individual behaviour, differences and its effects		-
CO-2	Understand importance of learning and role of perception		-
CO-3	Importance of motivation and groups		-
CO-4	Understanding Conflict and stress management		
CO-5	Basics of Communications		

UNIT- I

Introduction: Definition of Organizational behaviour and Historical development, Environmental context (Information Technology and Globalization, Design and cultural, Reward Systems).

The Individual: Foundations of individual behaviour, individual differences. Ability, Attitude, Aptitude, interests, values. **7 Hrs**

UNIT- II

Learning: Definition, Theories of learning, Individual decision making, Classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement.

Perception: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect. **7 Hrs**

UNIT- III

Motivation: Maslow's Hierarchy of needs, Me. Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Me Cleland three needs theory, Victor vroom's expectancy theory of motivation.

The Groups: Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making. **7 Hrs**

UNIT- IV

Conflict & Stress management: Definition of conflict, functional and dysfunctional conflict, stages of conflict process. Sources of stress, fatigue and its impact on productivity. Job satisfaction, job rotation, enrichment, job enlargement and reengineering work process.

8 Hrs

UNIT- V

Principles of Communication: Useful definitions, communication principles, communication system, role of communication in management, barriers in communication, how to overcome the barriers, rule of effective communication. **7 Hrs**

Text Books:

1. Organizational Behaviour, Stephen P Robbins, 9th Edition, Pearson Education Publications,ISBN-81-7808-561-5 2002

2. Organizational Behaviour- Fred Luthans, 9th Edition, Mc Graw Hill International Edition, ISBN-0-07-120412-12002

Reference Books:

1. Organizational Behaviour- Hellriegel, Srocum and Woodman, Thompson Learning, 9th Edition, Prentice Hall India, 2001
2. Organizational Behaviour- Aswathappa- Himalaya Publishers 2001
3. Organizational Behaviour- VSP Rao and others, Konark Publishers 2002
4. Organizational Behaviour (Human behaviour at work) 9th Edition, John Newstron/Keith Davis. 2002
5. Management of Organizational Behaviour, Paul Henry & Kenneth. H. Blanchard, PHI, 1996.

Group Core Syllabus (HSS)

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COURSE CODE	**16HS8GCPMF**	**COURSE TITLE**	**Project Management and Finance**
CREDITS	**3**	**L-T-P-S**	**2-0-0-1**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Apply the Knowledge of project management principles and to implement project management methodologies required for successful project completion	1	1, 2, 3
CO-2	Develop Ethical principles in project planning and execution as a team and documentation in project implementation	8, 9, 10	1, 2, 3
CO-3	Identify and Apply finance aspects for project implantation in time	11	1, 2, 3
CO-4	Use modern tools to simulate their respective projects, case studies and investigate the behaviour under various operating conditions.	5, 12	1, 2, 3

UNIT- I

Concepts of Project Management - Concepts of project , Categories of project , Project life cycle phases, Project management concepts, Tools and techniques for project management, The project manager, Basic education for a project manager, Roles and responsibilities of project manager ,Project manager as profession, Summary **5 Hrs**

UNIT- II

Establishing the Project - Scope, Time, Cost and performance goals, Feasibility report, Financing Arrangements, Preparation of cost estimates, Finalization of project implementation schedule, Evaluation of the project profitability, appointing a project manager, Fixing the Zero date, Summary **4 Hrs**

UNIT- III

Organizing Human Resources and Contracting - Delegation , Project managers authority, Project organization , Accountability in Project Execution , Contracts , R's of contracting, Tendering and Selection of Contractors, Team building, Summary **5 Hrs**

UNIT- IV

Organizing Systems and Procedures for Project Implementation -Working of systems, Design of Systems, Project work system design , Work breakdown structure, Project execution plan, Project procedure manual, Project control system, Planning, Scheduling and Monitoring, Monitoring contracts, Project diary , Summary **5 Hrs**

UNIT- V

Financing of Projects - Capital structure, Menu of financing , Internal accruals, Equity capital, Preference capital , Debentures (or bonds) , Methods of offering term loans, Working capital advances, Miscellaneous sources, Raising venture capital, Project financing structures, Financial closure, Financial institutions, Summary **5 Hrs**

Text Books:

1. Project Management, S Choudary, Tata McGRAW Hill Publishing Company Limited
2. Projects- Planning, Analysis , Selection, Financing ,Implementation and Review, Dr.Prasanna Chandra McGRAW Hill Publishing Company Limited

Reference Books:

1. Project Management, David I Cleland – Mcgraw Hill International edition
2. Project Management, Gopalakrishnan – Mcmillan India Ltd
3. Project Management, Harry – Maylor- Peason Publication

E Books:

1. Nptel lecture on Introduction to project management by prof. Arun Kanda
2. https://www.youtube.com/watch?v=5pwc2DYlKQU

BMS College of Engineering, Bangalore – 19

Autonomous College under VTU

COURSE CODE	**16HS8GCIPL**	**COURSE TITLE**	**Intellectual Property Rights and Cyber law**
CREDITS	**3**	**L-T-P-S**	**2-0-0-1**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Ability to understand and commit to professional ethics and responsibilities to obtain Intellectual property Rights like Patents, Copyright & Trademarks	8	-
CO-2	Understand the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law for the societal and environmental context	7	-
CO-3	Ability to use IPRs and Cyber Law to access societal, health, safety & Cultural issues	6	-
CO-4	Ability to work in multiple teams to effectively communicate IP & Cyber Law.	9, 10	-

UNIT- I

Basic principles of IP laws & Patents: Introduction, Concept of property, Constitutional aspects of IP, Evolution of the patent system in UK, US and India, Basis for protection, Origin and meaning of the term patent, Objective of a patent law, principles underlying the patent law in India, the legislative provisions regulating patents, Non – patentable inventions.

4 Hrs

UNIT- II

Procedure for obtaining patent: Submission of application, Filing provisional and complete specification, Examination of the application, advertisement of the acceptance, opposition, Grant and sealing of patent, Term of the patent, compulsory license.

Provisional and complete specification: Definition of Specification, Kinds of specification, provisional specification, complete specification, Claims, Conditions for amendment.

Rights conferred on a patentee: Patent rights, Exception and limitations, Duties of a Patentee.

Transfer of patent: Forms of transfer of Patent rights, Assignment, kinds of assignment, License, kinds of license, Rights conferred on a licensee, Transmission of patent by operation of law.

Infringement of patents: Construction of claims and infringement, patents held to be infringed, patents held to be not infringed.

Action for Infringement: Where a suit is to be instituted, procedure followed in the suit, Onus of establishment infringement, Defence by the defendant, The Relief's, Injunction, Damages or account of profits, patent agents, patent drafting, database searching, and Case studies.

6 Hrs

UNIT- III

Copy Right: Meaning and characteristics of copy right, Indian copy right law, requirement of copy right, Illustrations copy right in literary work, Musical work, Artistic work, work of architecture, Cinematograph film, sound recording.

Author and Ownership of copy right: Ownership of copy right, Contract of service, Contract for service, rights conferred by copy right, terms of copy right, license of copy right.

Infringement of copy right: Acts which constitute infringement, general principle, direct and indirect evidence of copying, Acts not constituting infringements, Infringements in literary, dramatic and musical works, Remedies against infringement of copy right, Case studies

Trade Marks: Introduction, Statutory authorities, procedure of registration of trademarks, rights conferred by registration of trademarks, licensing in trade mark, infringement of trade mark and action against infringement **6 Hrs**

UNIT- IV

Cyber Law: An introduction, Definition, why cyber law in India, Evolving cyber law prctices- for corporates, privacy in indian cyber space. Terrorism & Cyber Crime. Cyber theft and Indian telegraph act, Cyber Stalking **4 Hrs**

UNIT- V

Indian Cyber law: Protecting Indian children online, Spam, contempt in cyber space, Indian consumers & cyber space, E-courts of India. **4 Hrs**

Text Books:

1. Dr. T Ramakrishna, "Basic principles and acquisition of Intellectual Property Rights", CIPRA, NSLIU -2005.
2. Dr.B.L.Wadehhra, " Intellectual Property Law Handbook", Universal Law Publishing Co. Ltd., 2002.

3. Cyberlaw-The Indian perspective by Pavan Duggal, 2009 Edition.

Reference books:

1. Dr. T Ramakrishna, "Ownership and Enforcement of Intellectual Property Rights", CIPRA, NSLIU -2005.
2. "Intellectual Property Law (Bare Act with short comments)",Universal Law Publishing Co. Ltd. 2007.
3. "The Trade marks Act 1999 (Bare Act with short comments)", Universal Law Publishing Co. Ltd., 2005.

Project Work & Internship/Seminar

BMS College of Engineering, Bangalore – 19

Autonomous College under VTU

COURSE CODE	**16EC7DCPW1**	**COURSE TITLE**	**Project for Community Service**
CREDITS	**3**	**L-T-P-S**	**0-0-3-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Ability to apply knowledge to identify, gather information and analyse to formulate the problem definition for project through detailed investigation.	1,2,4	1, 2
CO-2	Ability to use appropriate tool/tools to implement and demonstrate the defined project.	5	3
CO-3	Ability to design and develop sustainable solution/system for the betterment of the society.	3,6,7	1, 2
CO-4	Ability to make effective presentation of the work with professional ethics as an individual or a member of a team.	8,9,10, 11	2
CO-5	Ability to develop sustainable system with scope for enhancement and continue life-long learning.	12	-

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COURSE CODE	16EC8DCMPJ	**COURSE TITLE**	Major Project
CREDITS	**10**	**L-T-P-S**	**0-0-10-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Ability to **apply knowledge** to identify, gather information and analyse to formulate the problem **definition for project** through detailed **investigation**.	1,2,4	1, 2
CO-2	Ability to use appropriate **tool/tools** to implement and demonstrate the defined project.	5	3
CO-3	Ability to **design and develop** sustainable solution/system for the betterment of the society.	3,6,7	1, 2
CO-4	Ability to make effective **presentation** of the work with professional **ethics** as an individual or a **member of a team**.	8,9,10, 11	2
CO-5	Ability to develop sustainable system with scope for enhancement and continue **life-long learning**.	12	-

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COURSE CODE	**16EC8GCSMR**	**COURSE TITLE**	**Internship/Technical Seminar**
CREDITS	**2**	**L-T-P-S**	**0-0-2-0**

CO-numbers	Course Outcomes	POs	PSOs
CO-1	Develop awareness about current global and contemporary issues in technology and science and skills to be life-long learners	6, 8, 9,10, 12	1, 2, 3
CO-2	Investigate some of the current scientific trends/issues facing society	7,8,10	1, 2, 3
CO-3	Practice skills that are necessary for any engineer/academic learner	9,10, 12	1, 2, 3