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

STATISTICAL SIGNAL PROCESSING

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

SEMESTER – I

Subject Code	16ESP12	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:

- Study random processes and its properties
- The basic theory of signal detection and estimation
- Identify the engineering problems that can be put into the frame of statistical signal processing
- Solve the identified problems using the standard techniques learned through this course,
- The fundamental understanding of statistical signal processing that may help apply and make contributions to the theory and the practice of statistical signal processing.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Random Processes: Random variables, random processes, white noise, filtering random processes, spectral factorization, ARMA, AR and MA processes (Text 1).	**10 Hours**	**L1, L2**
Module -2		
Signal Modeling: Least squares method, Padé approximation, Prony's method, finite data records, stochastic models, Levinson-Durbin recursion; Schur recursion; Levinson recursion (Text 1).	**10 Hours**	**L2, L3**

Module -3		
Spectrum Estimation: Nonparametric methods, minimum-variance spectrum estimation, maximum entropy method, parametric methods, frequency estimation, principal components spectrum estimation (Text 1).	**10 Hours**	**L1, L2**
Module -4		
Optimal and Adaptive Filtering: FIR and IIR Wiener filters, Discrete Kalman filter, FIR Adaptive filters: Steepest descent, LMS, LMS-based algorithms, adaptive recursive filters, RLS algorithm (Text 1).	**10 Hours**	**L2, L3**
Module -5		
Array Processing: Array fundamentals, beam-forming, optimum array processing, performance considerations, adaptive beam-forming, linearly constrained minimum-variance beam-formers, side-lobe cancellers, space-time adaptive processing (Text 2).	**10 Hours**	**L2, L3**

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

- Characterize an estimator.
- Design statistical DSP algorithms to meet desired needs
- Apply vector space methods to statistical signal processing problems
- Understand Wiener filter theory and design discrete and continuous Wiener filters
- Understand Kalman Filter theory and design discrete Kalman filters
- Use computer tools (such as Matlab) in developing and testing stochastic DSP algorithms
- Complete a term project.

Graduate Attributes (as per NBA):

- Engineering knowledge
- Problem analysis
- Design

Question paper pattern:

- The question paper will have ten 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. Monson H.Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley & Sons (Asia) Pte.Ltd., 2002.
2. Dimitris G. Manolakis, Vinay K. Ingle, and Stephen M. Kogon, "Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing”, McGraw-Hill International Edition, 2000.

Reference Books:

1. Bernard Widrow and Samuel D.Stearns, "Adaptive Signal Processing”, Pearson Education (Asia) Pte.Ltd., 2001.
2. Simon Haykin, "Adaptive Filters”, Pearson Education (Asia) Pte. Ltd, 4th edition, 2002.
3. J.G. Proakis, C.M. Rader, F. Ling, C.L. Nikias, M. Moonen and I.K. Proudler, "Algorithms for Statistical Signal Processing”, Prentice Hall, 2001, ISBN-0130622192.

ADVANCED EMBEDDED SYSTEM

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

SEMESTER – I

Subject Code	16EVE13	IA Marks	20
Number of Lecture	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.

MODERN DSP

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

Subject Code	16ESP14	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:

- With necessary background to pursue research in multiple areas of digital signal processing.
- With knowledge of Understanding the Sampling rate conversion methods
- To Know finite word length effects in DSP systems
- To explore non-parametric methods for power spectrum estimation and analyze power spectrum estimation using parametric methods.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction: **Multirate Digital Signal Processing:** Introduction, Decimation by a factor 'D', Interpolation by a factor 'I', Sampling rate Conversion by a factor 'I/D', implementation of Sampling rate conversion, Multistage implementation of Sampling rate conversion, Sampling rate conversion of Band Pass Signals, Sampling rate conversion by an arbitrary factor, Applications of Multirate Signal Processing, Digital Filter banks, Two Channel Quadrature Mirror Filter banks, M-Channel QMF bank (Text 1).	**10 Hours**	**L1, L2,L3**
Module -2		

Transform Analysis of LTI systems: The frequency response of LTI systems, System functions for systems characterized by linear constant coefficient difference equations, frequency response for rational system functions, Relationship between magnitude and phase, All pass systems, minimum phase systems, linear systems with generalized linear phase (Text 2).	**10 Hours**	**L1, L2**
Module -3		
Linear Prediction and Optimum Linear Filters: Representation of a random process, Forward and backward linear prediction, Solution of normal equations, Properties of the linear error-prediction filters, AR lattice and ARMA lattice-ladder filters, Wiener filters for filtering and prediction (Text 1).	**10 Hours**	**L1,L2, L3**
Module -4		
Time frequency transformation: The Fourier Transform: Its Power and Limitations, The short Time Fourier Transform, The Gabor transform, The wavelet transform, Perfect reconstruction Filter Banks and Wavelets, Recursive Multi resolution Decomposition, Haar Wavelet (Text 3).	**10 Hours**	**L1,L2**
Module -5		
Hardware and Software for Digital Signal Processors: Digital signal processor architecture, Digital signal processor hardware units, Fixed- point and floating-point formats (Text 4).	**10 Hours**	**L1,L2**

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

- Explain sampling and reconstruction processes and Generate different signals at different sample rates and determine the relevant parameters in specific applications
- Deduce and apply correlation functions and power spectra for various signal classes, in particular for stochastic signals
- Construct and apply simple multi-rate signal processing systems
- Solve and interpret the result of signal processing problems by use of Matlab
- Design of simple, specific signal processing systems based on an analysis of involved signal characteristics, the objective of the processing system, and utility of methods presented in the course.

Graduate Attributes (as per NBA):

- Engineering knowledge
- Problem analysis
- Design (Partly)

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. Proakis and Manolakis, "Digital Signal Processing", Prentice Hall, 4th edition, 1996.
2. Alan V. Oppenheim and Ronald W.Schafer, "Discrete-Time signal Processing", PHI Learning, 2003.
3. Roberto Cristi, "Modern Digital Signal Processing", Cengage Publishers, India, Eerstwhile Thompson Publications, 2003.
4. Li Tan, "Digital Signal Processing – Fundamentals and Applications", Elsevier, 2008.

Reference Book:

S.K.Mitra, "Digital Signal Processing: A Computer Based Approach", 3rd edition, Tata McGraw Hill, India, 2007.

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)
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.

MULTIRATE SYSTEMS AND FILTER BANKS

As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	16ESP152	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:

- To understand need of multi-rate systems and it applications.
- To understand theory of multi-rate DSP, solve numerical problems and write algorithms
- To understand theory of prediction and solution of normal equation

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Fundamentals of Multi-rate Systems: Basic multi-rate operations, interconnection of building blocks, poly-phase representation, multistage implementation, applications of multi-rate systems, special filters and filter banks (Text 1).	**8 Hours**	**L1, L2**
Module -2		
Maximally decimated filter banks: Errors created in the QMF bank, alias-free QMF system, power symmetric QMF banks, M-channel filter banks, poly-phase representation, perfect reconstruction systems, alias-free filter banks, tree structured filter banks, trans-multiplexers (Text 1).	**8 Hours**	**L2, L3**
Module -3		
Para-unitary Perfect Reconstruction Filter Banks: Lossless transfer matrices, filter bank properties induced by para-unitariness, two channel Para-unitary lattices, M-channel FIR Para-unitary QMF banks, transform coding (Text 1).	**8 Hours**	**L2, L3**
Module -4		

Linear Phase Perfect Reconstruction QMF Banks: Necessary conditions, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice (Text 1). **Cosine Modulated Filter Banks:** Pseudo-QMF bank and its design, efficient poly-phase structures, properties of cosine matrices, cosine modulated perfect reconstruction systems (Text 1).	**8 Hours**	**L2, L3**
Module -5		
Wavelet Transform: Short-time Fourier transform, Wavelet transform, discrete-time Ortho-normal wavelets, continuous time Ortho-normal wavelets (Text 2).	**8 Hours**	**L2, L3**

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

- Understand the fundamentals of multirate signal processing and its applications.
- Learn the theory of sampling rate conversion and develop methods for decimating, interpolating and changing the sampling rate of the signal and to develop efficient polyphaser implementations of sampling rate converters.
- Get a solid conceptual background in multirate filter banks an in-depth understanding of both the theoretical and practical aspects of multirate signal processing.
- Design perfect reconstruction and near perfect reconstruction filter bank system and to learn to assess the computational efficiency of multirate systems.
- Analyze the quantization effects in filter banks.
- Understand the use of filter banks in applications such as speech processing and communication

Graduate Attributes (as per NBA):

- Engineering knowledge
- Problem analysis
- Design

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. P.P.Vaidyanathan, “Multirate Systems and Filter Banks", Pearson Education (Asia) Pte. Ltd, 2004.
2. Gilbert Strang and Truong Nguyen, "Wavelets and Filter Banks", Wellesley-Cambridge Press, 1996.

Reference Book:

N. J. Fliege, "Multirate Digital Signal Processing”, John Wiley & Sons, USA, 2000.

MODERN SPECTRAL ANALYSIS & ESTIMATION

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

SEMESTER – I

Subject Code	16ESP153	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 Power spectral density and its estimation.
- Imparts knowledge of both Non-parametric & Parametric PSD estimation methods.
- For interpretation of the filter bank methods in terms of PSD.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Basic Concepts: Introduction, Energy Spectral Density of deterministic signals, Power Spectral Density of random signals, properties of Power Spectral Densities, The Spectral Estimation problem, Coherence Spectrum (Text 1).	**8 Hours**	**L1, L2**
Module -2		
Spectrum Estimation: Introduction, Correlogram method, Periodogram Computation of FFT, properties of Periodogram method such as bias analysis, window design considerations. Signals with Rational spectra. ARMA state – space Equation, sub space Parameter Estimation (Text 1).	**8 Hours**	**L2, L3**
Module -3		

Parametric Methods for line Spectra: Models of sinusoidal Signals in Noise, Non-linear least squares method. High Order Yule Walker method, Min – Norm Method, ESPRIT Method, Forward – Backward Estimation (Text 1).	**8 Hours**	**L2, L3**
Module -4		
Filter Bank Method: Filter bank Interpretation of the period gram, Refined Filter bank Method, Capon Method, Filter Bank Reinterpretation of the periodogram (Text 1).	**8 Hours**	**L1, L2**
Module -5		
Optimum Linear Filter : Optimum Signal Estimation, Linear MSE Estimation, Solution of the normal equations optimum FIR and IIR filters. Inverse filtering and deconvolution (Text 2).	**8 Hours**	**L2, L3**

Course outcomes:

After studying this course, students will be able to:

- Perform the spatial frequency analysis of signals.
- Use various methods and algorithm the estimation of PSD
- Analyze various signal characteristics for design of optimal systems

Graduate Attributes (as per NBA):

- Engineering knowledge
- Problem analysis
- Design (Partly)

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. Stoica and Moses, “Introduction to Spectral Analysis”, PHI, 1997.
2. Monalakis, Ingleand Kogen, “Stastical and Adaptive Signal Processing”, Tata McGraw Hill, 2000.

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.

SIGNAL PROCESSING LAB

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

Laboratory Code	16ESPL16	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

- Implement (MATLAB) basic operations on signals
- Understand signal behavior in time domain and frequency domain
- Understand Sampling rate variation using decimation and interpolation
- Understand the concept of power spectrum
- Pursue research work in signal processing

Laboratory Experiments: **NOTE: Experiments 1-10 are to be carried using Matlab and 11-12 using a DSP kit.**	**Revised Bloom's Taxonomy (RBT) Level**
1. Generate various fundamental discrete time signals.	**L1, L2**
2. Basic operations on signals (Multiplication, Folding, Scaling).	**L1, L2**
3. Find out the DFT & IDFT of a given sequence without using inbuilt instructions.	**L2, L3**
4. Interpolation & decimation of a given sequence.	**L2, L3**
5. Generation of DTMF (Dual Tone Multiple Frequency) signals.	**L2, L3**
6. Estimate the PSD of a noisy signal using periodogram and modified periodogram.	**L2, L3, L4**
7. Estimation of power spectrum using Bartlett and Welch methods.	**L2, L3**

8. Estimation of power spectrum using Blackman-Bukey method.	**L2, L3, L4**
9. Estimation of power spectrum using parametric methods (Yule-Walker & Burg).	**L2, L3, L4**
10. Design of LPC filter using Levinson-Durbin algorithm.	**L3, L4**
11. Noise cancellation using LMS algorithm (Implementation should be done using DSP kit)	**L2, L3**
12. Power spectrum estimation (Implementation should be done using DSP kit)	**L2, L3**

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

- Implement basic operation for signals using MATLAB
- Compute and visualize DFT and IDFT of any given signal
- Compute either decimated or interpolated signal
- Solve problems of power spectrum
- Can take up research work on signal processing

Graduate Attributes (as per NBA)

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

Conduct of Practical Examination:

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