K.S.INSTITUTE OF TECHNOLOGY, BANGALORE

(AFFLIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG.

Engineering Statistics and Linear Algebra IV
(Common to all Branches)

Course Title: COMPLEX ANALYSIS, PROBABILITY&STATISTICAL METHODS

Code : 18MAT41

Credits:03 | **L-T-P :2-2-0**
Contact Hours/Week: 04 | **Total Hours:50**
Exam. Marks:100 | **IA Marks :30**
Exam. Hours : 03

Course Learning Objectives: This course will enable students to:

- Understand and Analyze Single and Multiple Random Variables, and their extension to Random Processes.
- Familiarization with the concept of Vector spaces and orthogonality with a qualitative insight into applications incommunications.
- Compute the quantitative parameters for functions of single and Multiple Random Variables and Processes.
- Compute the quantitative parameters for Matrices and LinearTransformations.

Module-1

Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences.

Construction of analytic functions: Milne-Thomson method-Problems.

Module-2

Conformal transformations: Introduction. Discussion of transformations: $w = Z^2$, $w = e^z$, $w = z + \frac{1}{z}$, $(z \neq 0)$. Bilinear transformations- Problems.

Complex integration: Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.

Module-3

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.

Module-4

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation -problems. Regression analysis- lines of regression –problems.

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form- $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$.

Module-5

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

Course Outcomes:

At the end of the course the student will be able to:

- Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
- Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
- Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

Question paper pattern:

5. The question paper will have ten full questions carrying equal marks.
6. Each full question will be for 20 marks.

- There will be two full questions (with a maximum of four sub- questions) from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition,2016
2	Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers	44th Edition, 2017
3	Engineering Mathematics	Srimanta Pal et al	Oxford University Press	3rd Edition,2016
Reference Books				
1	Advanced Engineering Mathematics	C. Ray Wylie, Louis C.Barrett	McGraw-Hill	6th Edition 1995
2	Introductory Methods of Numerical Analysis	S.S.Sastry	Prentice Hall of India	4th Edition 2010
3	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill	11th Edition,2010
4	A Text Book of Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publications	2014

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – IV

ANALOG CIRCUITS

Subject Code	**18EC42**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**3+2 (Tutorial)**	**SEE Marks**	**60**
		Exam Hours	**03**

CREDITS – 04

Course Learning Objectives: This course will enable students to:

- Explain various BJT parameters, connections andconfigurations.
- Design and demonstrate the diode circuits and transistoramplifiers.
- ExplainvarioustypesofFETbiasing,anddemonstratetheuseofFETamplifiers.
- Construct frequency response of FET amplifiers at variousfrequencies.
- Analyze Power amplifier circuits in different modes ofoperation.
- Construct Feedback and Oscillator circuits usingFET.

Modules	RBT Level
Module -1	
BJT Biasing: Biasing in BJT amplifier circuits: The Classical Discrete circuit bias (Voltage-divider bias), Biasing using a collector to base feedback resistor. **Small signal operation and Models**: Collector current and transconductance, Base current and input resistance, Emitter current and input resistance, voltage gain, Separating the signal and the DC quantities, The hybrid Π model. **MOSFETs:BiasinginMOSamplifiercircuits:** Fixing V_{GS}, Fixing V_G, Draintogatefeedback resistor. **Small signal operation and modeling**: The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, transconductance. **[Text 1: 3.5(3.5.1, 3.5.3), 3.6(3.6.1 to 3.6.6), 4.5(4.5.1, 4.5.2, 4.5.3), 4.6(4.6.1 to 4.6.6)]**	**L1, L2,L3**
Module -2	
MOSFET Amplifier configuration: Basic configurations, characterizing amplifiers, CS amplifier with and without source resistance R_S, Source follower. **MOSFET internal capacitances and High frequency model:** The gate capacitive effect, Junction capacitances, High frequency model. **Frequency response of the CS amplifier**: The three frequency bands, high frequency response, Low frequency response. **Oscillators:** FET based Phase shift oscillator, LC and Crystal Oscillators (no derivation) **[Text 1: 4.7(4.7.1 to 4.7.4, 4.7.6) 4.8(4.8.1, 4.8.2, 4.8.3), 4.9, 12.2.2, 12.3.1, 12,3,2]**	**L1, L2, L3**
Module -3	
Feedback Amplifier: General feedback structure, Properties of negative feedback, The Four Basic Feedback Topologies, The series-shunt, series-series, shunt-shunt and shunt-series amplifiers (Qualitative Analysis). **Output Stages and Power Amplifiers:** Introduction, Classification of output stages,, Class A output stage, Class B output stage: Transfer Characteristics, Power Dissipation, Power Conversion efficiency, Class AB output stage, Class C tuned Amplifier. **[Text 1: 7.1, 7.2, 7.3, 7.4.1, 7.5.1, 7.6 (7.6.1 to 7.6.3), 13.1, 13.2, 13.3(13.3.1, 13.3.2, 13.3.3, 13.4, 13.7)]**	**L1, L2, L3**
Module -4	
Op-Amp with Negative Feedback and general applications Inverting and Non inverting Amplifiers – Closed Loop voltage gain, Input impedance, Output impedance, Bandwidth with feedback. DC and AC Amplifiers, Summing, Scaling and Averaging Amplifiers, Instrumentation amplifier, Comparators, Zero Crossing Detector, Schmitt trigger. **[Text 2: 3.3(3.3.1 to 3.3.6), 3.4(3.4.1 to 3.4.5) 6.2, 6.5, 6.6 (6.6.1), 8.2, 8.3, 8.4]**	**L1,L2, L3**
Module -5	

Op-Amp Circuits: DAC - Weighted resistor and R-2R ladder, ADC- Successive approximation type, Small Signal half wave rectifier, Active Filters, First and second order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters. **555 Timer and its applications:** Monostable and a stable Multivibrators. **[Text 2: 8.11(8.11.1a, 8.11.1b), 8.11.2a, 8.12.2, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 7.9, 9.4.1, 9.4.1(a), 9.4.3, 9.4.3(a)]**	**L1, L2, L3**

Course Outcomes: At the end of this course students will demonstrate the ability to

- Identify the performance characteristics and parameters of BJT and FET amplifier using small signal model.
- Design and Analyze the MOSFET amplifier and Oscillator circuits.
- Design and Analyze the BJT power amplifier.
- Identify the functioning and application of linear ICs.
- Design of Linear IC based circuits Like DAC, ADC, Rectifier and Filters.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthe module.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Books:

1. MicroelectronicCircuits,TheoryandApplications,AdelSSedra,KennethCSmith,6th Edition,Oxford, 2015.ISBN:978-0-19-808913-1
2. Op-AmpsandLinearIntegratedCircuits,RamakantAGayakwad,4th Edition.PearsonEducation,2000. ISBN:8120320581

Reference Books:

1. ElectronicDevicesandCircuitTheory,RobertLBoylestadandLouisNashelsky,11th Edition,Pearson Education, 2013, ISBN:978-93-325-4260-0.
2. Fundamentals of Microelectronics, BehzadRazavi, 2nd Edition, John Weily, 2015,ISBN 978-81-265-7135-2
3. J.Millman&C.C.Halkias—IntegratedElectronics,2nd edition,2010,TMH.ISBN0-07-462245-5

Web Link and Video Lectures:

1. https://nptel.ac.in/courses/117/101/117101106/
2. https://www.classcentral.com/course/swayam-analog-electronic-circuit-13894

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE)
SEMESTER –III

CONTROL SYSTEMS

Course Code	**18EC43**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**3**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (08 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand the basic features, configurations and application of controlsystems.
- Understand various terminologies and definitions for the controlsystems.
- Learn how to find a mathematical model of electrical, mechanical and electro- mechanical systems.
- Know how to fin d time response from the transferfunction.
- Find the transfer function via Mason s'rule.
- Analyze the stability of a system from the transferfunction.

Modules	RBT Level
Module – 1	
Introduction to Control Systems: Types of Control Systems, Effect of Feedback System s, Differential equation of Physical Systems –Mechanical Systems, Electrical Systems, Electromechanical systems, Analogous Systems.	**L1, L2, L3**
Module – 2	
Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs.	**L1, L2, L3**
Module – 3	
Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design).	**L1, L2, L3**
Module – 4	
Stability analysis: Concepts of stability, Necessary conditions for Stability, Routhstability criterion, Relative stability analysis: more on the Routh stability criterion. Introduction to Root-Locus Techniques, The root locus concepts, Construction of rootloci. **Frequency domain analysis and stability:** Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function.	**L1, L2, L3**
Module – 5	
Introduction to Polar Plots, (Inverse Polar Plotsexcluded) Mathematical preliminaries, Nyquist Stability criterion, (System s with transportation lag excluded) Introduction to lead, lag and lead- lag compensating networks (excluding design). **Introduction to State variable analysis:** Concepts of state, state variable and state models for electrical systems, Solution of state equations.	**L1, L2, L3**

Course Outcomes: At the end of the course, the students will be able to

- Develop the mathematical model of mechanical / electrical systems and obtain its transfer function using block reduction method /Signal flow graph method
- Ability to relate transient performance parameters (overshoot, rise time, peak time and settling time) for the given system and to evaluate steady state error.
- Identify various stability criteria and Determine the stability of a system in the time domain using Routh-Hurwitz criterion and Root-locus technique.
- Determine the stability of a system in the frequency domain using Nyquist and bode plots
- Develop a control system model in continuous and discrete time using state variable techniques

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Book:

J. Nagarath an d M.Gopal, " Control System s Engineering", New Age International(P) Limited, Publishers, Fifthedition- 2005,ISBN: 81 - 224 - 2008-7.

Reference Books:

1. "Modern Control Engineering," K.Ogata, Pearson Education Asia/ PHI,4th dition,2002. E ISBN 978 - 81 - 203 - 4010 - 7.
2. "Automatic Control Systems",BenjaminC. Kuo, JohnWileyIndia Pvt. Ltd.,8th dition, E 2008.
3. "Feedback and Control System," Joseph J Distefano III et al., Schaum'sOutlines, TMH, 2nd Edition2007.

Web Link and Video Lectures:

1. https://www.edx.org/course/introduction-to-control-system-design-a-first-look
2. https://www.classcentral.com/course/swayam-control-systems-13963
3. https://swayam.gov.in/nd1_noc19_de04/preview

B. E. (EC / TC)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – IV

ENGINEERING STATISTICS and LINEAR ALGEBRA

Course Code	**18EC44**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand and Analyze Single and Multiple Random Variables, and their extension to Random Processes.
- Familiarization with the concept of Vector spaces and orthogonality with a qualitative insight into applications incommunications.
- Compute the quantitative parameters for functions of single and Multiple Random Variables and Processes.
- Compute the quantitative parameters for Matrices and LinearTransformations.

Module-1	**RBT Level**
Single Random Variables: Definition of random variables, cumulative distribution function continuous and discrete random variables; probability mass function, probability density functions and properties; Expectations, Characteristic functions, Functions of single Random Variables, Conditioned Random variables. Application exercises to Some special distributions:Uniform,Exponential,Laplace,Gaussian;Binomial,andPoissondistribution. **(Chapter 4 Text 1)**	**L1, L2, L3**
Module -2	
Multiple Random variables: Concept, Two variable CDF and PDF, Two Variable expectations (Correlation, orthogonality, Independent), Two variable transformation, Two Gaussian Random variables, Sum of two independent Random Variables, Sum of IID Random Variables – Central limit Theorem and law of large numbers, Conditional joint Probabilities,ApplicationexercisestoChi-squareRV,Student-TRV,CauchyandRayleigh RVs. **(Chapter 5 Text1)**	**L1, L2, L3**
Module-3	
RandomProcesses: Ensemble,PDF,Independence,Expectations,Stationarity,Correlation Functions (ACF, CCF, Addition, and Multiplication), Ergodic Random Processes, Power Spectral Densities (Wiener Khinchin, Addition and Multiplication of RPs, Cross spectral densities), Linear Systems (output Mean, Cross correlation and Auto correlation of Input and output), Exercises with Noise. **(Chapter 6 Text1)**	**L1, L2, L3**
Module -4	
Vector Spaces: Vector spaces and Null subspaces, Rank and Row reduced form, Independence, Basis and dimension, Dimensions of the four subspaces, Rank-Nullity Theorem, Linear Transformations **Orthogonality:** Orthogonal Vectors and Subspaces, Projections and Least squares, OrthogonalBasesandGram-SchmidtOrthogonalizationprocedure.**(ReferChapters2and 3 Text2)**	**L1, L2, L3**
Module -5	
Determinants: Properties of Determinants, Permutations and Cofactors. **(Refer Chapter 4, Text 2**) **Eigenvalues and Eigen vectors:** Review of Eigenvalues and Diagonalization of a Matrix, Special Matrices (Positive Definite, Symmetric) and their properties, Singular Value Decomposition. **(Refer Chapter 5, Text 2)**	**L1, L2, L3**

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

- Identify Random Variables to extract quantitative statistical parameters and apply the same for special distributions.
- Analyze statistical representations and Eigen values of some special matrices and demonstrate the same using MATLAB.
- Analyze Random events in typical communication events to extract quantitative statistical parameters.
- Analyze vectors and vector spaces using suitable transformations and basis function sets.
- Analyze the concept of Multiple Random variables to extract quantitative statistical parameters.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthe module.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Books:

1. Richard H Williams, "Probability, Statistics and Random Processes for Engineers" Cengage Learning, 1st Edition, 2003, ISBN 13: 978-0-534- 36888-3, ISBN 10:0-534-36888-3.
2. GilbertStrang,"LinearAlgebraanditsApplications",CengageLearning,4thEdition,2006,ISBN 97809802327

Reference Books:

1. Hwei P. Hsu, "Theory and Problems of Probability, Random Variables, and Random Processes" Schaums Outline Series, McGraw Hill. ISBN 10: 0-07-030644-3.
2. K. N. HariBhat, K Anitha Sheela, Jayant Ganguly, "Probability Theory and Stochastic Processes for Engineers", Cengage Learning India, 2019, ISBN: Not inbook

Web Link and Video Lectures:

1. www.coursera.org/courses?query=linear%20algebra
2. www.classcentral.com/course/matrix-algebra-engineers-11986

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – IV

SIGNALS AND SYSTEMS

Course Code	**18EC45**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understandthemathematicaldescriptionofcontinuousanddiscretetimesignalsandsystems.
- Analyze the signals in time domain using convolution sum andIntegral.
- Classify signals into different categories based on theirproperties.
- Analyze Linear Time Invariant (LTI) systems in time and transformdomains.

Module-1	**RBT Level**
Introduction and Classification of signals: Definition of signal and systems, communication and control system as examples Classification of signals. **Basic Operations on signals**: Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shift and time reversal. **Elementary signals/Functions**: Exponential, sinusoidal, step,impulse and ramp functions. Expression of triangular, rectangular and other waveforms in terms of elementary signals.	**L1, L2, L3**
Module -2	
System Classification and properties: Linear-nonlinear, Time variant-invariant, causal-noncausal, static-dynamic, stable-unstable, invertible. **Time domain representation of LTI System:** Impulse response, convolution sum, convolution integral. Computation of convolution sum and convolution integral using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular.	**L1, L2, L3**
Module-3	
LTI system Properties in terms of impulse response: System interconnection, Memory less, Causal, Stable, Invertible and Deconvolution, and step response. **Fourier Representation of Periodic Signals**: CTF Sproperties and basic problems.	**L1, L2, L3**
Module -4	
Fourier Representation of aperiodic Signals: Introduction to Fourier Transform & DTFT, Definition and basic problems. **Properties of Fourier Transform**: Linearity, Time shift, Frequency shift, Scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem and problems on properties of Fourier Transform.	**L1, L2, L3**
Module -5	
The Z-Transforms: Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform, Causality and stability, Transform analysis of LTI systems.	**L1, L2, L3**

Course Outcomes: At the end of the course, students will be able to:

- Apply the basic operations on signals and classify elementary signals.
- Classify the various systems and analyze the concepts of convolution sum & integral on signals and
- Examine the system properties and represent periodic continuous/discrete signals in time and frequency domain using Fourier series.
- Make use of the properties of Fourier Transform on aperiodic signals to represent the signals in frequency domain.
- Make use of Z-transforms, inverse Z-transforms and transfer functions to analyze the complex LTI systems.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Book:

Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN 9971-51-239-4.

Reference Books:

1. **MichaelRoberts,**"FundamentalsofSignals&Systems",2ndedition,TataMcGraw-Hill,2010,ISBN 978-0-07-070221-9.
2. **AlanVOppenheim,AlanS,WillskyandAHamidNawab,**"SignalsandSystems"Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint2002.
3. **H.P Hsu, R. Ranjan,** "Signals and Systems", Scham's outlines, TMH,2006.
4. **B.P.Lathi,**"LinearSystemsandSignals",OxfordUniversityPress,2005.
5. **GaneshRaoandSatishTunga,**"SignalsandSystems",Pearson/Sanguine.

Web Link and Video Lectures:

1. www.edx.org/course/signals-and-systems-part-1
2. www.classcentral.com/course/swayam-principles-of-signals-and-systems-9900

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – IV

MICROCONTROLLER

Course Code	**18EC46**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours per Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- UnderstandthedifferencebetweenaMicroprocessorandaMicrocontrollerandembedded microcontrollers.
- Familiarize the basic architecture of 8051microcontroller.
- Program 8051microprocessor using Assembly Level Language andC.
- Understand the interrupt system of 8051 and the use ofinterrupts.
- UnderstandtheoperationanduseofinbuiltTimers/CountersandSerialportof8051.
- Interface 8051 to external memory and I/O devices using its I/Oports.

Module-1	RBT Level
8051 Microcontroller: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	**L1, L2**
Module -2	
8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.	**L1, L2**
Module-3	
8051 Stack, I/O Port Interfacing and Programming: 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops. Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.	**L1, L2, L3**
Module -4	
8051 Timers and Serial Port: 8051 Timers and Counters – Operation and Assembly languageprogrammingtogenerateapulseusing Mode-1andasquarewaveusingMode- 2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive dataserially.	**L1, L2, L3**
Module -5	
8051 Interrupts and Interfacing Applications: 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly language interfacing programming.	**L1, L2, L3**

Course outcomes: At the end of the course, students will be able to:

- Distinguish the role of functional units in the architecture of 8051 microcontroller
- Identify various instructions of 8051 Microcontroller
- Build solutions using assembly level language and high level language
- Make use of timers/counters, serial port and interrupts to generate delay and perform serial communication
- Design interfacing of peripherals to 8051 Microcontroller

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreducedto60marksasSEEmarksis60.

Text Books:

1. "The8051MicrocontrollerandEmbeddedSystems–usingassemblyandC",MuhammadAliMazidi andJaniceGillespieMazidiandRollinD.McKinlay;PHI,2006/Pearson,2006.
2. "The8051Microcontroller",KennethJ.Ayala,3rdEdition,Thomson/CengageLearning.

Reference Books:

1. "The8051MicrocontrollerBasedEmbeddedSystems",ManishKPatel,McGrawHill,2014,ISBN: 978-93-329-0125-4.
2. "Microcontrollers:Architecture,Programming,InterfacingandSystemDesign",RajKamal,Pearson Education,2005.

Web Link and Video Lectures:

1. www.edx.org/learn/microcontrollers
2. www.nptel.ac.in/courses/108/105/108105102/

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – IV

MICROCONTROLLER LABORATORY

Laboratory Code	**18ECL47**	**CIE Marks**	**40**
Number ofLectureHours/Week	**02Hr Tutorial (Instructions) + 02 Hours Laboratory**	**SEE Marks**	**60**
RBT Levels	**L1, L2, L3**	**Exam Hours**	**03**

CREDITS – 02

Course Learning Objectives: This laboratory course enables students to

- Understand the basics of microcontroller and itsapplications.
- Have in-depth knowledge of 8051 assembly languageprogramming.
- Understand controlling the devices using Cprogramming.
- The concepts of I/O interfacing for developing real time embeddedsystems.

Laboratory Experiments

I. PROGRAMMING

1. DataTransfer:BlockMove,Exchange,Sorting,Findinglargestelementinanarray.
2. Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bitaddressable).
3. Counters.
4. Boolean & Logical Instructions (Bitmanipulations).
5. Conditional CALL &RETURN.
6. Codeconversion:BCD–ASCII;ASCII–Decimal;Decimal-ASCII;HEX-DecimalandDecimal- HEX.
7. Programstogeneratedelay,Programsusingserialportandon-Chiptimer/counter.

II. INTERFACING

1. Interface a simple toggle switch to 8051 and write an ALP to generate an interrupt which switches on an LED (i) continuously as long as switch is on and (ii) only once for a small time when the switch is turnedon.
2. Write a C program to (i) transmit and (ii) to receive a set of characters serially by interfacing 8051 to a terminal.
3. Write ALPs to generate waveforms using ADCinterface.
4. Write ALP to interface an LCD display and to display a message onit.
5. Write ALP to interface a Stepper Motor to 8051 to rotate themotor.
6. Write ALP to interface ADC-0804 and convert an analog input connected toit.

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

- Develop Assembly level program for transferring data and to perform arithmetic operations like addition, multiplication etc
- Develop Assembly level program to act as a counter using subroutine
- Make use of timers for generating the delay and serial communication ports for transferring the data serially
- Examine the use of interrupts in controlling the switches connected to the ports
- Test for the working of interface like ADC ,stepper motor, LCD etc

Conduct of Practical Examination:

- All laboratory experiments are to be includedforpractical examination.
- Students are allowed to pick one experiment from thelot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup ofmarks.
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be madezero.

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – IV

ANALOG CIRCUITS LABORATORY

Laboratory Code	**18ECL48**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**02Hr Tutorial (Instructions) + 02 Hours Laboratory**	**SEE Marks**	**60**
RBT Level	**L1, L2, L3**	**Exam Hours**	**03**

CREDITS – 02

Course Learning Objectives: This laboratory course enables students to

- Understand the circuit configurations and connectivity of BJT and FET Amplifiers and Study of frequencyresponse
- Design and test of analog circuits usingOPAMPs
- Understand the feedback configurations of transistor and OPAMPcircuits
- Use of circuit simulation for the analysis of electroniccircuits.

Laboratory Experiments

PART A : Hardware Experiments

1. Design and setup the Common Source JFET/MOSFET amplifier and plot the frequency response.
2. Design and set up the BJT common emitter voltage amplifier with and without feedback and determine the gain- bandwidth product, input and output impedances.
3. Design and set-up BJT/FET i) Colpitts Oscillator, and ii) Crystal Oscillator
4. Design active second order Butterworth low pass and high pass filters.
5. Design Adder, Integrator and Differentiator circuits using Op-Amp
6. Test a comparator circuit and design a Schmitt trigger for the given UTP and LTP values and obtain the hysteresis.
7. Design 4 bit R – 2R Op-Amp Digital to Analog Converter (i) using 4 bit binary input from toggle switches and (ii) by generating digital inputs using mod-16 counter.
8. Design Monostable and a stable Multivibrator using 555 Timer.

PART-B : Simulation using EDA software (EDWinXP, PSpice, MultiSim, Proteus, CircuitLab or any other equivalent tool can be used)

1. RC Phase shift oscillator and Hartley oscillator
2. Narrow Band-pass Filter and Narrow band-reject filter
3. Precision Half and full wave rectifier
4. Monostable and A stable Multivibrator using 555 Timer.

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

- Design and test the setup of BJT and FET amplifiers and study its frequency response.
- Design and test oscillators by calculating its frequency of oscillations.
- Design and analyze the applications of Op-Amps for DACs, Filters, Schmitt Trigger, and adder, Integrator and differentiator circuits.
- Analyze and test the Multivibrators using 555 Timer.
- Analyze and implement the circuits of Oscillators, Filters, Rectifiers and Multivibrators using BJTs, ICs 741 and 555 through simulation software.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practicalexamination.
- Students are allowed to pick one experiment from thelot.
- Strictlyfollowtheinstructionsasprintedonthecoverpageofanswerscriptforbreakupofmarks.
- ChangeofexperimentisallowedonlyonceandMarksallottedtotheprocedureparttobemadezero.

Reference Books:

1. David A Bell, "Fundamentals of Electronic Devices and Circuits Lab Manual, 5th Edition, 2009, Oxford University Press.

B. E. Common to all Programmes
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE)
SEMESTER -IV

ADDITIONAL MATHEMATICS – II

(Mandatory Learning Course: Common to All Programmes)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B. Tech. programmes)

Course Code	**18MATDIP41**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:1:0)	SEE Marks	60
Credits	**0**	Exam Hours	03

Course Learning Objectives:

- Toprovideessentialconceptsoflinearalgebra,second&higherorderdifferentialequations along with methods to solvethem.
- To provide an insight into elementary probability theory and numericalmethods.

Module-1

Linear Algebra: Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and Eigen vectors of a square matrix. Problems.

Module-2

Numerical Methods: Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)- Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems.

Module-3

Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators.*[Particular Integral restricted to R(x)=* e^{ax}, sin *ax* /cos *ax for* $\frac{1}{f(D)}y = R(x)$.]

Module-4

Partial Differential Equations (PDE's):- Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.

Module-5

Probability: Introduction. Sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes's theorem, problems.

Course Outcomes: At the end of the course the student will be able to:
CO1: Solve systems of linear equations using matrix algebra.
CO2:Applytheknowledgeofnumericalmethodsinmodellingandsolvingengineeringproblems.
CO3:Makeuseofanalyticalmethodstosolvehigherorderdifferentialequations.
CO4:Classifypartialdifferentialequationsandsolvethembyexactmethods.
CO5:Applyelementaryprobabilitytheoryandsolverelatedproblems.

Question paper pattern:

7. The question paper will have ten full questions carrying equalmarks.
8. Each full question will be for 20marks.

- Therewillbetwofullquestions(withamaximum offoursub-questions)fromeachmodule.
- Each full question will have sub- question covering all the topics under amodule.
- The students will have to answer five full questions, selecting one full question fromeach

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	43rd Edition, 2015
Reference Books				

1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2015
2	Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publishers	7th Edition, 2007
3	Engineering Mathematics Vol. I	Rohit Khurana	Cengage Learning	1st Edition, 2015

K.S.INSTITUTE OF TECHNOLOGY, BANGALORE

(AFFLIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM)

DEPARTMENT OF ELECTRONICS &COMMUNICATION ENGG.

DIGITAL COMMUNICATION VI

Course Title: DIGITAL COMMUNICATION **Course Code : 18EC61**
Credits:03 **L-T-P :4-0-0**
Contact Hours/Week: 04 **Total Hours:50**
Exam. Marks:100 **IA Marks :30**
Exam. Hours : 03

Course Learning Objectives: This course will enable students to:

- Understand the mathematical representation of signal, symbol, andnoise.
- Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter andreceiver.
- Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channelconditions.
- Compute performance parameters and mitigate channel induced impediments in corrupted channel conditions.

Module-1	RBT Level
Bandpass Signal to Equivalent Low pass: Hilbert Transform, Pre-envelopes, Complex envelopes, Canonical representation of bandpass signals, Complex low pass representation of bandpass systems, Complex representation of band pass signals and systems **(Text 1: 2.8, 2.9, 2.10, 2.11, 2.12, 2.13).** **Line codes:** Unipolar, Polar, Bipolar (AMI) and Manchester code and their power spectral densities **(Text 1: Ch 6.10).** Overview of HDB3, B3ZS, B6ZS **(Ref. 1: 7.2)**	**L1,L2,L3**
Module-2	
Signaling over AWGN Channels- Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vectorchannel,Optimumreceiversusingcoherentdetection:MLDecoding,Correlationreceiver, matched filter receiver **(Text 1: 7.1, 7.2, 7.3,7.4).**	**L1,L2,L3**
Module – 3	
Digital Modulation Techniques: Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM **(Relevant topics in Text 1 of 7.6, 7.7).** Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability **(Relevant topics in Text 1 of 7.8).** Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams treatment of Transmitter and Receiver, Probability of error (without derivationof probability of error equation) **(Text 1: 7.11, 7.12. 7.13).**	**L1,L2,L3**
Module-4	
CommunicationthroughBandLimitedChannels:DigitalTransmissionthroughBandlimited channels: Digital PAM Transmission through Band limited Channels, Signal design for Band limited Channels: Design of band limited signals for zero ISI–The Nyquist Criterion (statement only),Designofbandlimitedsignalswithcontrolled ISI-PartialResponsesignals,Probabilityof error for detection of Digital PAM: Probability of error for detection of Digital PAM with Zero ISI,Symbol–by–Symboldetectionofdatawithcontrolled ISI**(Text2:9.1,9.2,9.3.1,9.3.2).** Channel Equalization: Linear Equalizers (ZFE, MMSE), **(Text 2: 9.4.2).**	**L1,L2,L3**
Module-5	
Principles of Spread Spectrum: Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Effect of De-spreading on a narrowband Interference, Probability of error (statement only), Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum, CDMA based on IS-95 **(Text 2: 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.4.2).**	**L1,L2,L3**

Course Outcomes: At the end of the course, the students will be able to:

- Develop the concepts of Band pass sampling to well specified signals and channels.
- Utilize the performance parameters and transfer rates for low pass and bandpass symbol under ideal and corrupted non band limited channels.
- Identify valid symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels.
- Identify the bandpass signals when subjected to corruption and distortion during transmission over a bandlimited channel.
- Identify the need for data security using spread spectrum technique and error rate calculation.

- Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimitedchannels.
- Demonstrate that bandpass signals subjected to corruption and distortion in a bandlimited channelcanbeprocessedatthereceivertomeetspecifiedperformancecriteria.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Books:

1. SimonHaykin,"DigitalCommunicationSystems",JohnWiley&sons,FirstEdition,2014,ISBN978- 0-471-64735-5.
2. JohnGProakisandMasoudSalehi,"FundamentalsofCommunicationSystems",2014Edition,Pearson Education, ISBN 978-8-131-70573-5.

Reference Books:

1. B.P.LathiandZhiDing,"ModernDigitalandAnalogcommunicationSystems",OxfordUniversity Press, 4th Edition, 2010, ISBN:978-0-198-07380-2.
2. IanAGloverandPeterMGrant,"DigitalCommunications",PearsonEducation,ThirdEdition,2010, ISBN978-0-273-71830-7.
3. Bernard Sklar and Ray, "Digital Communications - Fundamentals and Applications", Pearson Education, Third Edition, 2014, ISBN:978-81-317-2092-9.

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VI

EMBEDDED SYSTEMS

Course Code	**18EC62**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03+2 (Tutorial)**	**SEE Marks**	**60**
		Exam Hours	**03**

CREDITS – 04

Course Learning Objectives: This course will enable students to:

- Explainthearchitecturalfeaturesandinstructionsof32bitmicrocontroller-ARMCortexM3.
- DevelopProgramsusingthevariousinstructionsofARMCortexM3andClanguagefordifferent applications.
- Understandthebasichardwarecomponentsandtheirselectionmethodbasedonthecharacteristicsand attributes of an embeddedsystem.
- Develop the hardware software co-design and firmware designapproaches.
- Explain the need of real time operating system for embedded systemapplications.

Module1	**RBT Level**
ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence **(Text 1: Ch-1, 2, 3)**	**L1,L2**
Module2	
ARM Cortex M3 Instruction Sets and Programming: Assembly basics, Instruction list and description, Thumb and ARM instructions, Special instructions, Useful instructions, CMSIS, Assembly and C language Programming **(Text 1: Ch-4, Ch-10.1 to 10.6)**	**L1,L2, L3**
Module3	
Embedded System Components: Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Elements of an Embedded System (Block diagram and explanation), Differences between RISC and CISC, Harvard and Princeton, Big and LittleEndianformats,Memory(ROMandRAMtypes),Sensors,Actuators, Optocoupler,CommunicationInterfaces(I2C,SPI,IrDA,Bluetooth,Wi-Fi, Zigbeeonly) **(Text2:AlltheTopicsfromCh-1andCh-2(Figandexplanationbefore2.1)2.1.1.6to 2.1.1.8,2.2to2.2.2.3,2.3to2.3.2,2.3.3.3,selectedtopicsof2.4.1and2.4.2only)**.	**L1,L2**
Module4	
Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling (excluding UML), Embedded firmware design and development (excluding C language). **Text 2: Ch-3, Ch-4 (4.1, 4.2.1 and 4.2.2 only), Ch-7 (Sections 7.1, 7.2 only), Ch-9 (Sections 9.1, 9.2, 9.3.1, 9.3.2 only)**	**L1,L2, L3**
Module5	
RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), HowtochooseanRTOS,IntegrationandtestingofEmbeddedhardwareandfirmware,Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques **(Text 2: Ch-10 (Sections 10.1, 10.2, 10.3, 10.5.2, 10.7,10.8.1.1,10.8.1.2,10.8.2.2,10.10only),Ch-12,Ch-13(ablockdiagrambefore13.1,13.3, 13.4, 13.5, 13.6 only)**	**L1,L2, L3**

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

- Construct the architectural features and instructions of 32 bit microcontroller ARM Cortex M3.
- Make use of the knowledge gained for Programming ARM Cortex M3 for different applications.
- Identify the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Develop the hardware/software co-design and firmware design using ARM Cortex M3.Instruction set.
- Analyze the need of real time operating system for embedded system applications.

Question paperpattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

TextBooks:

1. JosephYiu,"TheDefinitiveGuidetotheARMCortex-M3",2nd Edition,Newnes,(Elsevier),2010.
2. ShibuKV,"IntroductiontoEmbeddedSystems",TataMcGrawHillEducationPrivateLimited,2nd Edition.

Reference Books:

1. JamesK.Peckol,"Embeddedsystems-Acontemporarydesigntool",JohnWiley,2008,ISBN:978-0- 471-72180-2.
2. YifengZhu,"EmbeddedSystemswithArmCortex-MMicrocontrollersinAssemblyLanguageand C", 2nd E -Man Press LLC ©2015 ISBN:098269263397809826926 39.
3. EmbeddedrealtimesystemsbyK.V.K.KPrasad,Dreamtechpublications,2003.
4. Embedded Systems by Rajkamal, 2nd Edition, McGraw hill Publications,2010.

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VI

MICROWAVE and ANTENNAS

Course Code	**18EC63**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03+02(Tutorial)**	**SEE Marks**	**60**
		Exam Hours	**03**

CREDITS – 04

Course Learning Objectives: This course will enable students to:

- Describe the microwave properties and its transmissionmedia
- Describe microwave devices for severalapplications
- Understandthebasicsofantennatheory
- Selectantennasforspecificapplications

Module1	**RBT Level**
Microwave Tubes: Introduction, Reflex Klystron Oscillator, Mechanism of Oscillations, Modes of Oscillations, Mode Curve (Qualitative Analysis only). **(Text 1: 9.1, 9.2.1)** **Microwave Transmission Lines:** Microwave Frequencies, Microwave devices, Microwave Systems, Transmission Line equations and solutions, Reflection Coefficient and Transmission Coefficient, Standing Wave and Standing Wave Ratio, Smith Chart, Single Stub matching. **(Text 2: 0.1, 0.2, 0.3, 3.1, 3.2, 3.3, 3.5, 3.6 Except Double stub matching**)	**L1,L2**
Module2	
Microwave Network theory: Introduction**,** Symmetrical Z and Y-Parameters for reciprocal Networks, S matrix representation of Multi-Port Networks. **(Text1: 6.1, 6.2, 6.3)** **Microwave Passive Devices:** Coaxial Connectors and Adapters, Attenuators, Phase Shifters, Waveguide Tees, Magic tees. **(Text 1: 6.4.2, 6.4.14, 6.4.15, 6.4.16)**	**L1,L2**
Module3	
Strip Lines: Introduction, Micro Strip lines, Parallel Strip lines, Coplanar Strip lines, Shielded Strip Lines**. (Text 2: 11.1, 11.2, 11.3, 11.4)** **Antenna Basics**: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Radio Communication Link, Antenna Field Zones. **(Text 3: 2.1 - 2.7, 2.9 – 2.11, 2.13)**	**L1,L2,L3**
Module4	
Point Sources and Arrays: Introduction, Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Arrays of two isotropic point sources, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing.**(Text 3: 5.1 – 5.6, 5.9, 5.13)** **Electric Dipoles:** Introduction, Short Electric Dipole, Fields of a Short Dipole, Radiation Resistance of a Short Electric Dipole, Thin Linear Antenna (Field Analyses) **(Text 3: 6.1 - 6.5)**	**L1,L2,L3, L4**
Module5	
LoopandHornAntenna: Introduction,Smallloop,TheLoopAntennaGeneralCase,TheLoop Antenna as a special case, Radiation resistance of loops, Directivity of Circular Loop Antennas with uniform current, Horn antennas Rectangular Horn Antennas.**(Text 3: 7.1, 7.2, 7.4, 7.6,7.7, 7.8, 7.19, 7.20)** **Antenna Types**: The Helix geometry, Helix modes, Practical Design considerations for the mono-filaraxialmodeHelicalAntenna,Yagi-Udaarray,Parabolicreflector**(Text3:8.3,8.4,8.5, 8.8, 9.5)**	**L1,L2,L3**

Course outcomes: At the end of the course students will be able to:

- Apply Smith charts to find solutions to transmission line problems.
- Analyze passive microwave devices using S-parameters
- Evaluate various parameters and characteristics of the microwave strip lines and devices.
- Estimate radiation patterns and performance parameters of n-isotropic antennas
- Recommend various antenna configurations based on application

Question paperpattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.

Text Books:

1. **MicrowaveEngineering**–AnnapurnaDas,SisirKDas,TMH,Publication,2nd,2010.
2. **Microwave Devices and circuits**- Samuel Y Liao, PearsonEducation
3. **Antennas and Wave Propagation**- John D. Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education,2013

Reference Books:

1. **MicrowaveEngineering**-DavidMPozar,JohnWileyIndiaPvt.Ltd.,3rdEdn,2008.
2. **Microwave Engineering** – Sushrut Das, Oxford Higher Education, 2ndEdn,2015
3. **AntennasandWavePropagation**–HarishandSachidananda:OxfordUniversity Press,2007

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VI

OPERATING SYSTEM

Course Code	**18EC641**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours /Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand the services provided by an operatingsystem.
- Explain how processes are synchronized andscheduled.
- Understanddifferentapproachesofmemorymanagementandvirtualmemorymanagement.
- Describe the structure and organization of the filesystem
- Understand interprocess communication and deadlocksituations.

Module-1	**RBT Level**
Introduction to Operating Systems OS, Goals of an OS, Operation of an OS, Computational Structures, Resource allocation techniques, Efficiency, System Performance and User Convenience, Classes operating System, Batchprocessing,Multiprogramming,TimeSharingSystems,RealTimeanddistributedOperating Systems**(Topics from Sections 1.2, 1.3, 2.2 to 2.8 ofText).**	**L1,L2**
Module-2	
Process Management: OS View of Processes, PCB, Fundamental State Transitions of a process, Threads, Kernel and User level Threads, Non-preemptive scheduling- FCFS and SRN, Preemptive Scheduling- RR and LCN, Scheduling in Unix and Scheduling in Linux **(Topics from Sections 3.3, 3.3.1 to 3.3.4, 3.4, 3.4.1, 3.4.2 , Selected scheduling topics from 4.2 and 4.3 , 4.6, 4.7 of Text).**	**L1,L2,L3**
Module – 3	
Memory Management: Contiguous Memory allocation, Non-Contiguos Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, VM handler, FIFO, LRU page replacement policies, Virtual memory in Unix and Linux**(Topics from Sections 5.5 to 5.9, 6.1 to 6.3 except Optimal policy and 6.3.1, 6.7,6.8 of Text).**	**L1,L2,L3**
Module-4	
File Systems: File systems and IOCS, File Operations, File Organizations, Directory structures, FileProtection,InterfacebetweenFilesystemandIOCS,Allocationofdiskspace,Implementing fileaccess **(Topics from Sections 7.1 to 7.8 of Text).**	**L1,L2**
Module-5	
Message Passing and Deadlocks: Overview of Message Passing, Implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling deadlocks, Deadlock detection algorithm, Deadlock Prevention **(Topics from Sections 10.1 to 10.3, 11.1 to 11.5 of Text).**	**L1,L2**

Course Outcomes: At the end of the course, the students will be able to:

- Explain the goals, structure, operation and types of operatingsystems.
- Apply scheduling techniques to find performancefactors.
- Explain organization of file systems andIOCS.
- Apply suitable techniques for contiguous and non-contiguous memoryallocation.
- Describe message passing, deadlock detection and preventionmethods.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthe module.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Book:

Operating Systems – A concept based approach, by Dhamdhere, TMH, 2nd edition.

Reference Books:

1. Operatingsystemsconcepts,SilberschatzandGalvin,JohnWileyIndiaPvt.Ltd,5thedition,2001.
2. Operatingsystem–internalsanddesignsystem,WilliamStalling,PearsonEducation,4thed,2006.
3. Design of operating systems, Tannanbhaum, TMH,2001.

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VI

ARITIFICAL NEURAL NETWORKS

Course Code	**18EC642**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours / Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand the basics of ANN and comparison with Humanbrain.
- AcquireknowledgeonGeneralizationandfunctionapproximationofvariousANNarchitectures.
- Understand reinforcement learning using neuralnetworks
- Acquire knowledge of unsupervised learning using neuralnetworks.

Module-1	**RBT**
Introduction: Biological Neuron – Artificial Neural Model - Types of activation functions – **Architecture**: Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks. **Learning:** Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem.	**L1, L2**
Module-2	
Supervised Learning: Perceptron learning and Non Separable sets, α-Least Mean Square Learning,MSEErrorsurface,SteepestDescentSearch,μ-LMSapproximatetogradientdescent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Back propagation Learning Algorithm, Practical consideration of BPalgorithm.	**L1,L2, L3**
Module-3	
Support Vector Machines and Radial Basis Function: Learning from Examples, Statistical Learning Theory, Support Vector Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.	**L1,L2, L3**
Module-4	
Attractor Neural Networks: Associative Learning Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neuralNetwork,SimulatedAnnealing,BoltzmannMachine,BidirectionalAssociativeMemory.	**L1,L2, L3**
Module-5	
Self-organization Feature Map: Maximal Eigenvector Filtering, Extracting Principal Components,GeneralizedLearningLaws,VectorQuantization,Self-organizationFeatureMaps, Application of SOM, Growing NeuralGas.	**L1,L2, L3**

Course Outcomes: At the end of the course, students should be able to:

- Understandtheroleofneuralnetworksinengineering,artificialintelligence,andcognitivemodelling.
- Understand the concepts and techniques of neural networks through the study of the most important neural networkmodels.
- Evaluate whether neural networks are appropriate to a particularapplication.
- Apply neural networks to particular application, and to know what steps to take to improve performance.

Question paperpattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Book:

NeuralNetworksAClassroomApproach–SatishKumar,McGrawHillEducation(India)Pvt.Ltd,Second Edition.

Reference Books:

1. **Introduction to Artificial Neural Systems**-J.M. Zurada, Jaico Publications1994.
2. **Artificial Neural Networks**-B. Yegnanarayana, PHI, New Delhi1998.

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER –VI

DATA STRUCTURE USING C++

Course Code	**18EC643**	IA Marks	40
Number of Lecture Hours/Week	03	Exam Marks	60
Total Number of Lecture/ Hours	40 (08 Hrs per Module)	Exam Hours	03

CREDITS – 03

Course Learning Objectives: This course will enable students to

- Solve the problems using object orientedapproach
- Explain fundamentals of data structures and their applications essential for programming/problemsolving
- Analyze Linear Data Structures: Stack, Queues,Lists
- Analyze Non Linear Data Structures:Trees
- Assess appropriate data structure during program development/ProblemSolving

Module-1

INTRODUCTION: C++ and itsfeatures,Data types, Variables, Operators, Expressions, Control structures, classes and Objects, Functions and parameters, function overloading, Recursion, Constructors, DestructorsandOperator overloading, Inheritance, Polymorphism, Programming examples. L1,L2

Module -2

ARRAYS AND MATRICES: Arrays, Matrices, Special matrices, Sparse matrices.
POINTERS: Pointers, Dynamic memory allocation
LINEAR LISTS: Data objects and structures, Introduction to Linear and Non Linear data structures, Linear list data structures, Array Representation, Vector Representation, Singly Linked lists and chains. L1, L2

Module -3

STACKS: The abstract data types, Array Representation, Linked Representation, Applications – Parsing and Evaluation of arithmetic expressions, Parenthesis Matching & Towers of Hanoi. L1, L2,L3

Module -4

QUEUES: The abstract data types, Array Representation, Linked Representation, Applications-Railroad car arrangement, Priority Queues
HASHING: Dictionaries, Linear representation, Hash table representation. L1, L2, L3

Module -5

TREES: Binary trees, Properties and representation of binary trees, Common binary tree operations, Binary tree traversal the ADT binary tree, ADT binary tree and the class linked binary tree. Binary search trees operations and implementation. Heaps, Applications-Heap Sorting L1, L2,L3

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

- Acquire knowledge of Dynamic memory allocation, Various types of data structures, operations and algorithms and Sparse matrices andHashing
- Understand non Linear data structures trees and theirapplications
- Design appropriate data structures for solving computingproblems
- Analyze the operations of Linear Data structures: Stack, Queue and LinkedList and their applications

Text Book:

1. Data structures, Algorithms, and applications in C++, SartajSahni, Universities Press, 2nd Edition, 2005.

Reference Books:

2. Object Oriented Programming with C++, E.Balaguruswamy, TMH, 6th Edition, 2013.

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VI

DIGITAL SYSTEM DESIGN USING VERILOG

Course Code	**18EC644**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (08 Hrs per module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to

- Understand the concepts of VerilogLanguage.
- Design the digital systems as an activity in a larger systems designcontext.
- Study the design and operation of semiconductor memories frequently used in application specific digitalsystem.
- InspecthoweffectivelyIC'sareembeddedinpackageandassembledinPCB'sfordifferent application.
- DesignanddiagnosisofprocessorsandI/Ocontrollersused inembeddedsystems.

Module -1	**RBT Level**
Introduction and Methodology: Digital Systems and Embedded Systems, Real-World Circuits, Models, Design Methodology **(1.1, 1.3 to 1.5 of Text).** **Combinational Basics:** Combinational Components and Circuits, Verification of Combinational Circuits **(2.3 and 2.4 of Text**). **Number Basics:** Unsigned integers, Signed Integers, Fixed point Numbers, Floating point Numbers **(3.1.1, 3.2.1, 3.3.1 and 3.4).** **Sequential Basics**: Sequential Datapaths and Control Clocked Synchronous Timing Methodology **(4.3 up to 4.3.1, 4.4 up to 4.4.1 of Text).**	**L1,L2, L3**
Module -2	
Memories: Concepts, Memory Types, Error Detection and Correction **(Chap 5 of Text).**	**L1,L2, L3**
Module -3	
Implementation Fabrics: Integrated Circuits, Programmable Logic Devices, Packaging and Circuit boards, Interconnection and Signal integrity **(Chap 6 of Text).**	**L1,L2, L3**
Module -4	
I/O interfacing: I/O devices, I/O controllers, Parallel Buses, Serial Transmission, I/O software **(Chap 8 of Text).**	**L1,L2, L3**
Module -5	
Design Methodology: Design flow, Design optimization, Design for test, Nontechnical Issues **(Chap 10 of Text).**	**L1,L2, L3, L4**

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

- Constructthecombinationalcircuits,usingdiscretegatesandprogrammablelogicdevices.
- Describe how arithmetic operations can be performed for each kind of code, and also combinational circuits that implement arithmeticoperations.
- Design a semiconductor memory for specific chipdesign.
- Design embedded systems using small microcontrollers, larger CPUs/DSPs, or hard or soft processorcores.
- Synthesize different types of I/O controllers that are used in embeddedsystem.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.

- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Book:

Peter J. Ashenden, “Digital Design: An Embedded Systems Approach Using VERILOG”, Elesvier, 2010.

Reference Books:

1. Ming-BoLin,“DigitalSystemDesignsandPractices:UsingVerilogHDLandFPGAs”,Wiley,2008
2. Charles Roth,Lizy K. John,“ByeongKilLeeDigital Systems Design Using Verilog, Cengage”, Cengage, 1stEdition.
3. Donald E. Thomas, Philip R. Moorby, “The Verilog Hardware Description Language”, Springer, Fifth edition.
4. Michael D. Ciletti, “Advanced Digital Design with the Verilog HDL” Pearson (Prentice Hall), Second edition.

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VI

NANOELECTRONICS

Course Code	**18EC645**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8 Hours / Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Enhancebasicengineeringscienceand technicalknowledgeofNanoelectronics.
- Explainbasicsoftop-downandbottom-upfabricationprocess,devicesandsystems.
- Describe technologies involved in modern day electronicdevices.
- Knowvariousnanostructuresofcarbon andthenatureofthecarbonbonditself.
- Learn the photo physical properties of sensor used in generating asignal.

Module-1	RBT Level
Introduction: Overview of nanoscience and engineering. Development milestones in microfabricationandelectronicindustry.Moore'slawandcontinuedminiaturization,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).**	**L1, L2**
Module-2	
Characterization: Classification, Microscopic techniques, Field ion microscopy,scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques **(Text 1).** **Inorganic semiconductor nanostructures:** overview of semiconductor physics. Quantum confinementinsemiconductornanostructures:quantumwells,quantumwires,quantumdots,super-lattices, band offsets, electronic density of states **(Text1).**	**L1, L2**
Module-3	
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.**(Text 1).** **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).**	**L1, L2**
Module-4	
Carbon Nanostructures: Carbon molecules, Carbon Clusters, Carbon Nanotubes, application of Carbon Nanotubes. **(Text 2)**	**L1, L2**
Module-5	
Nanosensors: Introduction,WhatisSensorandNanosensors?,WhatmakesthemPossible?,Order From Chaos, Characterization, Perception, NanosensorsBased On Quantum Size Effects, Electrochemical Sensors, Sensors Based On Physical Properties, Nanobiosensors, Smart dust Sensor for the future. **(Text3)** **Applications:** Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIP's, NEMS, MEMS **(Text 1).**	**L1, L2**

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

- Understand the principles behind Nanoscience engineering andNanoelectronics.
- Know the effect of particles size on mechanical, thermal, optical and electrical properties of nanomaterials.
- Knowthepropertiesofcarbonandcarbonnanotubesanditsapplications.

- Knowthepropertiesusedforsensingandtheuseofsmartdustsensors.
- Apply the knowledge to prepare and characterizenanomaterials.
- Analyse the process flow required to fabricate state-of-the-art transistortechnology.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Books:

1. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley, 2007.
2. CharlesPPoole,Jr,FrankJOwens,"IntroductiontoNanotechnology", John Wiley, Copyright 2006, Reprint2011.
3. TPradeep,"Nano:Theessentials-UnderstandingNanoscienceandNanotechnology",TMH.

Reference Book:

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

B. E. ECE
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VI

PYTHON APPLICATION PROGRAMMING

Subject Code	**18EC 646**	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course Learning Objectives: This course will enable students to

- Learn Syntax and Semantics and create Functionsin Python.
- Handle Strings and Files inPython.
- UnderstandLists,DictionariesandRegularexpressionsin Python.
- ImplementObjectOrientedProgrammingconceptsinPython
- Build Web Services, Network and Database Programs inPython.

Module – 1	**Teaching Hours**
Why should you learn to write programs, Variables, expressions and statements, Conditional execution, Functions	**8 Hours**
Module – 2	
Iteration, Strings, Files	**8 Hours**
Module – 3	
Lists, Dictionaries, Tuples, Regular Expressions	**8 Hours**
Module – 4	
Classes and objects, Classes and functions, Classes and methods	**8 Hours**
Module – 5	
Networked programs, Using Web Services, Using databases and SQL	**8 Hours**

Course outcomes: The students should be able to:

- ExaminePythonsyntaxandsemanticsandbefluentin theuseof Pythonflowcontrolandfunctions.
- DemonstrateproficiencyinhandlingStringsandFileSystems.
- Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use RegularExpressions.
- InterprettheconceptsofObject-OrientedProgrammingasusedinPython.
- ImplementexemplaryapplicationsrelatedtoNetworkProgramming,WebServicesandDatabasesin Python.

Question paper pattern:

- The question paper will have TENquestions.
- TherewillbeTWOquestionsfromeachmodule.
- Eachquestionwillhavequestionscoveringallthetopicsunderamodule.
- ThestudentswillhavetoanswerFIVEfullquestions,selectingONEfullquestionfromeachmodule.

Text Books:

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, Create Space Independent Publishing Platform, 2016 (Chapters 1 – 13,15).
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015 (Chapters15,16,17)

References:

1. Mark Lutz, "Programming Python", 4th Edition, O'Reilly Media, 2011.ISBN-13: 978-9350232873.
2. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13:978-9332555365.
3. Reema Thareja, "Python Programming using problem solving approach", Oxford university press,2017

OPEN ELECTIVES-A OFFERED BY EC/TC BOARD

B. E. EC/TE ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VI			
SIGNAL PROCESSING			
Course Code	**18EC651**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8Hours/Module)**	**Exam Hours**	**03**
CREDITS – 03			

Course objective: This course will enable students to:

- Understand,representandclassifycontinuoustimeanddiscretetimesignalsandsystems,togetherwith the representation of LTIsystems.
- Ability to represent continuous time signals (both periodic and non-periodic) in the time domain, s-domain and the frequencydomain
- Understandthepropertiesofanalogfilters,andhavetheabilitytodesignButterworthfilters
- Understand and apply sampling theorem and convert a signal from continuous time to discrete time or from discrete time to continuous time (without loss ofinformation)
- Able to represent the discrete time signal in the frequencydomain
- Able to design FIR and IIR filters to meet givenspecifications

Module-1	RBT Level
Signal Definition, Signal Classification, System definition, System classification, for both continuous time and discrete time. Definition of LTI systems **(Chapter 1)**	**L1, L2**
Module-2	
Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems, **(Chapter 3)**	**L1, L2**
Module-3	
Frequency response of ideal analog filters, Salient features of Butterworth filters Design and implementation of Analog Butterworth filters to meet given specifications **(Chapter 8)**	**L1,L2, L3**
Module-4	
Sampling Theorem- Statement and proof, converting the analog signal to a digital signal. Practical sampling. The Discrete Fourier Transform, Properties of DFT. Comparing the frequency response of analog and digital systems. (FFT not included) **(Chapter 3, 4)**	**L1,L2, L3**
Module-5	
Definition of FIR and IIR filters. Frequency response of ideal digital filters Transforming the Analog Butterworth filter to the Digital IIR Filter using suitable mapping techniques, to meet given specifications. Design of FIR Filters using the Window technique, and the frequency sampling technique to meet given specifications Comparing the designed filter with the desired filter frequency response **(Chapter 8)**	**L1,L2, L3**

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

- Understandandexplaincontinuoustimeanddiscretetimesignalsandsystems,intimeandfrequency domain
- Applytheconceptsofsignalsandsystemstoobtainthedesiredparameter/representation
- Analysethegivensystemandclassifythesystem/arriveatasuitableconclusion
- Design analog/digital filters to meet givenspecifications
- Design and implement the analog filter using components/ suitable simulationtools *(assignment component)*
- Designandimplementthedigitalfilter(FIR/IIR)usingsuitablesimulationtools,andrecordtheinput and output of the filter for the given audio signal *(assignmentcomponent)*

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Book:

'Signals and Systems', by Simon Haykin and Barry Van Veen, Wiley.

References:

1. 'Theory and Application of Digital Signal Processing', Rabiner andGold
2. 'Signals and Systems', Schaum's Outlineseries
3. 'Digital Signal Processing', Schaum's Outlineseries

B. E. EC/TC
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE)
SEMESTER –VI

SENSORS and SIGNAL CONDITIONING

Course Code	**18EC652**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE marks**	**60**
Total Number of Lecture Hours	**40 (08 Hrs/module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand various technologies associated in manufacturing ofsensors
- Acquire knowledge about types of sensors used in modern digitalsystems
- Get acquainted about material properties required to makesensors

Module 1	**RBT Level**
Introduction to sensor bases measurement systems: General concepts and terminology, sensor classification, primary sensors, material for sensors, microsensortechnology,magnetoresistors,lightdependentresistors,resistivehygrometers,resistive gas sensors, liquid conductivitysensors **(Selected topics from ch.1 & 2 of Text)**	**L1, L2**
Module 2	
Reactance Variation and Electromagnetic Sensors: -Capacitive Sensors, Inductive Sensors, Electromagnetic Sensors. **Signal Conditioning for Reactance Variation Sensors**-Problems and Alternatives, ac Bridges CarrierAmplifiers,CoherentDetection,SpecificSignalConditionersforCapacitiveSensors, Resolver-to-Digital and Digital-to-ResolverConverters.	**L1, L2**
Module 3	
Self-generating Sensors-Thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors.	**L2,L3**
Module 4	
Digital and intelligent sensors-position encoders, resonant sensors,sensors based on quartz resonators, SAW sensors, Vibrating wire strain gages, vibrating cylinder sensors, Digitalflow meters.	**L2,L3**
Module 5	
Sensors based on semiconductor junctions -Thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, charge- coupled sensors – types of CCD imaging sensors, ultrasonic-based sensors.	**L2,L3**

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

- Appreciate various types of sensors and theirconstruction
- Use sensors specific to the end useapplication
- Design systems integrated withsensors

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreducedto60 marksasSEEmarksis60.

Text Book:

"SensorsandSignalConditioning",RamonPallásAreny,JohnG.Webster,2ndedition,JohnWileyandSons, 2000

B. E. (EC / TC)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VI

EMBEDDED SYSTEMS LAB

Course Code	**18ECL66**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**02Hr Tutorial(Instructions) + 02 Hours Laboratory**	**SEE Marks**	**60**
RBT Levels	**L1, L2, L3**	**Exam Hours**	**03**

CREDITS – 02

Course Learning Objectives: This course will enable students to:

- UnderstandtheinstructionsetofARMCortexM3,a32bitmicrocontrollerandthesoftwaretool required for programming in Assembly and Clanguage.
- ProgramARMCortexM3usingthevariousinstructionsinassemblylevellanguagefordifferent applications.
- Interface external devices and I/O with ARM CortexM3.
- DevelopClanguageprogramsandlibraryfunctionsforembeddedsystemapplications.

Laboratory Experiments

ConductthefollowingexperimentsonanARMCORTEXM3evaluationboardtolearnALPandusing evaluation version of Embedded 'C' &Keil uVision-4tool/compiler.

PART A:

1. ALP to multiply two 16 bit binarynumbers.
2. ALP to find the sum of first 10 integernumbers.
3. ALP to find the number of 0's and 1's in a 32 bitdata
4. ALP to find determine whether the given 16 bit is even orodd
5. ALP to write data toRAM

PART B:

6. Display "Hello world" message using internalUART
7. Interface and Control the speed of a DCMotor.
8. InterfaceaSteppermotorandrotateitin clockwiseandanti-clockwisedirection.
9. Interface a DAC and generate Triangular and Squarewaveforms.
10. Interface a 4x4 keyboard and display the key code on anLCD.
11. Demonstrate the use of an external interrupt to toggle an LEDOn/Off.
12. DisplaytheHexdigits0 toFona7-segmentLEDinterface,with anappropriatedelay.
13. Measure Ambient temperature using a sensor and SPI ADCIC.

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

- Apply the instruction set of 32 bit microcontroller ARM Cortex M3, and the software tool required for programming in Assembly and C language.
- Develop assembly language programs using ARM Cortex M3 for different applications
- Develop C language programs to interface external devices and I/O with ARM Cortex M3.
- Develop C language programs for embedded system applications.
- Develop C language programs which makes use of library functions for embedded system applications.

Conduction of Practical Examination:

- OneQuestionfromPARTAandoneQuestionfromPARTBtobeaskedintheexamination.
- Strictlyfollowtheinstructionsasprintedonthecoverpageofanswerscriptforbreakupofmarks.
- ChangeofexperimentisallowedonlyonceandMarksallottedtotheprocedureparttobemadezero.

B. E. ECE
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VI

COMMUNICATION LAB

Course Code	**18ECL67**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**02Hr Tutorial(Instructions) + 02 Hours Laboratory**	**SEE Marks**	**60**
RBT Levels	**L1, L2, L3**	**Exam Hours**	**03**

CREDITS – 02

Course Learning Objectives: This course will enable students to:

- Design and test the communication circuits for different analog modulationschemes.
- Design and demonstrate the digital modulationtechniques
- Demonstrate and measure the wave propagation in microstripantennas
- Characteristics of microstrip devices and measurement of itsparameters.
- Understandtheprobabilityoferrorcomputationsofcoherentdigitalmodulationschemes.

Laboratory Experiments

PART-A: Experiments No. 1 to 5 has to be performed using discrete components.

1. Amplitude Modulation andDemodulation: i) Standard AM, ii)DSBSC (LM741 and LF398 ICs can be used)
2. Frequency modulation and demodulation (IC 8038/2206 can beused)
3. Pulse sampling, flat top sampling andreconstruction
4. Time Division Multiplexing and Demultiplexing of two bandlimitedsignals.
5. FSK and PSK generation anddetection
6. Measurementoffrequency,guidewavelength,power,VSWRandattenuationinmicrowavetestbench.
7. Obtain the Radiation Pattern and Measurement of directivity and gain of microstrip dipole and Yagi antennas.
8. Determinationof
    a. Coupling and isolation characteristics of microstrip directionalcoupler.
    b. Resonance characteristics of microstrip ring resonator and computation of dielectric constant of thesubstrate.
    c. Power division and isolation of microstrip powerdivider.

PART-B: Simulation Experiments using SCILAB/MATLAB/Simulink or LabVIEW

1. Simulate NRZ, RZ, half-sinusoid and raised cosine pulses and generate eye diagram for binary polar signaling.
2. Pulse code modulation and demodulationsystem.
3. Computations of the Probability of bit error for coherent binary ASK, FSK and PSK for an AWGN Channel and Compare them with their Performancecurves.
4. DigitalModulationSchemesi)DPSKTransmitterandreceiver,ii)QPSKTransmitterandReceiver.

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

- Make use of the characteristics and response of microwave devices
- Utilize the characteristics of micros trip antennas and measurement of its parameters.
- Construct the digital modulation schemes with the display of waveforms and computation of performance parameters
- Make use of the characteristics of Optical Fibre Communication and calculate the parameters associated with it.
- Model different digital communication concepts using simulation

Conduct of Practical Examination:

- All laboratory experiments are to be considered for practicalexamination.
- Forexaminationonequestionfrom**PART-A**andonequestionfrom**PART-Bor**onlyonequestionfrom **PART-B** experiments based on the complexity, to be set.
- Students are allowed to pick one experiment from thelot.
- Strictlyfollowtheinstructionsasprintedonthecoverpageofanswerscriptforbreakupofmarks.
- ChangeofexperimentisallowedonlyonceandMarksallottedtotheprocedureparttobemadezero.

K.S.INSTITUTE OF TECHNOLOGY, BANGALORE

(AFFLIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM)

DEPARTMENT OF ELECTRONICS &COMMUNICATION ENGG.

WIRELESS AND CELLULAR COMMUNICATION VIII

Course Title: WIRELESS AND CELLULAR COMMUNICATION Course Code : 18EC81
Credits:03 L-T-P :4-0-0
Contact Hours/Week: 04 Total Hours:50
Exam. Marks:100 IA Marks :30
Exam. Hours : 03

Course Learning Objectives: This course will enable students to:

- Understandtheconceptsofpropagationoverwirelesschannelsfromaphysicsstandpoint
- Application of Communication theory both Physical and networking to understand GSM systems that handle mobiletelephony
- ApplicationofCommunicationtheorybothPhysicalandnetworkingtounderstandCDMAsystemsthat handle mobiletelephony.
- ApplicationofCommunicationtheorybothPhysicalandnetworkingtounderstandLTE-4Gsystems.

Module-1	RBT Level
Mobile Radio Propagation – Large Scale Path Loss - Free Space Propagation Model, Relating Power to Electric Field, Three Basic Propagation Mechanisms – Reflection (Ground Reflection) , Diffraction, Scattering, Practical Link Budget, **(Text 1 - 2.2 and Ref1 - Chapter 4).** **Fading and Multipath** – Broadband wireless channel, Delay Spread and Coherence Bandwidth, Doppler Spread and Coherence Time, Angular spread and Coherence Distance **(Text 1 – 2.4)** , Statistical Channel Model of a Broadband Fading Channel **(Text 1 – 2.5.1)** **The Cellular Concept** – Cellular Concept , Analysis of Cellular Systems, Sectoring **(Text 1-2.3)**	**L1, L2**
Module-2	
GSM and TDMA Technology **GSM System overview** – Introduction, GSM Network and System Architecture, GSM Channel Concept. **GSM System Operations** – GSM Identities, System Operations –Traffic cases, GSM Infrastructure Communications (Um Interface) **(Text 2, Part1 and Part 2 of Chapter 5)**	**L1,L2,L3**
Module-3	
CDMA Technology **CDMA System Overview** – Introduction, CDMA Network and System Architecture **CDMABasics**–CDMAChannelConcepts,CDMASystem(Layer3)operations,3GCDMA (**Text 2-Part 1, Part2 and Part 3 of Chapter6)**	**L1,L2,L3**
Module-4	
LTE – 4G **Key Enablers for LTE 4G** – OFDM, SC-FDE, SC-FDMA, Channel Dependant Multiuser Resource Scheduling, Multi-Antenna Techniques, Flat IP Architecture, LTE Network Architecture. **(Text 1, Sec 1.4)** **Multi-Carrier Modulation –** Multicarrier concepts, OFDM Basics, OFDM in LTE, Timing andFrequencySynchronization,PeaktoAverageRation,SC-FrequencyDomainEqualization, Computational Complexity Advantage of OFDM andSC-FDE. **(Text 1, Sec 3.1 – 3.7)**	**L1,L2,L3**
Module-5	

LTE - 4G **OFDMA and SC-FDMA –** Multiple Access for OFDM Systems, OFDMA, SCFDMA, Multiuser Diversity and Opportunistic Scheduling, OFDMA and SC-FDMA in LTE, OFDMA system Design Considerations. **(Text 1, Sec 4.1 – 4.6)** **The LTE Standard –** Introduction to LTE and Hierarchical Channel Structure of LTE, Downlink OFDMA Radio Resources, Uplink SC-FDMA Radio Resources. **(Text 1, Sec 6.1 – 6.4)**	**L1, L2,L3**

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

- Make use of the system architecture and the functional standard specified in LTE 4G.
- Identify the role of the layer of LTE radio interface protocols and EPS Data convergence protocols to set up, reconfigure and release data and voice from users.
- Utilize the UTRAN and EPS handling processes from set up to release including mobility management for a variety of data call scenarios.
- Identify the difference between uplink , down link and the physical layer procedures that provide the services to upper layers.
- Utilize the Performance of resource management and packet data processing and transport algorithms.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof20 marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreducedto60 marksasSEEmarksis60.

Text Books:

1. "Fundamentals of LTE" Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, Pearson education (Formerly Prentice Hall, Communications Engg and Emerging Technologies), ISBN-13:978-0-13-703311-9.
2. "IntroductiontoWirelessTelecommunicationsSystemsandNetworks",GaryMullet,First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN - 13: 978-81-315-0559-5.

Reference Books:

1. "Wireless Communications: Principles and Practice" Theodore Rappaport, 2nd Edition, PrenticeHallCommunicationsEngineeringandEmergingTechnologiesSeries,2002,ISBN0- 13-042232-0.
2. LTEforUMTSEvolutiontoLTE-Advanced'HarriHolmaandAnttiToskala,SecondEdition- 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.2

B. E. EC/TC
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VIII

NETWORK SECURITY

Subject Code	**18EC821**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**3**	**SEE Marks**	**60**
Total Number of LectureHours	**40 (08 Hours / Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Describe network security services andmechanisms.
- Understand Transport Level Security and Secure SocketLayer
- Know about Security concerns in Internet Protocolsecurity
- Discuss about Intruders, Intrusion detection and MaliciousSoftware
- Discuss about Firewalls, Firewall characteristics, Biasing andConfiguration

Module-1	**RBT Level**
Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks. **(Chapter1-Text2)**	**L1, L2**
Module-2	
Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH)**(Chapter15- Text1)**	**L1,L2**
Module-3	
IP Security: Overview of IP Security (IPSec),IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange. **(Chapter19-Text1)**	**L1,L2**
Module-4	
Intruders, Intrusion Detection.**(Chapter20-Text1)** **MALICIOUS SOFTWARE:** Viruses and Related Threats, Virus Countermeasures, **(Chapter21-Text1)**	**L1,L2**
Module-5	
Firewalls: The Need for firewalls, Firewall Characteristics, Types of Firewalls, Firewall Biasing, Firewall locationandconfiguration **(Chapter22-Text1)**	**L1, L2**

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

- Explain network security services and mechanisms and explain securityconcepts
- Understand the conceptof Transport Level Security and Secure Socket Layer.
- Explain Security concerns in Internet Protocolsecurity
- Explain Intruders, Intrusion detection and MaliciousSoftware
- Describe Firewalls, Firewall Characteristics, Biasing andConfiguration

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof20 marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreducedto60 marksasSEEmarksis60.

TEXT BOOKS:

1. CryptographyandNetworkSecurityPrinciplesandPractice|,PearsonEducationInc.,William Stallings, 5th Edition, 2014, ISBN: 978-81-317-6166-3.
2. Cryptography and Network Security, Atul Kahate, TMH,2003.

REFERENCE BOOKS:

1. Cryptography and Network Security, Behrouz A. Forouzan, TMH, 2007.

B. E. EC/TC
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VIII

MICRO ELECTROMECHANICAL SYSTEMS

Course Code	**18EC822**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**3**	**SEE Marks**	**60**
Total Number of LectureHours	**40 (08 Hours / Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand overview of microsystems, their fabrication and applicationareas.
- Working principles of several MEMSdevices.
- Develop mathematical and analytical models of MEMSdevices.
- Know methods to fabricate MEMSdevices.
- Various application areas where MEMS devices can beused.

Module-1	**RBT Level**
Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.	**L1, L2**
Module-2	
Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics. **Engineering Science for Microsystems Design and Fabrication:** Introduction, Molecular Theory of Matter and Inter-molecular Forces, Plasma Physics, Electrochemistry.	**L1,L2**
Module-3	
Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates,MechanicalVibration,Thermomechanics,FractureMechanics,ThinFilmMechanics, Overview on Finite Element StressAnalysis.	**L1,L2**
Module-4	
Scaling Laws in Miniaturization: Introduction, Scalingin Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer.	**L1,L2**
Module-5	
OverviewofMicromanufacturing:Introduction,BulkMicromanufacturing,Surface Micromachining, TheLIGAProcess, Summary on Micromanufacturing.	**L1, L2**

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

- Appreciate the technologies related to Micro Electro MechanicalSystems.
- Understand design and fabrication processes involved with MEMSDevices.
- AnalyzetheMEMSdevicesanddevelopsuitablemathematicalmodels.
  Know various application areas for MEMSdevice.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof20 marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreducedto60 marksasSEEmarksis60.

TextBook:

Tai-RanHsu,MEMSandMicrosystems:Design,ManufactureandNanoscaleEngineering,2nd Ed, Wiley.

Reference Books:

1. HansH.Gatzen,VolkerSaile,JurgLeuthold,MicroandNanoFabrication:ToolsandProcesses, Springer,2015.
2. DilipKumarBhattacharya,BrajeshKumarKaushik,MicroelectromechanicalSystems(MEMS), Cenage Learning.

B. E. EC/TC
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VIII

RADAR ENGINEERING

Course Code	**18EC823**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**3**	**SEE Marks**	**60**
Total Number of LectureHours	**40 (08 Hours / Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Understand the Radar fundamentals and analyze the radarsignals.
- Understandvarioustechnologiesinvolvedinthedesignofradartransmittersandreceivers.
- Learn various radars like MTI, Doppler and tracking radars and theircomparison

Module-1	**RBT Level**
BasicsofRadar: Introduction,MaximumUnambiguousRange,RadarWaveforms, Definitions with respecttopulsewaveform-PRF,PRI,DutyCycle,PeakTransmitterPower,Averagetransmitter Power. Simple form of the Radar Equation, Radar Block Diagram and Operation, Radar Frequencies,ApplicationsofRadar,TheOriginsofRadar,IllustrativeProblems.**(Chapter1of Text)**	**L1, L2,L3**
Module-2	
TheRadarEquation:PredictionofRange`Performance,DetectionofsignalinNoise, MinimumDetectableSignal,ReceiverNoise,SNR,ModifiedRadarRangeEquation, Envelope Detector—FalseAlarmTimeandProbability,ProbabilityofDetection,RadarCrossSectionof Targets: simple targets –sphere, cone-sphere, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), IllustrativeProblems. **(Chapter 2 of Text, Except 2.4, 2.6, 2.8 & 2.11)**	**L1,L2,L3**
Module-3	
MTIandPulseDopplerRadar: Introduction,Principle,DopplerFrequencyShift,SimpleCW Radar, Sweep to Sweep subtraction and Delay Line Canceler, MTI Radar with– Power Amplifier Transmitter, Delay Line Cancelers— Frequency Response of Single Delay- Line Canceler, Blind Speeds, Clutter Attenuation, MTI Improvement Factor, N- Pulse Delay-Line Canceler,DigitalMTIProcessing–Blindphases,IandQChannels,DigitalMTIDopplersignal processor, Moving Target Detector- OriginalMTD. **(Chapter 3: 3.1, 3.2, 3.5, 3.6 of Text)**	**L1,L2,L3**
Module-4	
Tracking Radar: Tracking with Radar- Types of Tracking Radar Systems, Monopulse Tracking- Amplitude Comparison Monopulse(one-and two-coordinates), Phase Comparison Monopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range, Comparison of Trackers.**(Chapter4: 4.1, 4.2, 4.3 of Text)**	**L1,L2,L3**
Module-5	
TheRadarAntenna: FunctionsofTheRadarAntenna,AntennaParameters,ReflectorAntennasandElectronicallySteeredPhasedarrayAntennas.(Chapter9:9.1,9.29.4, 9.5 ofText) **Radar Receiver:** The Radar Receiver, Receiver Noise Figure, Super Heterodyne Receiver, Duplexers and Receivers Protectors, Radar Displays. **(Chapter 11 ofText)**	**L1, L2,L3**

CourseOutcomes:Attheendofthecourse,studentswillbeableto:

- Understandtheradarfundamentalsandradarsignals.
- Explaintheworkingprinciplepulse Dopplerradars,theirapplicationsandlimitations.
- Describe the working of various radar transmitters andreceivers.
- Analyzetherangeparametersofpulseradarsystemwhichaffectthesystemperformance.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,eachof20 marks.

- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreducedto60 marksasSEEmarksis60.

TEXT BOOK:

Introduction to Radar Systems- Merrill I Skolink, 3e, TMH, 2001

REFERENCE BOOKS:

1. Radar Principles, Technology, Applications—ByronEdde, Pearson Education,2004.
2. Radar Principles–Peebles. Jr, P.Z. Wiley. New York,1998.
3. PrinciplesofModemRadar:BasicPrinciples–MarkA.Rkhards,JamesA.Scheer,WilliamA.HoIm. Yesdee,2013

B. E. ECE
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VIII

OPTICAL COMMUNICATION NETWORKS

Course Code	**18EC824**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**3**	**SEE Marks**	
Total Number of Lecture Hours	**40 (8 Hours / Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Learn the basic principle of optical fiber communication with different modes of light propagation.
- Understand the transmission characteristics and losses in opticalfiber.
- Studyofopticalcomponentsanditsapplicationsinopticalcommunicationnetworks.
- Learn the network standards in optical fiber andunderstandthe network architectures alongwith its functionalities.

Module -1	RBT Level
Optical fiber Communications: Historical development, The general system, Advantages of optical fiber communication, Optical fiber wave guides: Ray theory transmission, Modes in planar guide, Phase and group velocity, Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers.**(Text 2)**	**L1, L2**
Module -2	
Transmission characteristics of optical fiber: Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber. **Optical Fiber Connectors:** Fiber alignment and joint loss, Fiber splices: Fusion Splices, Mechanical splices, Fiber connectors: Cylindrical ferrule connectors, Duplex and Multiple fiberconnectors,Fibercouplers:threeandfourportcouplers,starcouplers,OpticalIsolators and Circulators**.(Text2)**	**L1, L2**
Module -3	
Optical sources: Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant Frequencies.	**L1, L2**
Photodetectors: Physical principles of Photodiodes, Photo detector noise, Detector response time. **Optical Receiver:** Optical Receiver Operation: Error sources, Front End Amplifiers, Receiver sensitivity, Quantum Limit.**(Text1)**	
Module -4	
WDM Concepts and Components: Overview of WDM: Operational Principles of WDM, WDMstandards,Mach-ZehnderInterferometerMultiplexers,IsolatorsandCirculators,Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings. Optical amplifiers: Basic application and Types, Semiconductor optical amplifiers, Erbium Doped Fiber Amplifiers, Raman Amplifiers, Wideband Optical Amplifiers. **(Text1)**	**L1, L2**
Module -5	

Optical Networks: Optical network evolution and concepts: Optical networking terminology, Optical network node and switching elements, Wavelength division multiplexed networks, Public telecommunication network overview. Optical network transmission modes, layers and protocols: Synchronous networks, Asynchronous transfer mode, OSI reference model, Optical transport network, Internet protocol, Wavelength routing networks: Routing and wavelength assignment, Optical switching networks: Optical circuit switched networks, packet switched networks, Multiprotocol Label Switching, Optical burst switching networks. **(Text 2)**	**L1, L2**

Course Outcomes: At the end of the course, students will be able to:

- Classificationandworkingofopticalfiberwithdifferentmodesofsignalpropagation.
- Describe the transmission characteristics and losses in optical fibercommunication.
- Describetheconstructionandworkingprincipleofopticalconnectors,multiplexersandamplifiers.
- Describetheconstructionalfeaturesandthecharacteristicsofoptical Sources anddetectors.
- Illustratethenetworkingaspectsofopticalfiberanddescribevariousstandardsassociated withit.

Question paper pattern:

- Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreducedto60 marksasSEEmarksis60.

Text Books:

1. GerdKeiser,OpticalFiberCommunication,5th Edition,McGrawHillEducation(India)PrivateLimited,2015. ISBN:1-25-900687-5.

2. JohnMSenior,OpticalFiberCommunications,PrinciplesandPractice,3rd Edition,PearsonEducation,2010, ISBN:978-81-317-3266-3

Reference Book:

Joseph C Palais, Fiber Optic Communication, Pearson Education, 2005, ISBN:0130085103.

B. E. ECE
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE) SEMESTER – VIII

BIOMEDICAL SIGNAL PROCESSING

Course Code	**18EC825**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**3**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40 (8Hours/Module)**	**Exam Hours**	**03**

CREDITS – 03

Course Learning Objectives: This course will enable students to:

- Describetheorigin,propertiesandsuitablemodelsofimportantbiologicalsignalssuchasECGandEEG.
- Know the basic signal processing techniques in analysing biologicalsignals.
- Acquiremathematicalandcomputationalskillsrelevanttothefieldofbiomedicalsignalprocessing.
- Describe the basics of ECG signal compressionalgorithms.
- Know the complexity of various biologicalphenomena.
- Understand the promises, challenges of the biomedicalengineering.

Module -1	RBT Level
Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. **Electrocardiography:** Basic electrocardiography, ECG leads systems, ECG signal characteristics. **Signal Conversion** :Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits **(Text-1)**	**L1,L2**
Module -2	
Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. **AdaptiveNoiseCancelling:** Principalnoisecancellermodel,60-Hzadaptivecancellingusing a sine wave model, other applications of adaptive filtering **(Text-1)**	**L1,L2,L3**
Module -3	
DataCompressionTechniques: Turningpointalgorithm,AZTECalgorithm,Fanalgorithm, Huffman coding, data reduction algorithms The Fourier transform, Correlation, Convolution, Power spectrum estimation, Frequency domain analysis of the ECG **(Text-1)**	**L1,L2, L3**
Module -4	
Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Real-time ECG processingalgorithm,ECGinterpretation,STsegmentanalyzer,Portablearrhythmiamonitor. **(Text -2)**	**L1,L2, L3**
Module -5	
Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation. **Analysis of EEG channels:** Detection of EEG rhythms, Template matching for EEG, spike and wave detection **(Text-2)**	**L1,L2, L3**

Course Outcomes: At the end of the course, students will be able to:

- Possessthebasicmathematical,scientificandcomputationalskillsnecessarytoanalyseECGandEEG signals.
- ApplyclassicalandmodernfilteringandcompressiontechniquesforECGandEEGsignals
- Develop a thorough understanding on basics of ECG and EEG featureextraction.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20marks.
- Each full question can have a maximum of 4 subquestions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsofthemodule.
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.
- Thetotalmarkswillbeproportionallyreduced to60 marksasSEEmarksis60.

Text Books:

1. **Biomedical Digital Signal Processing**- Willis J. Tompkins, PHI2001.
2. **BiomedicalSignalProcessingPrinciplesandTechniques**-DCReddy,McGraw-Hillpublications 2005.

Reference Book:

Biomedical Signal Analysis-Rangaraj M. Rangayyan, John Wiley & Sons 2002.