ADVANCED ENGINEERING MATHEMATICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16ELD11	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Acquaint with principles of linear algebra, calculus of variations, probability theory and random process.
- Apply the knowledge of linear algebra, calculus of variations, probability theory and random process in the applications of electronics and communication engineering sciences.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Linear Algebra-I Introduction to vector spaces and sub-spaces, definitions, illustrative examples and simple problems. Linearly independent and dependent vectors-definition and problems. Basis vectors, dimension of a vector space. Linear transformations- definition, properties and problems. Rank-Nullity theorem (without proof). Matrix form of linear transformations-Illustrative examples.	**10 Hours (Text 1 & Ref. 1)**	**L1,L2**
Module -2		
Linear Algebra-II Computation of Eigen values and Eigen vectors of real symmetric matrices-Given's method. Orthogonal vectors and orthogonal bases. Gram-Schmidt orthogonalization process. QR decomposition, singular value decomposition, least square approximations.	**10 Hours (Text 1 & Ref. 1)**	**L1,L2**
Module -3		

Calculus of Variations Concept of functional-Eulers equation. functional dependent on first and higher order derivatives, functional on several dependent variables. Isoperimetric problems-variation problems with moving boundaries.	**10 Hours (Text 2 & Ref. 2)**	**L1,L2**
Module -4		
Probability Theory Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions-illustrations. Binomial, Poisson, Exponential, Gaussian and Rayleigh distributions-examples.	**10 Hours (Text 3 & Ref. 3)**	**L1,L2**
Module -5		
Joint probability distributions Definition and properties of CDF, PDF, PMF, conditional distributions. Expectation, covariance and correlation. Independent random variables. Statement of central limit theorem-Illustrative examples. Random process- Classification, stationary and ergodic random process. Auto correlation function-properties, Gaussian random process.	**10 Hours (Text 3 & Ref. 3)**	**L1,L2**

Course Outcomes: After studying this course, students will be able to:

1. Understand vector spaces, basis, linear transformations and the process of obtaining matrix of linear transformations arising in magnification and rotation of images.
2. Apply the techniques of QR and singular value decomposition for data compression, least square approximation in solving inconsistent linear systems.
3. Utilize the concepts of functionals and their variations in the applications of communication systems, decision theory, synthesis and optimization of digital circuits.
4. Learn the idea of random variables (discrete/continuous) and probability distributions in analyzing the probability models arising in control systems and system communications.
5. Apply the idea of joint probability distributions and the role of parameter-dependent random variables in random process.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. David C.Lay, Steven R. Lay and J.J.McDonald: Linear Algebra and its Applications, 5th Edition, Pearson Education Ltd., 2015.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.
3. Scott L.Miller, DonaldG. Childers: "Probability and Random Process with application to Signal Processing", Elsevier Academic Press, 2nd Edition,2013.

Reference books:

1. Richard Bronson: "Schaum's Outlines of Theory and Problems of Matrix Operations", McGraw-Hill, 1988.
2. Elsgolts, L.:"Differential Equations and Calculus of Variations", MIR Publications, 3rd Edition, 1977.
3. T.Veerarajan: "Probability, Statistics and Random Process", 3rd Edition, Tata McGraw Hill Co.,2008.

Web links:

1. http://nptel.ac.in/courses.php?disciplineId=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://ocw.mit.edu/courses/mathematics/
4. www.wolfram.com

ANTENNA THEORY AND DESIGN

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16ECS12	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Introduce and discuss different types of Antennas, various terminologies, excitations.
- Study different types of Arrays, Pattern-multiplication, Feeding techniques.
- Calculate gain of aperture antennas, Reflector antennas and analyze general feed model.
- Define, describe, and illustrate principle behind antenna synthesis.
- Introduction of Method of moments, Pocklington's integral equation, Source modeling.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Antenna Fundamentals and Definitions: Radiation Mechanisms, Overview, EM Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation patterns, Directivity and Gain, Antenna impedance, Radiation efficiency, Antenna polarization.	**10 Hours**	**L1,L2**
Module -2		
Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Non-uniformly excited equally spaced linear arrays, Mutual coupling. **Antenna Synthesis**: Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods, Dolph Chebyshev linear array, Taylor line source method.	**10 Hours**	**L1,L2,L3, L4, L5**
Module -3		

Resonant Antennas: Wires and Patches, Dipole antenna, Yagi-Uda antennas, Micro-strip antenna. **Broadband antennas**: Traveling wave antennas Helical antennas, Biconical antennas, Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas.	**10 Hours**	**L1,L2,L3, L5**
Module -4		
Aperture antennas: Techniques for evaluating gain, Reflector antennas- Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, Field representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice.	**10 Hours**	**L1,L2,L3, L5**
Module -5		
CEM for antennas: The method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics.	**10 Hours**	**L1,L2**

Course Outcomes:

After studying this course, students will be able to:

- Classify different types of antennas
- Define and illustrate various types of array antennas
- Design antennas like Yagi-Uda, Helical antennas and other broad band antennas
- Describe different antenna synthesis methods.
- Apply methods like MOM

Post Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Stutzman and Thiele, “Antenna Theory and Design”, 2nd Edition, John Wiley, 2010.

Reference Books:

1. C. A. Balanis, “Antenna Theory Analysis and Design”, John Wiley, 2nd Edition 2007.
2. J. D. Krauss, “Antennas and Wave Propagation”, McGraw Hill TMH, 4th Edition, 2010.
3. A.R.Harish, M.Sachidanada, “Antennas and propagation”, Pearson Education, 2015.

ADVANCED EMBEDDED SYSTEM

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16EVE13	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Describe the hardware software co-design and firmware design approaches
- Explain the architectural features of ARM CORTEX M3, a 32 bit microcontroller including memory map, interrupts and exceptions.
- Program ARM CORTEX M3 using the various instructions, for different applications.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Embedded System: Embedded vs General computing system, classification, application and purpose of ES. Core of an Embedded System, Memory, Sensors, Actuators, LED, Opto coupler, Communication Interface, Reset circuits, RTC, WDT, Characteristics and Quality Attributes of Embedded Systems (Text 1: Selected Topics from Ch -1, 2, 3).	**10 Hours**	**L1, L2, L3**
Module -2		
Hardware Software Co-Design, embedded firmware design approaches, computational models, embedded firmware development languages, Integration and testing of Embedded Hardware and firmware, Components in embedded system development environment (IDE), Files generated during compilation, simulators, emulators and debugging (Text 1: Selected Topics From Ch-7, 9, 12, 13).	**10 Hours**	**L1, L2, L3, L4**

Module -3		
ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence (Text 2: Ch 1, 2, 3)	**10 Hours**	**L1, L2, L3**
Module -4		
Instruction Sets: Assembly basics, Instruction list and description, useful instructions, Memory Systems, Memory maps, Cortex M3 implementation overview, pipeline and bus interface (Text 2: Ch-4, 5, 6)	**10 Hours**	**L1, L2, L3, L4**
Module -5		
Exceptions, Nested Vector interrupt controller design, Systick Timer, Cortex-M3 Programming using assembly and C language, CMSIS (Text 2: Ch-7, 8, 10)	**10 Hours**	**L1, L2, L3**

Course Outcomes:

After studying this course, students will be able to:

- Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Explain the hardware software co-design and firmware design approaches.
- Acquire the knowledge of the architectural features of ARM CORTEX M3, a 32 bit microcontroller including memory map, interrupts and exceptions.
- Apply the knowledge gained for Programming ARM CORTEX M3 for different applications.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of Solutions

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. K. V. Shibu, "Introduction to embedded systems", TMH education Pvt. Ltd. 2009.
2. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd edn, Newnes, (Elsevier), 2010.

Reference Book:

James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008.

ADVANCED DIGITAL COMMUNICATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16ECS14	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Analyze the operation of different modulation techniques and analyze the error performance of digital modulation techniques in presence of AWGN noise.
- Explain and demonstrate the model of discrete time channel with ISI.
- Explain the model of discrete time channel by equalizer.
- Explain various types of equalizers used for channel modeling and adjusting the filter coefficients
- Understand the concept of spread spectrum communication system and analyze the error performance.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Digital Modulation Schemes: Representation of Digitally Modulated Signals, Memory less Modulation Methods-PAM, Phase Modulation, QAM, Multidimensional Signalling, Signalling Schemes with memory: CPFSK, CPM, MSK, OQPSK. Transmit PSD for Modulation Schemes (Chapter 3: 3.1, 3.2, 3.3, 3.4.1 and 3.4.2 of Text).	**10 Hours**	**L1,L2,L3, L4**
Module -2		

Optimum Receivers for AWGN channels: Waveform and Vector channel models, Waveform and Vector AWGN channels- Optimal detection, Implementation, Optimal Detection and Error Probability for Band limited signaling, Optimal detection and error probability for power limited signaling. Non Coherent Detection (without derivations (Chapter 4: 4.1, 4.2 - 4.2.1, 4.2.2, 4.3, 4.4, 4.5.1, 4.5.2, eqn 4.5.45 to 4.5.47, 4.5.5 upto eqn 4.5.62 of Text).	**10 Hours**	**L1,L2,L3 L4**
Module -3		
Multichannel and Multicarrier Signalling: Multichannel Communications in an AWGN channel, Multicarrier Communications in AWGN channel (Chapter 11- 11.1, 11.2-1 to 11.2-5 of Text). **Synchronization**: Signal Parameter estimation, Carrier Phase Estimation, Symbol Timing Recovery (Chapter 5- 5.1 to 5.3, of Text).	**10 Hours**	**L2,L3,L4**
Module -4		
Digital Communication through band-limited channels: Characterization of Band-limited channels, Optimum Receiver for channels with ISI and AWGN, Linear equalization, Decision feedback equalization (Chapter 9: 9.1,9.3- 9.3.1, 9.3.2, 9.4- 9.4.1, 9.4.2, 9.4.4, 9.4.5, 9.5-9.5.1, 9.5.3 of Text). Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, Adaptive equalization of Trellis - coded signals (Chapter 10: 10.1, 10.2, 10.3 of Text).	**10 Hours**	**L1,L2,L3, L4**
Module -5		
Spread spectrum signals for digital communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, Frequency hopped spread spectrum signals, CDMA, Time hopping SS, Synchronization of SS systems (Chapter 12 of Text).	**10 Hours**	**L1,L2**

Course Outcomes:

After studying this course, students will be able to:

- Acquire knowledge of
  - Advanced topics on digital communication.
  - Application and practical implementation of various Digital Modulation techniques.
  - Inter symbol interference (ISI) and its channel modeling .
  - Different types spread spectrum system
  - Different filtering algorithms for the ISI elimination
  - The effect of signal characteristics on the choice of a channel model.
- Analyse the performance of
  - Digital Modulation techniques.
  - Different filtering algorithms.
  - Spread spectrum communication system

Post Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

John G. Proakis, Masoud Salehi, "Digital Communications", McGraw Hill, 5th Edition, 2008.

Reference: Book:

Bernard Sklar, "Digital Communication - Fundamental and applications", Pearson education (Asia), Pvt. Ltd., 2nd edition, 2001.

ADVANCED COMPUTER NETWORKS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER –I

Subject Code	16ECS151	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Develop an awareness towards basic networking principles
- Learn various aspects involved in multiple access and multiplexing
- Develop an awareness regarding the LAN architectures and the various data switching techniques
- Learn the scheduling techniques of networks
- Learn protocols operating in at different layers of computer networks
- Develop an awareness towards the network control and traffic management

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction to networks: Computer network, Telephone networks, Networking principles (Text 1), Protocol layering (Text 2), Multiplexing- TDM, FDM, SM, WDM (Text 1). **Multiple Access:** Introduction, Choices and constraints, base technologies, centralized and distributed access schemes (Text 2).	**08 Hours**	**L1, L2, L3**
Module -2		
Local Area Networks: Ethernet - Physical layer, MAC, LLC, LAN interconnection, Token ring- Physical layer, MAC, LLC, FDDI (Text 1). Switching- introduction, circuit switching, packet switching, multicasting (Text 2). **Scheduling:** Introduction, requirements, choices, performance bounds, best- effort techniques. Naming and addressing (Text 2).	**08 Hours**	**L1, L2, L3**

Module -3		
SONET, SDH (Text 2), ATM Networks- features, signaling and routing, header and adaptation layers (Text 1), virtual circuits, SSCOP, Internet- addressing, routing, end point control (Text 2). **Internet protocols-** IP, TCP, UDP, ICMP, HTTP (Text 2).	**08 Hours**	**L1, L2, L3**
Module -4		
Traffic Management: Introduction, framework for traffic management, traffic models, traffic classes, traffic scheduling (Text 2). **Control of Networks:** Objectives and methods of control, routing optimization in circuit and datagram networks, Markov chains, Queuing models in circuit and datagram networks (Text 1).	**08 Hours**	**L1, L2, L3**
Module -5		
Congestion and flow control: Window congestion control, rate congestion control, control in ATM Networks (Text 1), flow control model, open loop flow control, closed loop flow control (Text 2).	**08 Hours**	**L1, L2, L3, L5**

Course outcomes: After studying this course, students will be able to:

- Choose
  - appropriate multiple access and multiplexing techniques as per the requirement.
  - standards for establishing a computer network
  - switching techniques based on the applications of the network
  - IP configuration for the network with suitable routing, scheduling, error control and flow control
- Analyze and develop various network traffic management and control techniques

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. J. Walrand and P. Varaya, "High performance communication networks", Harcourt Asia (Morgan Kaufmann), 2000.
2. S. Keshav, "An Engineering approach to Computer Networking", Pearson Education, 1997.

Reference Books:

1. Leon-Garcia, and I. Widjaja, "Communication network: Fundamental concepts and key architectures", TMH, 2000.
2. J. F. Kurose, and K. W. Ross, "Computer networking: A top down approach featuring the Internet", Pearson Education, 2001.

NANOELECTRONICS

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	16EVE152	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Enhance basic engineering science and technological knowledge of nanoelectronics.
- Explain basics of top-down and bottom-up fabrication process, devices and systems.
- Describe technologies involved in modern day electronic devices.
- Appreciate the complexities in scaling down the electronic devices in the future.

Modules	Teaching hours	Revised Bloom's Taxonomy (RBT)
Module -1		
Introduction: Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moores' law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometerlength scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems (Text 1).	**8 Hours**	**L1, L2**
Module -2		
Characterization: Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques (Text 1).	**8 Hours**	**L2,L3**

Module -3		
Characterization: spectroscopy techniques: photon, radiofrequency, electron, surface analysis and dept profiling: electron, mass, Ion beam, Reflectrometry, Techniques for property measurement: mechanical, electron, magnetic, thermal properties. **Inorganic semiconductor nanostructures:** overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states (Text 1).	**8 Hours**	**L1-L3**
Module -4		
Fabrication techniques: requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, collidal quantum dots, self-assembly techniques. **Physical processes:** modulation doping, quantum hall effect, resonant tunneling, charging effects, ballistic carrier transport, Inter band absorption, intraband absorption, Light emission processes, phonon bottleneck, quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural (Text 1).	**8 Hours**	**L1-L3**
Module -5		
Methods of measuring properties: atomic, crystollography, microscopy, spectroscopy (Text 2). **Applications**: Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIP's, NEMS, MEMS (Text 1).	**8 Hours**	**L1-L4**

Course outcomes:

After studying this course, students will be able to:

- Know the principles behind Nanoscience engineering and Nanoelectronics.
- Apply the knowledge to prepare and characterize nanomaterials.
- Know the effect of particles size on mechanical, thermal, optical and electrical properties of nanomaterials.
- Design the process flow required to fabricate state of the art transistor tech nology.
- Analyze the requirements for new materials and device structure in the futu re technologies.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley, 2007.
2. Charles P Poole, Jr, Frank J Owens, "Introduction to Nanotechnology", John Wiley, Copyright 2006, Reprint 2011.

Reference Book:

Ed William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, "Hand Book of Nanoscience Engineering and Technology", CRC press, 2003.

OPTICAL COMMUNICATION AND NETWORKING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER –I

Subject Code	16ECS153	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Mathematically analyze and conceptualize basics of optical networking and its associated nonlinear artifacts and effects.
- Develop awareness regarding optical devices and their working strategies
- Develop awareness of WDM principles, and that of power penalty issues existent in optical Networks
- Get insight into the design of various types of Lasers and understand the techniques of coherent transmission.
- Develop an awareness towards the backbone architectures of optical networking with the present trends in access networks
- Design second generation optical networks using various existent & devices like OADM, OLT and OXC and to mathematically model the problems in the design of WDM networks

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction to optical networking: Propagation of signals in optical fiber, Different losses, Nonlinear effects, Solutions, Optical sources, Detectors. **Optical Components (Part-1**): Couplers, Isolators, Circulators and Multiplexers.	**08 Hours**	**L1, L2, L3**
Module -2		
Optical Components (Part-2): Filters, Gratings, Interferometers, Amplifiers. **Modulation - Demodulation**: Formats, Ideal receivers, Practical detection receivers, Optical preamplifiers, Noise considerations, Bit error rates, Coherent detection.	**08 Hours**	**L1, L2, L3**

Module -3		
Transmission System Engineering: System model, Power penalty, Transmitter, Receiver, Different optical amplifiers **Client Layers:** Client layers of optical layer, SONET/SDH, Multiplexing, layers, Frame structure, ATM functions, Adaptation layers, Quality of Service (QoS) and flow control, ESCON, HIPPI.	**08 Hours**	**L1, L2, L3**
Module -4		
WDM network elements: Optical line terminal, Optical line amplifiers, Optical Add/ Drop Multiplexors, Optical cross connectors. **WDM Network Design**: WDM network design, Cost tradeoffs, LTD and RWA problems, Routing and wavelength assignment, Wavelength conversion.	**08 Hours**	**L1, L2, L3**
Module -5		
Control and Management (Part-1): Network management functions, management framework, Information model, management protocols, Layers within optical layer. **Control and Management (Part-2):** Performance and fault management, Impact of transparency, BER measurement, Optical trace, Alarm management, Configuration management.	**08 Hours**	**L1, L2, L3**

Course outcomes: After studying this course, students will be able to:

- Recognize and select various optical networking components according to the prescribed design specifications
- Learn
  - the aspects of data transmission, loss hindrances and other artifacts affecting the network operation
  - the issues involved in setting up and maintenance of access part of optical network with the latest trends in the data communication
- Design a WDM network and study the component and network management aspects

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

1. Rajiv Ramswami and K. N. Sivarajan, "Optical Networks", Morgon Kauffman Publishers, 3rd edition, 2010.

Reference Books:

1. John M. Senior, "Optical fiber communication", Pearson edition, 2000.
2. Gerd Kaiser, "Optical fiber Communication Systems", John Wiley, New York, 1997.
3. P. E. Green, "Optical Networks", Prentice Hall, 1994.

SIMULATION, MODELLING AND ANALYSIS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16ECS154	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Understand the process of simulation and modeling
- Learn simulation of deterministic and probabilistic models, with a focus of statistical data analysis and simulation data.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Basic Simulation Modeling: Nature of simulation, Systems, Models and Simulation, Discrete- Event Simulation, Simulation of Single Server Queuing System, Simulation of inventory system, Parallel and distributed simulation and the high level architecture, Steps in sound simulation study, and Other types of simulation, Advantages and disadvantages. (1.1, 1.2, 1.3, 1.4, 1.4.1, 1.4.2, 1.4.3, 1.5, 1.5.1, 1.5.2, 1.6, 1.7, 1.8, 1.9 of Text)	**8 Hours**	**L1,L2**
Module -2		

Review of Basic Probability and Statistics Random Variables and their properties, Simulation Output Data and Stochastic Processes, Estimation of Means, Variances and Correlations, Confidence Intervals and Hypothesis tests for the Mean **Building valid, credible and appropriately detailed simulation models**: Introduction and definitions, Guidelines for determining the level of models detail, Management's Role in the Simulation Process, Techniques for increasing model validity and credibility, Statistical procedure for comparing the real world observations and simulation output data. (4.2, 4.3, 4.4, 4.5, 5.1, 5.2, 5.4, 5.5, 5.6, 5.6.1, 5.6.2 of Text)	**8 Hours**	**L1,L2, L3**
Module -3		
Selecting Input Probability Distributions: Useful probability distributions, activity I, II and III. Shifted and truncated distributions; Specifying multivariate distribution, correlations, and stochastic processes; Selecting the distribution in the absence of data, Models of arrival process (6.2, 6.4, 6.5, 6.6, 6.8, 6.10, 6.11, 6.12 of Text).	**8 Hours**	**L1,L2, l3**
Module -4		
Random Number Generators: Linear congruential Generators, Other kinds, Testing number generators, **Generating the Random Variates**: General approaches, Generating continuous random variates, Generating discrete random variates, Generating random vectors, and correlated random variates; Generating arrival processes (7.2, 7.3, 7.4, 8.2, 8.3, 8.4, 8.5, 8.6 of Text).	**8 Hours**	**L1,L2, L3**
Module -5		

Output data analysis for a single system: Transient and steady state behavior of a stochastic process; Types of simulations with regard to analysis; Statistical analysis for terminating simulation; Statistical analysis for steady state parameters; Statistical analysis for steady state cycle parameters; Multiple measures of performance, Time plots of important variables. (9.2, 9.3, 9.4, 9.4.1, 9.4.3, 9.5, 9.5.1, 9.5.2, 9.5.3, 9.6, 9.7, 9.8 of Text)	**8 Hours**	**L1,L2,L3**

Course Outcomes:

After studying this course, students will be able to:

- Define the need of simulation and modeling.
- Describe various simulation models.
- Discuss the process of selecting of probability distributions.
- Perform output data analysis.

Post Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design and development of solutions.
- Interpretation of data

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Averill Law, "Simulation modeling and analysis", McGraw Hill 4th edition, 2007.

Reference Books:

1. Tayfur Altiok and Benjamin Melamed, “Simulation modeling and analysis with ARENA”, Elsevier, Academic press, 2007.
2. Jerry Banks, "Discrete event system Simulation", Pearson, 2009
3. Seila Ceric and Tadikamalla, "Applied simulation modeling", Cengage, 2009.
4. George. S. Fishman, "Discrete event simulation", Springer, 2001.
5. Frank L. Severance, "System modeling and simulation", Wiley, 2009.

ADVANCED COMMUNICATION LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Laboratory Code	16ECSL16	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This laboratory course enables students to get practical experience

- Radiation pattern of antennas.
- Determining gain and directivity of a given antenna.
- Working of Klystron source.
- S-parameters of some microwave passive devices.

Laboratory Experiments: NOTE: Experiments can be done using Hardware tools such as Spectrum analyzers, Signal sources, Power Supplies, Oscilloscopes, High frequency signal sources, Fiber optic kits, Microwave measurement benches, DSP processor kit, FPGA kit, Logic analyzers, PC setups, etc. Software tools based experiments can be done using, FEKO or equivalent open source simulator, MATLAB etc.	**Revised Bloom's Taxonomy (RBT) Level**
1. Matlab/C implementation of to obtain the radiation pattern of an antenna.	L3,L4
2. Study of radiation pattern of different antennas.	L2, L3
3. Determine the directivity and gains of Horn/ Yagi/ dipole/ Parabolic antennas.	L3, L4
4. Impedance measurements of Horn/Yagi/dipole/Parabolic antennas.	L3, L4
5. Study of radiation pattern of E & H plane horns.	L2, L3
6. Significance of Pocklington's integral equation.	L1,L2
7. Study of digital modulation techniques using CD4051 IC.	L2, L3
8. Conduct an experiment for Voice and data multiplexing using optical fiber.	L3,L4

9. Determination of the modes transit time, electronic timing range and sensitivity of Klystron source.	L3, L4
10. Determination of VI characteristics of GUNN diode, and measurement of guide wave length, frequency, and VSWR.	L3,L4
11. Determination of coupling coefficient and insertion loss of directional couplers and Magic tree.	L3,L4
12. Build a hardware pseudo-random signal source and determine statistics of the generated signal source.	L1,L2,L3,L4

Course outcomes: On the completion of this laboratory course, the students will be able to:

- Plot the radiation pattern of some antennas using matlab and wave guide setup
- Obtain the S-parameters of Magic tee and directional couplers.
- Test the IC CD4051 for modulation techniques.
- Study multiplexing techniques using OFC kit.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.