K.S.INSTITUTE OF TECHNOLOGY, BANGALORE
(AFFLIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG.

ENGINEERING MATHEMATICS-IV

(Common to all Branches)

Course Title: Engineering Mathematics-IV **Course Code:**
15MAT41Credits:04 **L-T-P:4-0-0**
Contact Hours/Week: 04 **Total Hours:50**
Exam. Marks:80 **IA Marks:20**
Exam. Hours: 03

Modules	RBT Level
Module-1	
Numerical Methods : Numerical solution of ordinary differential equations of first order and first degree, Taylor's series method, modified Euler's method, Runge - Kutta method of fourth order. Milne's and Adams- Bashforth predictor and corrector methods (No derivations of formulae).	L1, L3
Module-2	
Numerical Methods: Numerical solution of second order ordinary differential equations, Runge-Kutta method and Milne'smethod. Special Functions: Series solution-Frobenious method. Series solution of Bessel's differential equation leading to *Jn(x)*-Bessel's function of first kind. Basic properties and orthogonality. Series solution of Legendre's differential equation leading to *Pn(x)*-Legendre polynomials. Rodrigue's formula, problems.	L3
Module-3	
Complex Variables: Review of a function of a complex variable, limits, continuity,differentiability.Analyticfunctions-Cauchy-Riemannequationsin cartesian and polar forms. Properties and construction of analytic functions. Complex line integrals-Cauchy's theorem and Cauchy's integral formula, Residue, poles, Cauchy's Residue theorem (without proof) and problems. Transformations: Conformaltransformations, discussion of transformations: $w=z^2$, $w=e^z$, $w=z+\frac{1}{z}$ $(z\neq 0)$and bilineartransformations- problems.	L1, L3, L3
Module-4	
Probability Distributions:Random variables (discrete and continuous), probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and normal distributions, problems.	L3

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance, correlationcoefficient.	
Module-5	
Sampling Theory: Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. Stochastic process: Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability-simple problems.	L3 L1
Course Outcomes: On completion of this course, students are ableto: • **Apply** Numerical methods to obtain the solution of first order and first degree differential equations. • **Make use of** probability theory on discrete and continuous random variables to obtain the solution of problems on different distributions and joint probability distribution. • **Identify** the problems on sampling distribution and on markov chains in attempting the engineering problems for feasible random events. • **Utilize** the Bessel and Legendre functions for the problems arising in engineering fields. • **Construc**t the analytic functions. Calculate residues and poles of complex potentials in flow problems.	
Question paper pattern: • The question paper will have tenquestions. • Each full Question consisting of 16marks • Therewillbe2fullquestions(withamaximumoffoursubquestions) from eachmodule. • Eachfullquestionwillhavesubquestionscoveringallthetopics under amodule. • Thestudentswillhavetoanswer5fullquestions,selectingonefull question from eachmodule.	
Text Books: *1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.*	

2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley& Sons,10thEd.,2015.	
Reference Books: 1. *N.P.Bali and Manish Goyal: A Text Book of Engineering Mathematics, Laxmi Publishers,7thEd.,2010.* 2. *B.V.Ramana:"HigherEngineeringMathematics"TataMcGraw-Hill,2006.* 3. *H. K. Dass and Er. RajnishVerma: "Higher EngineeringMathematics", S. Chand publishing, 1stedition, 2011.*	
Web Link and Video Lectures: 1. *http://nptel.ac.in/courses.php?disciplineID=111* 2. *http://www.khanacademy.org/* 3. *http://www.class-central.com/subject/math*	

ADDITIONAL MATHEMATICS - II

B.E., IV Semester, Common to all Branches

(A Bridge course for Lateral Entry students of IV Sem. B. E.)

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

Subject Code	15MATDIP41	IA Marks	--
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (08 Hours per Module)		

Credits – 00

Course Objectives: This course will enable students to:

- Understand essential concepts of linearalgebra.
- Solve second and higher order differentialequations.
- Understand Laplace and inverse Laplace transforms and elementaryprobability theory.

Modules	RBT Level
Module-1	
LinearAlgebra:Introduction-rankofmatrixbyelementaryrowoperations - Echelon form. Consistency of system of linear equations - Gauss eliminationmethod.EigenvaluesandEigenvectorsofasquarematrix. Application of Cayley-Hamilton theorem (without proof) to compute the inverse of a matrix- Examples.	L1,L3
Module-2	
Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non- homogeneous equations. Inverse differential operators. Solutions of initial value problems. Method of undetermined coefficients and variation of parameters.	L1,L3
Module-3	
Laplace transforms: Laplace transforms of elementary functions. Transformsofderivativesandintegrals,transformsofperiodicfunctionand unit step function-Problems only.	L1,L2
Module-4	
Inverse Laplace transforms : Definition of inverse Laplace transforms. Evaluation of Inverse transforms by standard methods. Application to solutions of Linear differential equations and simultaneous differential equations.	L1,L2
Module-5	
Probability:Introduction.Samplespaceandevents.Axiomsofprobability. Additionandmultiplicationtheorems.Conditionalprobability–illustrative examples. Bayes'stheorem-examples.	L1,L2
Course Outcomes: On completion of this course, students are able to: • Solvesystemsoflinearequationsinthedifferentareasoflinearalgebra. • Solvesecondandhigherorderdifferentialequationsoccurringinof electrical circuits, damped/un-dampedvibrations.	

• DescribeLaplacetransformsofstandardandperiodicfunctions. • Determinethegeneral/completesolutionstolinearODEusinginverse Laplacetransforms. • Recall basic concepts of elementary probability theory and, solve problemsrelatedtothedecisiontheory,synthesisandoptimizationof digitalcircuits.	
Question paper pattern: • The question paper will have tenquestions. • Each full Question consisting of 16marks • Therewillbe2fullquestions(withamaximumoffoursub questions) from eachmodule. • Eachfullquestionwillhavesubquestionscoveringallthetopics under amodule. • Thestudentswillhavetoanswer5fullquestions,selectingonefull question from eachmodule.	
Text Book : *B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.*	
Reference Books: 1. *E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.,2015.* 2. *N.P.Bali and Manish Goyal: A Text Book of EngineeringMathematics, Laxmi Publishers,7th Ed., 2007.*	

MICROPROCESSORS

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

SEMESTER – IV (EC/TC)

Subject Code	15EC42	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Familiarize basic architecture of 8086microprocessor
- Program 8086 Microprocessor using Assembly LevelLanguage
- Use Macros and Procedures in 8086Programs
- Understandinterfacingof16bitmicroprocessorwithmemoryandperipheralchips involving systemdesign
- Understandthearchitectureof8088,8087CoprocessorandotherCPU architectures

Modules	RBT Level
Module -1	
8086PROCESSOR:Historicalbackground(referReferenceBook1), 8086 CPU Architecture (1.1 – 1.3 ofText). Addressing modes, Machine language instruction formats, Machine coding the program (2.2, 2.1, 3.2 ofText). INSTRUCTION SET OF 8086: Data transfer and arithmetic instructions. Control/Branch Instructions, Illustration of these instructions with example programs (2.3 of Text).	L1, L2, L3
Module -2	
Logical Instructions, String manipulation instructions,Flag manipulation and Processor control instructions, Illustration ofthese instructions with example programs. Assembler Directives and Operators, Assembly Language Programming and example programs (2.3, 2.4, 3.4 ofText).	L1, L2, L3
Module -3	
Stack and Interrupts: Introductiontostack,Stackstructureof8086,ProgrammingforStack. Interrupts and Interrupt Service routines, Interrupt cycle of 8086, NMI,INTR,Interruptprogramming,Passingparameterstoprocedures, Macros, Timing and Delays. (Chap. 4 ofText).	L1, L2, L3
Module -4	

8086 Bus Configuration and Timings: Physical memory Organization, General Bus operation cycle, I/O addressingcapability,Specialprocessoractivities,Minimummode8086 systemandTimingdiagrams,MaximumMode8086systemandTiming diagrams. (1.4 to 1.9 ofText). Basic Peripherals and their Interfacing with 8086 (Part 1) : Static RAM Interfacing with 8086 (5.1.1), Interfacing I/O ports, PIO 8255, Modesofoperation–Mode-0andBSRMode,InterfacingKeyboardand 7-Segmentdigitsusing8255(Refer5.3,5.4,5.5ofText).	L1, L2, L3
Module 5	
Basic Peripherals and their Interfacing with 8086 (Part 2): InterfacingADC-0808/0809,DAC-0800,StepperMotorusing8255 (5.6.1, 5.7.2, 5.8). Timer 8254 – Mode 0, 1, 2 & 3 and Interfacing programmes for these modes (refer 6.1 ofText). INT 21H DOS Function calls - for handling Keyboard and Display (refer Appendix-B of Text). Other Architectures: Architecture of 8088 (refer 1.10 upto 1.10.1 of Text) and Architecture of NDP 8087 (refer 8.3.1, 8.3.5 of Text). Von-Neumann&HarvardCPUarchitectureandCISC&RISCCPU architecture (refer Reference Book1).	L1, L2, L3

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

- Identify the different CPU architectures, 8086 Microprocessor architecture and addressing modes of 8086.
- Make use of the instruction set and addressing modes of 8086 to develop assembly language programs
- Make use of stacks , interrupts to develop programs
- Model the static memory chips, 8255 & 8254, and use of INT 21 DOS interrupt function calls to handle keyboard and display
- Experiment with 8086 Microprocessor the ADC-0808, DAC-0800 and stepper motors using PPI 8255 with 8086.

Question paper pattern:

- The question paper will have tenquestions.
- Each full Question consisting of 16marks
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestion from eachmodule.

Reference Books:

1. Microprocessor and Interfacing - Douglas V Hall, SSSP Rao, 3rd edition TMH,2012.
2. Microcomputer systems-The 8086 /8088 Family –Y.C. Liu and A. Gibson, 2nd edition, PHI-2003.
3. The 8086Microprocessor: Programming &InterfacingthePC – Kenneth J Ayala, CENGAGE Learning,2011.
4. The Intel Microprocessor, Architecture, Programming and Interfacing-BarryB.Brey,6e,PearsonEducation/PHI,2003.

TextBook:

Advanced Microprocessorsand Peripherals - A.K. Ray and K.M. Bhurchandi, TMH, 3rd Edition, 2012, ISBN978-1-25-900613-5.

Web Link and Video Lectures:

1. https://www.coursera.org/courses?query=microprocessor
2. https://www.udemy.com/course/certificate-program-in-introduction-to-microprocessors/

CONTROL SYSTEMS

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

SEMESTER – IV (EC/TC)

Subject Code	15EC43	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of LectureHours	50(10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understandthebasicfeatures,configurationsandapplicationofcontrolsystems.
- Understandvarioustermino logiesanddefinitionsforthecontrolsystems.
- Learnhowtofindamathematicalmodelofelectrical,mechanicalandelectro- mechanicalsystems.
- Know how to find time response from the transferfunction.
- Find the transfer function via Masons'rule.
- Analyze the stability of a system from the transferfunction.

Modules	RBT Level
Module -1	
IntroductiontoControlSystems:TypesofControlSystems,Effectof Feedback Systems, Differential equation of Physical Systems – MechanicalSystems,ElectricalSystems,AnalogousSystems.Block diagramsandsignalflowgraphs:Transferfunctions,Blockdiagram algebra and Signal Flowgraphs.	L1, L2, L3
Module -2	
TimeResponseoffeedbackcontrolsystems:Standardtestsignals,Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steadystateerrorsanderrorconstants.IntroductiontoPI,PDandPID Controllers (excludingdesign).	L1, L2, L3
Module -3	
Stability analysis: Concepts of stability, Necessary conditions for Stability,Routhstabilitycriterion,Relativestabilityanalysis:moreon theRouthstabilitycriterion,IntroductiontoRoot-LocusTechniques, The root locus concepts, Construction of rootloci.	L1, L2, L3
Module -4	

Frequency domain analysis and stability: Correlationbetweentimeandfrequencyresponse,BodePlots, Experimental determination of transferfunction. IntroductiontoPolarPlots,(InversePolarPlotsexcluded)Mathematical preliminaries,NyquistStabilitycriterion,(Systemswithtransportation lagexcluded) Introductiontolead,lagandlead-lagcompensatingnetworks(excluding design).	L1, L2, L3
Module -5	
Introduction to Digital Control System: Introduction, Spectrum Analysis of Sampling process, Signal reconstruction, Difference equations. Introduction to State variable analysis: Introduction, ConceptofState,Statevariables&Statemodel,StatemodelforLinear Continuous & Discrete time systems,Diaganolisation.	L1, L2, L3

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

- 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:

- The question paper will have tenquestions.
- Each full Question consisting of 16marks
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestion from eachmodule.

TextBook:

J.NagarathandM.Gopal,"ControlSystemsEngineering",NewAgeInternational (P) Limited, Publishers, Fifth edition-2005, ISBN:81-224-2008-7.

Reference Books:

1. "Modern Control Engineering," K.Ogata, Pearson Education Asia/PHI, 4th Edition, 2002. ISBN978-81-203-4010-7.
2. "Automatic Control Systems", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition,2008.
3. "Feedback and Control System," Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition2007.

Web Link and Video Lectures: 1. https://www.udemy.com/topic/control-systems/ 2. https://www.coursera.org/courses?query=control%20systems	

SIGNALS AND SYSTEMS

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

SEMESTER – IV (EC/TC)

Subject Code	15EC44	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of LectureHours	50(10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understandthemathematicaldescriptionofcontinuousanddiscretetimesignals andsystems.
- Analyzethesignalsintimedomainusingconvolutiondifference/differential equations
- Classifysignalsintodifferentcategoriesbasedontheirproperties.
- AnalyzeLinearTimeInvariant(LTI)systemsintimeandtransformdomains.
- Buildbasicsforunderstandingofcoursessuchassignalprocessing,control system andcommunication.

Modules	RBT Level
Module -1	
Introduction and Classification of signals: Definition of signal and systems, communication and control systems as examples.Sampling of analog signals, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy andpower. Elementary signals/Functions: Exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sync functions. Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding. Systems:Definition,Classification:linearandnon-linear,timevariant andinvariant,causalandnon-causal,staticanddynamic,stableand unstable,invertible.	L1, L2, L3
Module -2	
Time domain representation of LTI System: System modeling: Input-outputrelation,definitionofimpulseresponse,convolutionsum, convolution integral, computation of convolution integral and convolution sum using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Properties of convolution.	L1, L2, L3
Module -3	

System interconnection, system properties in terms of impulse response, step response in terms of impulse response (4 Hours). Fourier Representation of Periodic Signals : Introduction to CTFS and DTFS, definition, properties (No derivation) and basic problems (inverse Fourier series is excluded) (06 Hours).	L1, L2, L3
Module -4	
Fourier Representation of aperiodic Signals: FT representation of aperiodic CT signals - FT, definition, FT of standard CT signals, Properties and their significance (4 Hours). FTrepresentation of aperiodic discrete signals-DTFT , definition, DTFT of standard discrete signals, Properties and their significance (4Hours). Impulse sampling and reconstruction: Sampling theorem (only statement) and reconstruction of signals (2 Hours).	L1, L2, L3
Module -5	
Z-Transforms: Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z- Transform, Transform analysis of LTI systems.	L1, L2, L3
Course Outcomes: At the end of the course, students will be ableto: • Identify different types of signals (continuous/discrete, periodic/aperiodic, even /odd, energy/power and deterministic/random signals.) • Identify the linearity, causality, time-invariance and stability properties of continuous and discrete time systems. • Solve the response of a Continuous and Discrete LTI system using convolution integral and convolution sum. • Solve the spectral characteristics of continuous and discrete time signal using Fourier analysis. • Solve Z-transforms, inverse Z-transforms and transfer functions of complex LTI systems.	
Question paper pattern: • The question paper will have tenquestions. • Each full Question consisting of 16marks • Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule. • Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module. • Thestudentswillhavetoanswer5fullquestions,selectingonefullquestion from each module.	
Text Book: Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, 2008, WileyIndia. ISBN 9971-51-239-4.	

Reference Books:

1. Michael Roberts, “Fundamentals of Signals & Systems”, 2nd edition, Tata McGraw-Hill, 2010, ISBN978-0-07-070221-9.
2. Alan V Oppenheim, Alan S, Willskyand A Hamid Nawab, “Signals and Systems” 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, “Linear Systems and Signals”, Oxford University Press,2005.
5. Ganesh Rao and Satish Tunga, “Signals and Systems”, Pearson/Sanguine Technical Publishers,2004.

Web Link and Video Lectures:

1. https://www.classcentral.com/course/swayam-principles-of-signals-and-systems
2. https://freevideolectures.com/subject/signals-systems/

PRINCIPLES OF COMMUNICATION SYSTEMS

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

SEMESTER – IV (EC/TC)

Subject Code	15EC45	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50(10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- DesignsimplesystemsforgeneratinganddemodulatingAM,DSB,SSBandVSB signals.
- UnderstandtheconceptsinAnglemodulationforthedesignofcommunication systems.
- Designsimplesystemsforgeneratinganddemodulatingfrequencymodulated signals.
- Learn the concepts of random process and varioustypes of noise.
- Evaluatetheperformanceofthecommunicationsysteminpresenceofnoise.
- Analyze pulse modulation and samplingtechniques.

Modules	RBT Level
Module – 1	
AMPLITUDE MODULATION: Introduction, Amplitude Modulation: Time & Frequency – Domain description, Switching modulator, Envelop detector. DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION: Time and Frequency – Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing. SINGLE SIDE–BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION: SSB Modulation, VSB Modulation, FrequencyTranslation, Frequency- Division Multiplexing, Theme Example: VSB Transmission of Analog andDigitalTelevision. (Chapter 3 ofText).	L1, L2, L3
Module – 2	
ANGLE MODULATION: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase–Locked Loop: Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM Systems. The Superheterodyne Receiver(refer Chapter 4 ofText).	L1, L2, L3
Module – 3	

RANDOM VARIABLES &PROCESS : Introduction, Probability, Conditional Probability, Random variables, Several Random Variables. Statistical Averages: Function of a random variable, Moments, Random Processes, Mean, Correlation and Covariance function: Properties of autocorrelation function, Cross–correlation functions (refer Chapter 5 of Text). NOISE: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth(referChapter5ofText),NoiseFigure(referSection6.7ofText).	L1, L2, L3
Module – 4	
NOISE IN ANALOG MODULATION: Introduction, Receiver Model, NoiseinDSB-SCreceivers,NoiseinAMreceivers,Thresholdeffect,Noisein FM receivers, Capture effect, FM threshold effect, FM thresholdreduction, Pre-emphasisandDe-emphasisinFM(referChapter6ofText).	L1, L2, L3
Module – 5	
DIGITAL REPRESENTATION OF ANALOG SIGNALS: Introduction, Why Digitize Analog Sources?, The Sampling process, Pulse Amplitude Modulation, Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves, The Quantization Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing (refer Chapter 7 of Text), Application to Vocoder (refer Section 6.8 of Reference Book 1).	L1, L2, L3

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

- Apply the time and frequency domain knowledge for the generation and demodulation of amplitude modulated signals.
- Identify the performance of different generation and detection methodologies of AM, FM and multiplexing.
- Utilize analog signals in time domain as random processes and identify the types of basic Noise
- Identify the influence of noise in receivers of analog modulated signals
- Compare the characteristics of pulse modulation techniques

Question paper pattern:

- The question paper will have tenquestions.
- Each full Question consisting of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)fromeach module.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfrom eachmodule.

Text Book:

Communication Systems , Simon Haykins&Moher, 5th Edition, John Willey, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

Reference Books:

1. Modern Digital and Analog Communication Systems, B. P. Lathi, Oxford University Press., 4th edition.
2. An Introduction to Analog and Digital Communication , Simon Haykins, John Wiley India Pvt. Ltd., 2008, ISBN978–81–265–3653–5.
3. PrinciplesofCommunicationSystems,H.Taub&D.L.Schilling,TMH, 2011.
4. CommunicationSystems,HaroldP.E,SternSamyandA.Mahmond,Pearson Edition,2004.
5. Communication Systems :Analog and Digital, R.P.Singh and S.Sapre: TMH 2nd edition,2007.

Web Link and Video Lectures: 1. https://swayam.gov.in/nd1_noc19_ee46/preview 2. https://www.udemy.com/course/analog-communication/	

LINEAR INTEGRATED CIRCUITS

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

SEMESTER – IV (EC/TC)

Subject Code	15EC46	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50(10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Defineanddescribevariousparametersof Op-Amp,itscharacteristicsand specifications.
- DiscusstheeffectsofInputandOutputvoltagerangesuponOp-Ampcircuits.
- SketchandAnalyzeOp-Ampcircuitstodetermine InputImpedances,output Impedances and other performanceparameters.
- SketchandExplaintypicalFrequencyResponsegraphsforeachoftheFiltercircuits showingButterworthandChebyshevresponseswhereeverappropriate.
- DescribeandSketchthevariousswitchingcircuitsofOp-Ampsandanalyzeits operations.
- DifferentiatebetweenvarioustypesofDACsandADCsandevaluatetheperformance ofeachwithneatcircuitdiagramsandassumingsuitableinputs.

Modules	RBT Level
Module -1	
Operational AmplifierFundamentals: Basic Op-amp circuit, Op-Amp parameters – Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedances, Slew rate and Frequency limitations. OP-Amps as DC Amplifiers – Biasing OP-amps, Direct coupled voltage followers, Non- inverting amplifiers, inverting amplifiers, Summing amplifiers, and Difference amplifiers. Interpretation of OP-amp LM741 & TL081 datasheet.(Text1)	L1, L2,L3
Module -2	
Op-Amps as AC Amplifiers: Capacitor coupled voltage follower, High inputimpedance– Capacitorcoupledvoltagefollower,Capacitorcoupled non inverting amplifiers, High input impedance – Capacitor coupledNon inverting amplifiers, Capacitor coupled inverting amplifiers, setting the uppercut-offfrequency,Capacitorcoupleddifferenceamplifier. OP-Amp Applications: Voltage sources, current sources and current sinks, current amplifiers, instrumentation amplifier, precision rectifiers.(Text1)	L1, L2,L3
Module-3	

More Applications : Limiting circuits, Clamping circuits, Peakdetectors, Sample and hold circuits, V to I and I to V converters, Differentiating Circuit, Integrator Circuit, Phase shift oscillator, Wien bridge oscillator, Crossing detectors, inverting Schmitt trigger. (Text 1) Log and antilog amplifiers, Multiplier and divider. (Text2)	L1, L2,L3

Module -4	
ActiveFilters:FirstorderandsecondorderactiveLow-passandhighpass filters, Bandpass Filter, BandstopFilter. (Text 1) Voltage Regulators: Introduction, Series Op-amp regulator, IC voltage regulators. 723 general purpose regulators. (Text 2)	L1, L2,L3
Module -5	
Phase locked loop: Basic Principles, Phase detector/comparator, VCO. DAC and ADC convertor: DAC using R-2R, ADC using Successive approximation. Other IC Application: 555 timer, Basic timer circuit, 555 timer used as astable and monostablemultivibrator. (Text 2)	L1, L2,L3

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

- Identify Op-amp circuit and parameters including CMRR, PSRR, Input
- & Output Impedances and Slew Rate.
- Construct Op-amp based AC Amplifiers and Develop circuits for Op-amp based Voltage / Current Sources & Sinks, Current, Instrumentation and Precision Amplifiers.
- Develop circuits for Op Amp based linear and non-linear circuits comprising of limiting, clamping, Sample & Hold, Differentiator / Integrator Circuits, Peak Detectors ,Oscillators and Multiplier & Divider.
- Design first & Second Order Filters and Voltage Regulators.
- Illustrate applications of linear ICs in phase detector, VCO, DAC, ADC and Timer.

Question paper pattern:

- The question paper will have tenquestions.
- Each full Question consisting of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)fromeach module.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfrom eachmodule.

TextBooks:

1. "OperationalAmplifiersandLinearIC's",DavidA.Bell,2ndedition,PHI/Pearson, 2004. ISBN978-81-203-2359-9.
2. "LinearIntegratedCircuits",D.RoyChoudhuryandShailB.Jain,4th edition, Reprint 2006, New Age International ISBN978-81-224-3098-1.

Reference Books:

1. RamakantAGayakwad,“Op-AmpsandLinearIntegratedCircuits”, Pearson, 4th Ed, 2015. ISBN81-7808-501-1.
2. BSomanathanNair,“LinearIntegratedCircuits:Analysis,Design& Applications,” Wiley India, 1st Edition,2015.
3. JamesCox,“LinearElectronicsCircuitsandDevices”,CengageLearning, Indian Edition, 2008, ISBN-13:978-07-668-3018-7.
4. Data Sheet:http://www.ti.com/lit/ds/symlink/tl081.pdf.

Web Link and Video Lectures:

1. https://e-box.co.in/linear-integrated-circuits.shtml
2. https://freevideolectures.com/course/2915/linear-integrated-circuits

MICROPROCESSOR LABORATORY

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

SEMESTER – IV (EC/TC)

Laboratory Code	15ECL47	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
RBT Level	L1, L2, L3	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to:

- Getfamiliarizewith8086instructionsandDOS21Hinterruptsandfunction calls.
- Developandtestassemblylanguageprogramstouseinstructionsof8086.
- Getfamiliarizewithinterfacingofvariousperipheraldeviceswith8086 microprocessor for simpleapplications.

Laboratory Experiments:

1. Programs involving:

Data transfer instructions like :

i) Byte and word data transfer in different addressingModes
ii) Block move (with and withoutoverlap)
iii) Block interchange

2. Programs involving :

Arithmetic & logical operations like :

i) Addition and Subtraction of multi precisionnos.
ii) MultiplicationandDivisionofsignedandunsignedHexadecimalnos.
iii) ASCII adjustmentinstructions.
iv) Codeconversions.

3. Programs involving:

Bit manipulation instructions like checking:

i) Whether given data is positive ornegative
ii) Whethergivendataisoddoreven
iii) Logical1’sand0’sinagivendata
iv) 2 out 5code
v) Bit wise and nibble wisepalindrome

4. Programs involving:

Branch/ Loop instructions like

i) Arrays:addition/subtractionofNnos.,Findinglargestandsmallestnos., Ascending and descendingorder.
ii) TwoapplicationprogramsusingProceduresandMacros(Subroutines).

5. Programs involving

String manipulation like string transfer, string reversing, searching for a string.

6. Programs involving

ProgramstouseDOSinterruptINT21hFunctioncallsforReadingaCharacterfrom keyboard,BufferedKeyboardinput,Displayofcharacter/Stringonconsole.

7. Interfacing Experiments :

Experimentsoninterfacing8086withthefollowinginterfacingmodulesthroughDIO (DigitalInput/Output-PCIbuscompatiblecard/8086Trainer)

1. Matrix keyboardinterfacing
2. Seven segment displayinterface
3. Logical controllerinterface
4. Stepper motorinterface
5. ADC and DAC Interface (8bit)
6. Lightdependentresistor(LDR),Relayand BuzzerInterfacetomakelight operated switches

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

- Identify the different CPU architectures, 8086 Microprocessor architecture and addressing modes of 8086.
- Make use of the instruction set and addressing modes of 8086 to develop assembly language programs
- Make use of stacks , interrupts to develop programs.
- Model the static memory chips, 8255 & 8254, and use of INT 21 DOS interrupt function calls to handle keyboard and display
- Experiment with 8086 Microprocessor to interface the ADC-0808, DAC-0800 and stepper motor using PPI 8255.

Conduct of Practical Examination:

- Alllaboratoryexperimentsaretobeincludedforpracticalexamination.
- Forexamination,onequestionfromsoftwareandonequestionfromhardware interfacing to beset.
- Students are allowed to pick one experiment from thelot.
- ChangeofexperimentisallowedonlyonceandMarksallottedtotheprocedure part to be madezero.

LINEAR ICS AND COMMUNICATION LAB

As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV (EC/TC)

Laboratory Code	15ECL48	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
RBT Level	L1, L2, L3	Exam Hours	03

CREDITS – 02

Courseobjectives: This laboratory course enables studentsto:

- Design,DemonstrateandAnalyzeinstrumentationamplifier,filters,DAC,adder, differentiator and integrator circuits, usingop-amp.
- Design,DemonstrateandAnalyzemultivibratorsandoscillatorcircuitsusing Op-amp
- Design,DemonstrateandAnalyzeanalogsystemsforAM,FMandMixer operations.
- Design,DemonstrateandAnalyzebalancemodulationandfrequencysynthesis.
- Demonstrate and Analyze pulse sampling and flat topsampling.

Laboratory Experiments:

1.Designaninstrumentationamplifierofadifferentialmodegainof'A'usingthree amplifiers.

2. Design of RC Phase shift and Wien's bridge oscillators using Op-amp.

3. Design active second order Butterworth low pass and high pass filters.

4.Design4bitR–2ROp-AmpDigitaltoAnalogConverter(i)using4bitbinaryinput fromtoggleswitchesand(ii)bygeneratingdigitalinputsusingmod-16counter.

5. Design Adder, Integrator and Differentiator using Op-Amp.

6. Design of Monostable and AstableMultivibratorusing 555 Timer.

7. Demonstrate Pulse sampling, flat top sampling and reconstruction.

8. Amplitude modulation using transistor/FET (Generation and detection).

9. Frequency modulation using IC 8038/2206 and demodulation.

10. Design BJT/FET Mixer.

11.DSBSC generation using Balance Modulator IC 1496/1596.

12. Frequency synthesis using PLL.

Conduct of Practical Examination:

- Alllaboratoryexperimentsaretobeincludedforpracticalexamination.
- Students are allowed to pick one experiment from thelot.
- ChangeofexperimentisallowedonlyonceandMarksallottedtotheprocedure part to be madezero.

Course Outcomes: This laboratory course enables students to:

- Inspect the basic analog systems for a given specification using the basic building blocks and ICs.
- Examine the performance of instrumentation amplifier, LPF, HPF,DAC and oscillators using linear IC.
- Analyze with Linear ICs for applications like addition,integration, differentiation and 555 timer operations to generate pulses.
- Test for pulse and flat top sampling techniques.
- Experiment with Amplitude and Frequency Modulation techniques to find the percentage of modulation and use PLL to synthesize the Frequency.

B.E E&C SIXTH SEMESTERSYLLABUS

DIGITALCOMMUNICATION

B.E., VI Semester, Electronics &Communication Engineering/
TelecommunicationEngineering
[As per Choice Based Credit System (CBCS) scheme]

Subject Code	15EC61	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50 (10Hours/Module)	Exam Hours	03
CREDITS – 04			

Course Objectives: The objectives of the course is to enable students to:

- Understand the mathematical representation of signal, symbol, noise and channels.
- Apply the concept of signal conversion to symbols and signal processing to symbols in transmitter and receiver functionalblocks.
- Compute performance issues and parameters for symbol processing and recovery in ideal and corrupted channelconditions.
- Compute performance parameters and mitigate for these parameters in corrupted and distorted channelconditions.

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	
SignalingoverAWGNChannels-Introduction,Geometricrepresentationof signals, Gram-Schmidt Orthogonalization procedure, Conversion of the continuousAWGNchannelintoavectorchannel,Optimumreceiversusing coherent detection: ML Decoding, Correlation receiver, 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 derivation of probability of error equation)(Text 1: 7.11, 7.12.7.13).	
Module-4	
Communication through Band Limited Channels : Digital Transmission through Band limited channels: Digital PAM Transmission through Band limited Channels, Signal design for Band limited Channels: Design ofband limitedsignalsforzeroISI–TheNyquistCriterion(statementonly),Designof band limited signals with controlled ISI-Partial Response signals, Probability of error for detection of Digital PAM: Probability of error for detectionofDigitalPAMwithZeroISI,Symbol–by–Symboldetectionofdata with controlled ISI (Text 2: 9.1, 9.2, 9.3.1,9.3.2). ChannelEqualization:LinearEqualizers(ZFE,MMSE),AdaptiveEqualizers (Text 2:9.4.2).	L1, L2, L3
Module-5	
Principlesof 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, FrequencyHoppedSpreadSpectrum,CDMAbasedonIS-95(Text2:11.3.1, 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 ableto:

- Develop the concepts of Band pass sampling to well specified signals and channels.
- Utilize 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.

Question paper pattern:

- The question paper will have tenquestions
- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module
- The students will have to answer 5 full questions, selecting one full question from eachmodule

Text Books:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN978-0-471-64735-5.
2. John G Proakis and Masoud Salehi, "Fundamentals of Communication Systems",2014Edition,PearsonEducation,ISBN978-8-131-70573-5.

Reference Books:

1. B.P.Lathi and Zhi Ding, "Modern Digital and Analog communication Systems", Oxford University Press, 4th Edition, 2010, ISBN:978-0-198-07380-2.
2. IanAGloverandPeterMGrant,"DigitalCommunications",PearsonEducation, Third Edition, 2010, ISBN978-0-273-71830-7.
3. John G Proakis and MasoudSalehi, "Communication Systems Engineering", 2nd Edition, Pearson Education, ISBN978-93-325-5513-6.

Web Link and Video Lectures:

1. https://www.classcentral.com/course/swayam-modern-digital-communication-techniques
2. https://nptel.ac.in/courses/117/101/117101051/

ARM MICROCONTROLLER & EMBEDDED SYSTEMS

B.E., VI Semester, Electronics & Communication Engineering/ Telecommunication Engineering
[As per Choice Based Credit System (CBCS) scheme]

ARM MICROCONTROLLER & EMBEDDEDSYSTEMS

B.E., VI Semester, Electronics & Communication Engineering/ Telecommunication Engineering
[As per Choice Based Credit System (CBCS) Scheme]

Course Code	15EC62	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
TotalNumber of Lecture Hours	50 (10 Hours / Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understandthearchitecturalfeaturesandinstructionsetof32bit microcontroller ARM CortexM3.
- ProgramARMCortexM3usingthevariousinstructionsandClanguagefor differentapplications.
- Understandthebasichardwarecomponentsandtheirselectionmethodbasedon the characteristics and attributes of an embeddedsystem.
- Developthehardwaresoftwareco-designandfirmwaredesignapproaches.
- Explaintheneedofrealtimeoperatingsystemforembeddedsystemapplications.

Module-1

ARM-32bit 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

Module-2

ARM Cortex M3 Instruction Sets and Programming: Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming (Text 1: Ch-4, Ch-5, Ch-10(10.1,
10.2, 10.3, 10.5 only) L1, L2, L3

Module-3

Embedded System Components: Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, Optocoupler, Relay, Piezo buzzer, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.
(Text 2: All the Topics from Ch-1 and Ch-2, excluding 2.3.3.4 (stepper motor), 2.3.3.8
(keyboard) and 2.3.3.9 (PPI) sections). L1, L2, L3

Module-4

Embedded SystemDesign Concepts : Characteristics and Quality Attributesof Embedded Systems, Operational and non-operational quality attributes,Embedded

Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling (excluding UML), Embedded firmware design and development (excluding C language).
(Text 2: Ch-3, Ch-4, 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

Module-5

RTOS and IDE for Embedded System Design: Operating System basics, Types of operatingsystems,Task,processandthreads(OnlyPOSIXThreadswithanexample 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), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excludingKeil),
Disassembler/decompiler, simulator, emulator and debuggingtechniques
(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, 10.10 only), Ch 12, Ch-13 (a block diagram before 13.1, 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

Text Books :

1. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes, (Elsevier),2010.
2. Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2nd Edition.

Web Link and Video Lectures:

1. https://nptel.ac.in/courses/117/106/117106111/
2. https://www.classcentral.com/course/swayam-embedded-system-design-with-arm

VLSI Design

B.E., VI Semester, Electronics & Communication Engineering

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

Subject Code	15EC63	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of LectureHours	50 (10 Hours / Module)	Exam Hours	03
CREDITS – 04			

Course Objectives: The objectives of the course is to enable students to:

- Impart knowledge of MOS transistor theory and CMOS technologies
- Impartknowledgeonarchitecturalchoicesandperformancetradeoffsinvolved in designing and realizing the circuits in CMOStechnology
- Cultivate the concepts of subsystem designprocesses
- Demonstrate the concepts of CMOStesting

Module-1	RBT Level
Introduction : A Brief History, MOS Transistors, MOS Transistor Theory, Ideal I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics (1.1, 1.3, 2.1, 2.2, 2.4, 2.5 of TEXT2). Fabrication: nMOS Fabrication, CMOS Fabrication [P-well process, N-well process, Twin tub process], BiCMOS Technology (1.7, 1.8,1.10 of TEXT1).	L1, L2
Module-2	
MOS and BiCMOS Circuit Design Processes : MOS Layers, Stick Diagrams, Design Rules and Layout. Basic Circuit Concepts: Sheet Resistance, Area Capacitances of Layers, Standard Unit of Capacitance, Some Area Capacitance Calculations, Delay Unit, Inverter Delays, Driving Large Capacitive Loads (3.1 to 3.3, 4.1, 4.3to 4.8 of TEXT1).	L1, L2, L3
Module-3	
Scaling of MOS Circuits: Scaling Models & Scaling Factors for Device Parameters Subsystem Design Processes: Some General considerations, An illustration of Design Processes, Illustration of the Design Processes - Regularity, DesignofanALUSubsystem,TheManchesterCarry-chainandAdder Enhancement Techniques(5.1, 5.2, 7.1, 7.2, 8.2, 8.3, 8.4.1, 8.4.2 of TEXT1).	L1, L2, L3
Module-4	
Subsystem Design: Some Architectural Issues, Switch Logic, Gate(restoring) Logic, Parity Generators, Multiplexers, The Programmable Logic Array (PLA) (6.1to 6.3, 6.4.1, 6.4.3, 6.4.6 of TEXT1). FPGA Based Systems: Introduction, Basic concepts, Digital design and FPGA's, FPGA based System design, FPGA architecture, Physical design for FPGA's (1.1 to 1.4, 3.2, 4.8 of TEXT3).	L1, L2, L3
Module-5	
Memory, Registers and Aspects of system Timing - SystemTiming Considerations,SomecommonlyusedStorage/Memoryelements(9.1,9.2of TEXT1).	L1, L2, L3

Testing and Verification: Introduction, Logic Verification, Logic Verification Principles,ManufacturingTestPrinciples,Designfortestability(12.1,12.1.1, 12.3, 12.5, 12.6 of TEXT2).	

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

- Utilize the concept of basic MOS transistor, CMOS fabrication flow and technology scaling.
- Make use of the knowledge of physical design aspects to make stick and layout diagrams for various gates.
- Identify the concept of Memory elements along with timing considerations with scaling fundamentals
- Experiment with the basic knowledge of FPGA based system design and testability issues in VLSI Design
- Analyze the various CMOS subsystems and architectural issues with the design constraints.

Question paper pattern:

- The question paper will have tenquestions
- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module
- The students will have to answer 5 full questions, selecting one full question from eachmodule

Text Books:

1. "Basic VLSI Design" - Douglas A. Pucknell& Kamran Eshraghian, PHI 3rd Edition (original Edition – 1994).
2. "CMOS VLSI Design- A Circuits and Systems Perspective"- Neil H.E. Weste, David Harris, Ayan Banerjee, 3rd Edition, PearsonEducation.
3. "FPGA Based System Design"- Wayne Wolf, Pearson Education, 2004, Technology andEngineering.

Web Link and Video Lectures:

1. https://www.coursera.org/learn/vlsi-cad-logic
2. https://www.classcentral.com/tag/vlsi-design

COMPUTER COMMUNICATION NETWORKS

B.E., VI Semester, Electronics & Communication Engineering / Telecommunication Engineering

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

COMPUTER COMMUNICATION NETWORKS

B.E., VI Semester, Electronics & Communication Engineering / Telecommunication Engineering

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

Course Code	15EC64	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50 (10 Hours /Module)	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable students to:

- UnderstandthelayeringarchitectureofOSIreferencemodelandTCP/IPprotocol suite.
- Understand the protocols associated with eachlayer.
- Learnthedifferentnetworkingarchitecturesandtheirrepresentations.
- Learnthevariousroutingtechniquesandthetransportlayerservices.

Module-1

Introduction: Data Communications: Components, Representations, Data Flow, Networks: Physical Structures, Network Types: LAN, WAN, Switching, Internet.

Network Models: Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP.

Data-Link Layer: Introduction: Nodes and Links, Services, Categories' of link, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control(DLC)

services:Framing,FlowandErrorControl,DataLinkLayerProtocols:SimpleProtocol, Stop and Wait protocol, Piggybacking. L1,L2

Module-2

Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling, Token Passing.

Wired LANs: Ethernet: Ethernet Protocol: IEEE802, Ethernet Evolution, Standard Ethernet: Characteristics, Addressing, Access Method, Efficiency, Implementation, Fast Ethernet: Access Method, Physical Layer, Gigabit Ethernet: MAC Sublayer, Physical Layer, 10 Gigabit Ethernet. L1, L2

Module-3

WirelessLANs:Introduction:ArchitecturalComparison,Characteristics,IEEE802.11: Architecture, MAC Sublayer, Addressing Mechanism, Physical Layer, Bluetooth: Architecture,Layers.

Connecting Devices:Hubs, Switches, VirtualLANs: Membership, Configuration, Communication between Switches and Routers, Advantages.

Network Layer: Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach,IPV4Addresses:AddressSpace,ClassfulAddressing,ClasslessAddressing,

DHCP, Network Address Resolution, Forwarding of IP Packets: Based on destination Address and Label. L1, L2

Module-4

Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams, ICMPv4: Messages, Debugging Tools, MobileIP: Addressing, Agents, Three Phases, Inefficiency in MobileIP.

Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing, Unicast Routing Protocol: Internet Structure, Routing Information Protocol, Open Shortest Path First, Border GatewayProtocol

Version 4. L1, L2, L3

Module-5

Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-Back-N Protocol, Selective repeat protocol, User DatagramProtocol: UserDatagram,UDPServices,UDPApplications,TransmissionControlProtocol:TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Flow control, Error control, TCP congestion control. L1,L2

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

- Make use of the layering architecture of computer networks and distinguish between the OSI reference model and TCP/IP protocol suite.
- Identify the protocols and services of Data link layer
- Identify the protocols and functions associated with the transport layer services.
- Construct a network model and determine the routing of packets using different routing algorithms.
- Distinguish the basic network configurations and standards associated with each network.

Text Book:

Data Communications and Networking , Forouzan, 5th Edition, McGraw Hill, 2016 ISBN: 1-25-906475-3

Reference Books:

1. ComputerNetworks,JamesJKurose,KeithWRoss,PearsonEducation, 2013, ISBN:0-273-76896-4
2. IntroductiontoDataCommunicationandNetworking,WayarlesTomasi, Pearson Education, 2007, ISBN:0130138282

Web Link and Video Lectures:

1. https://www.classcentral.com/course/fundamentals-network-communications
2. https://www.udacity.com/course/computer-networking--ud436

CELLULAR MOBILE COMMUNICATIONS

B.E., VI Semester, Electronics & Communication Engineering/ Telecommunication Engineering

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

Subject Code	15EC651	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (8 Hours /Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course enables students to:

- Understandtheapplicationofmultiuseraccessinacellularcommunication scenario.
- Understandthepropagationmechanismsinanurbanmobilecommunications using statistical and empiricalmodels.
- Understandsystemarchitecture,callprocessingprotocolsandservicesofGSM, GPRS andEDGE.
- Understandsystemarchitecture,callprocessingprotocolsandservicesofCDMA based systems IS95 andCDMA2000.

Module-1	RBT Level
Cellular Concept: Frequency Reuse, Channel Assignment Strategies, Interference and System Capacity, Power Control for Reducing Interference, Trunking and Grade of Service, Improving Capacity in Cellular Systems. Mobile Radio Propagation: Large Scale path Loss- Free Space Model, Three basicpropagationmechanisms,PracticalLinkBudgetDesignusingPathLoss Models,OutdoorPropagationModels–Okumura,Hata,PCSExtensionto Hata Model (explanations only) (Text 1).	L1, L2
Module-2	
Mobile Radio Propagation: Small -Scale Fading and Multipath: Small scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of Mobile Multipath Channels, Types of Small-Scale Fading, Rayleigh and Ricean Distributions,StatisticalModelforMultipathFadingChannels(Clarke'sModel for Flat Fading only).(Text 1)	L1, L2
Module-3	
System Architecture and Addressing : Systemarchitecture,TheSIMconcept,Addressing,Registersandsubscriber data,Locationregisters(HLRandVLR)Security-relatedregisters(AUCand EIR), Subscriber data, Network interfaces andconfigurations. Air Interface – GSM PhysicalLayer: Logical channels, Physical channels, Synchronization- Frequency and clock synchronization, Adaptive frame synchronization, Mapping of logical onto physical channels, Radio subsystem link control, Channel coding, source codingandspeechprocessing,Sourcecodingandspeechprocessing,Channel coding, Power-upscenario. GSM Protocols: Protocol architecture planes, Protocol architecture of the user plane, Protocol architecture of the signaling plane, Signaling at the air interface (Um), Signaling at the A and Abis interfaces, Security-related network functions,	L1, L2

Signaling at the user interface.(Text 2)	
Module-4	
GSM Roaming Scenarios and Handover : Mobileapplicationpartinterfaces,Locationregistrationandlocationupdate, Connection establishment and termination, Handover. (up to 6.4.1 only in Text2) Services: Classical GSM services, Popular GSM services: SMS and MMS. Improved data services in GSM : GPRS, HSCSD andEDGE GPRSSystemarchitectureofGPRS,Services,Sessionmanagement,mobility managementandrouting,Protocolarchitecture,Signalingplane,Interworking with IP networks, Air interface, Authentication and ciphering, Summary of GPRS. HSCSD: Architecture, Air interface, HSCSD resource allocation and capacity issues. EDGE: The EDGE concept, EDGE physical layer, modulation and coding, EDGE: effects on the GSM system architecture, ECSD and EGPRS. (Text 2)	L1, L2
Module-5	
CDMA Technology – Introduction to CDMA,CDMA frequency bands, CDMA Network and System Architecture, CDMA Channel concept, Forward Logical Channels, Reverse logical Channels, CDMA frame format, CDMA System Operations(Initialization/Registration), Call Establishment, CDMA Call handoff,IS-95B,CDMA2000,W-CDMA,UMTS,CDMA data networks, Evolution of CDMA to 3G, CDMA 2000 RAN Components, CDMA 2000 Packet Data Service. (Text 3)	L1, L2

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

- Identify the statistical characterization of urban mobile channels to compute the performance for simple modulation schemes.
- Identify the functionalities of GSM, GPRS and CDMA to meet high data rate requirements and limited improvements that are needed
- Analyse the call process procedure between a calling number and called number for all scenarios in GSM or CDMA based systems
- Build and validate voice / data call handling for various scenarios in GSM and CDMA systems for national and international interworking situations
- Choose voice and data call handling for various scenarios CDMA systems for national and international interworking situations

Question paper pattern:

- The question paper will have tenquestions
- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module
- The students will have to answer 5 full questions, selecting one full question from eachmodule

Text Books:

1. Theodore Rapport, "Wireless Communications – Principles and Practice", Prentice Hall of India , 2nd Edition, 2007, ISBN978-8-120-32381-0.
2. JorgEberspacher,Hans-JorgVogel,ChristianBettstetter,ChristianHartmann,

"GSM–Architecture,ProtocolsandServices",Wiley,3rdEdition,2009,ISBN-978- 0-470-03070-7.
3. Gary J Mullet, "Introduction To Wireless Telecommunications Systems and Networks", Cengage Learning.

ADAPTIVE SIGNAL PROCESSING

B.E., VI Semester, Electronics & Communication Engineering/ Telecommunication Engineering

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

Subject Code	15EC652	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (8 Hours /Module)	Exam Hours	03

CREDITS – 03

Course Objectives: The objectives of this course are to:

- Introduce to the concept and need of adaptive filters and popular adaptive signal processingalgorithms
- Understandtheconceptsoftrainingandconvergenceandthetrade-offbetween performance andcomplexity.
- Introduce to common linear estimationtechniques
- Demonstrate applications of adaptive systems to sampleproblems.
- Introduce inverse adaptivemodelling.

Module-1	RBT Level
Adaptive systems: Definitions and characteristics - applications – properties-examples - adaptive linear combiner input signal and weight vectors-performancefunction-gradientandminimummeansquareerror- introductiontofiltering-smoothingandprediction-linearoptimumfiltering- orthogonality-Wiener–Hopfequation-performancesurface(Chapters1&2 of Text).	L1, L2
Module-2	
Searching performance surface -stability and rate of convergence : Learning curve-gradient search - Newton's method - method of steepest descent - comparison - Gradient estimation - performance penalty-variance -excessMSEandtimeconstants–mis-adjustments(Chapters4&5ofText).	L1, L2
Module-3	
LMS algorithm convergence of weight vector: LMS/Newton algorithm - properties - sequential regression algorithm - adaptive recursive filters - random-search algorithms - lattice structure - adaptive filters with orthogonal signals (Chapters 6& 8 of Text).	L1, L2, L3
Module-4	
Applications-adaptivemod elingand system identification : Multipath communicationchannel,geophysicalexploration,FIRdigitalfiltersynthesis. (Chapter 9 ofText).	L1, L2, L3
Module-5	
Inverse adaptive modeling : Equalization, and deconvolution adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis(Chapter 10 of Text).	L1, L2, L3

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

- Devise filtering solutions for optimising the cost function indicating error in estimationofparametersandappreciatetheneedforadaptationindesign.
- Evaluate the performance of various methods for designing adaptivefilters

through estimation of different parameters of stationary random process clearly considering practical application specifications.

- Analyse convergence and stability issues associated with adaptive filter design and come up with optimum solutions for real life applications taking care of requirements in terms of complexity andaccuracy.
- Design and implement filtering solutions for applications such as channel equalisation, interference cancelling and prediction considering present day challenges.

Question paper pattern:

- The question paper will have tenquestions
- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module.
- The students will have to answer 5 full questions, selecting one full question from eachmodule.

Text Book:

Bernard Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Person Education, 1985.

Reference Books:

1. SimonHaykin,"AdaptiveFilterTheory",PearsonEducation,2003.
2. John R. Treichler, C. Richard Johnson, Michael G. Larimore, "Theory and Design of Adaptive Filters", Prentice-Hall of India,2002.

ARITIFICAL NEURAL NETWORKS

B.E., VI Semester, Electronics & Communication Engineering/ Telecommunication Engineering

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

Subject Code	15EC653	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (8 Hours /Module)	Exam Hours	03

CREDITS – 03

Course Objectives: The objectives of this course are:

- UnderstandthebasicsofANNandcomparisonwithHumanbrain
- Provide knowledge on Generalization and function approximation andvarious architectures of building anANN
- Provideknowledgeofreinforcementlearningusingneuralnetworks
- Provideknowledgeofunsupervisedlearningusingneuralnetworks.

Module-1	RBT Level
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:LearningAlgorithms,ErrorcorrectionandGradientDescentRules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron ConvergenceTheorem.	L1, L2
Module-2	
Supervised Learning: Perceptron learning and Non Separable sets, α-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, μ-LMS approximate to gradient descent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Backpropagation Learning Algorithm, Practical consideration of BP algorithm.	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	
AttractorNeuralNetworks:AssociativeLearningAttractorAssociativeMemory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, SimulatedAnnealing, Boltzmann Machine, Bidirectional Associative Memory.	L1, L2, L3
Module-5	
Self-organization Feature Map :Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self-organization Feature Maps, Application of SOM, Growing Neural Gas.	L1, L2, L3

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

- Understandtheroleofneuralnetworksinengineering,artificialintelligence,and cognitivemodelling.
- Understandtheconceptsandtechniquesofneuralnetworksthroughthestudyof the most important neural networkmodels.
- Evaluatewhetherneuralnetworksareappropriatetoaparticularapplication.
- Applyneuralnetworkstoparticularapplications,andtoknowwhatstepstotake to improve performance.

Question paper pattern:

The question paper will have ten questions.

- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Each full question will have sub questions covering all the topics under a module.Thestudentswillhavetoanswer5fullquestions,selectingonefull question from eachmodule.

Text Book:

Neural Networks A Classroom Approach– Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition.

Reference Books:

1. Introduction to Artificial Neural Systems- J.M. Zurada, Jaico Publications 1994.
2. Artificial Neural Networks- B. Yegnanarayana, PHI, New Delhi1998.

DIGITAL SWITCHINGSYSTEMS

B.E., VI Semester, Electronics &Communication Engineering/ TelecommunicationEngineering

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

Subject Code	15EC654	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (8 Hours /Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to

- Understandthebasicsoftelecommunicationnetworksanddigitaltransmissionof data.
- Studyabouttheevolutionofswitchingsystemsandthedigitalswitching.
- Study about the telecommunication traffic and itsmeasurements.
- Learnthetechnologiesassociatedwiththedataswitchingoperations.
- Understandtheuseofsoftwarefortheswitchinganditsmaintenance

Module-1	RBT Level
DEVELOPMENTOFTELECOMMUNICATIONS:Networkstructure,Network services, terminology, Regulation, Standards. Introduction to telecommunications transmission, Power levels, Four wire circuits, Digital transmission, FDM,TDM, PDH andSDH [Text-1]	L1, L2
Module-2	
EVOLUTION OF SWITCHING SYSTEMS: Introduction, Message switching, Circuit switching, Functions of switching systems, Distribution systems, Basics of crossbar systems, Electronicswitching. DIGITAL SWITCHING SYSTEMS: Switching system hierarchy, Evolution of digital switching systems, Stored program control switching systems, Building blocks of a digital switching system, Basic callprocessing. [Text-1 and 2]	L1, L2
Module-3	
TELECOMMUNICATIONS TRAFFIC: Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, lost call systems, Queuing systems. SWITCHING SYSTEMS: Introduction, Single stage networks, Gradings,Link Systems, GOS of Linked systems. [Text-1]	L1, L2
Module-4	
TIME DIVISION SWITCHING: Introduction, space and time switching, Time switching networks, Synchronisation. SWITCHING SYSTEM SOFTWARE: Introduction, Basic software architecture, Software architecture for level 1to 3 control, Digital switching system software classification, Call models, Software linkages during call, Feature flow diagram, Feature interaction. [Text-1 and 2]	L1, L2
Module-5	
MAINTENANCE OF DIGITAL SWITCHING SYSTEM: Introduction , Software maintenance, Interface of a typical digital switching system central office, System outage and its impact on digital switching system reliability,Impact	L1, L2

of software patches on digital switching system maintainability, A methodology for proper maintenance of digital switching system A GENERIC DIGITAL SWITCHING SYSTEM MODEL: Introduction, Hardwarearchitecture,Softwarearchitecture,Recoverystrategy,Simplecall through a digital system, Common characteristics of digital switching systems. Reliability analysis.[Text-2]	

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

- Identify the basic concepts and parameters of telecommunication networks and services.
- Identify the basic concepts and parameters of telecommunication networks and services.
- Model the traffic flow in lost call systems and queuing systems.
- Organize the digital switching software architecture for various levels of control.
- Identify the software aspects of switching systems and its maintenance.

Question paper pattern:

- The question paper will have tenquestions
- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module
- The students will have to answer 5 full questions, selecting one full question from eachmodule

Text Books:

1. TelecommunicationandSwitching,TrafficandNetworks-JEFlood:Pearson Education,2002.
2. Digital Switching Systems, Syed R. Ali, TMH Ed2002.

Reference Book:

Digital Telephony - John C Bellamy: Wiley India Pvt. Ltd, 3rd Ed, 2008.

MICROELECTRONICS

B.E., VI Semester, Electronics & Communication Engineering/ Telecommunication Engineering

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

Subject Code	15EC655	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of LectureHours	40 (8 Hours /Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- BefamiliarwiththeMOSFETphysicalstructureandoperation,terminal characteristics,circuitmodelsandbasiccircuitapplications.
- Confrontintegrateddeviceand/orcircuitdesignproblems,identifythedesign issues, and developsolutions.
- Analyzeanddesignmicroelectroniccircuitsforlinearamplifieranddigital applications.
- Contrast the input/output and gain characteristics of single-transistor, differentialandcommontwo-transistorlinearamplifierbuildingblockstages.

Module-1	RBT Level
MOSFETS: Device Structure and Physical Operation, V-I Characteristics, MOSFET Circuits at DC, MOSFET as an amplifier and as a switch.	L1, L2
Module-2	
MOSFETS (continued): Biasing in MOS amplifier Circuits, Small Signal Operation and Models, Basic MOSFET amplifier, MOSFET internal capacitances, frequency response of CS amplifier.	L1, L2
Module-3	
MOSFETS (continued): Discrete circuit MOS amplifiers. Single Stage IC Amplifier: Comparison of MOSFET and BJT, Current sources, Current mirrors and Current steering circuits, high frequency response- general considerations.	L1, L2, L3
Module-4	
Single Stage IC Amplifier(continued) :CS with active loads, high frequency response of CS, CG amplifiers with active loads, high frequency response of CG, Cascode amplifiers. CS with source degeneration (only MOS amplifiers to be dealt).	L1, L2
Module-5	
Differential and Multistage Amplifiers: The MOS differential pair, small signal operation of MOS differential pair, Differential amplifier with active loads, and frequency response of the differential amplifiers. Multistage amplifiers (only MOS amplifiers to be dealt).	L1, L2
Course outcomes: After studying this course, students will be ableto: • Explain the underlying physics and principles of operation of Metaloxide-semiconductor(MOS)capacitorsandMOSfieldeffect transistors(MOSFETs). • DescribeandapplysimplelargesignalcircuitmodelsforMOSFETs. • Analyzeanddesignmicroelectroniccircuitsforlinearamplifierfor digitalapplications.	

• UseofdiscreteMOScircuitstodesignSinglestageandMultistage amplifiers to meet stated operatingspecifications.	

Question paper pattern:

- The question paper will have tenquestions
- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module.
- The students will have to answer 5 full questions, selecting one full question from eachmodule.

Text Book:

"Microelectronic Circuits", Adel Sedra and K.C. Smith, 6th Edition, Oxford University Press, International Version, 2009.

Reference Books:

1. "Microelectronics Anintegratedapproach", Roger T Howe, Charles G Sodini, Pearsoneducation.
2. "Fundamentals of Microelectronics", BehzadRazavi, John Wiley India Pvt. Ltd,2008.
3. "Microelectronics–AnalysisandDesign",SundaramNatarajan,TataMcGraw- Hill,2007.

EMBEDDED CONTROLLERLAB

B.E., VI Semester, Electronics &Communication Engineering/
TelecommunicationEngineering
[As per Choice Based Credit System (CBCS) scheme]

Subject Code	15ECL67	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial(Instructions) + 02 Hours Laboratory = 03	Exam Marks	80
RBT Levels	L1, L2, L3	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to:

- UnderstandtheinstructionsetofARMCortexM3,a32bitmicrocontrollerandthe softwaretoolrequiredforprogramminginAssemblyandClanguage.
- ProgramARMCortexM3usingthevariousinstructionsinassemblylevellanguage for differentapplications.
- Interface external devices and I/O with ARM CortexM3.
- DevelopClanguageprogramsandlibraryfunctionsforembeddedsystem applications.

Laboratory Experiments

PART-A: Conduct the following Study experiments to learn ALP using ARM Cortex M3 Registers using an Evaluation board and the required software tool.

1. ALP to multiply two 16 bit binarynumbers.
2. ALP to find the sum of first 10 integernumbers.

PART-B: Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' &Keil uVision-4 tool/compiler.

1. Display “Hello World” message using InternalUART.
2. Interface and Control a DCMotor.
3. InterfaceaSteppermotorandrotateitinclockwiseandanti-clockwise direction.

4. InterfaceaDACandgenerateTriangularandSquarewaveforms.
5. Interfacea4x4keyboardanddisplaythekeycodeonanLCD.
6. UsingtheInternalPWMmoduleofARMcontrollergeneratePWMandvaryits dutycycle.
7. Demonstratetheuseofanexternalinterrupttotoggleanled On/Off.
8. DisplaytheHexdigits0toFona7-segmentLEDinterface,withan appropriate delay inbetween.
9. InterfaceasimpleSwitchanddisplayitsstatusthroughRelay,Buzzerand LED.
10. MeasureAmbienttemperatureusingasensorandSPIADCIC.

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:

1. PART-BexperimentsusingEmbedded-Careonlytobeconsideredforthepractical examination.PART-AALPprogramsareforstudypurposeandcanbeconsidered for Internal Marksevaluation.
2. Strictlyfollowtheinstructionsasprintedonthecoverpageofanswerscriptfor breakup ofmarks.
3. ChangeofexperimentisallowedonlyonceandMarksallottedtotheprocedure part to be madezero.

COMPUTER NETWORKS LABORATORY

B.E., VI Semester, Electronics & Communication Engineering

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

Subject Code	15ECL68	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial(Instructions) + 02 Hours Laboratory = 03	Exam Marks	80
RBT Levels	L1, L2, L3	Exam Hours	03
CREDITS – 02			

Course objectives: This course will enable students to:

- Choosesuitabletoolstomodelanetworkandunderstandtheprotocolsatvarious OSI referencelevels.
- DesignasuitablenetworkandsimulateusingaNetworksimulatortool.
- SimulatethenetworkingconceptsandprotocolsusingC/C++programming.
- Modelthenetworksfordifferentconfigurationsandanalyzetheresults.

Laboratory Experiments

PART-A: Simulation experiments using NS2/ NS3/ OPNET/ NCTUNS/ NetSim/ QualNet or any other equivalent tool

1. Implement a point to point network with four nodes and duplex links between them.Analyzethenetworkperformancebysettingthequeuesizeandvaryingthe bandwidth.
2. Implementafournodepointtopointnetworkwithlinksn0-n2,n1-n2andn2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applicationsoverTCPandUDPagentschangingtheparameteranddeterminethe number of packets sent byTCP/UDP.
3. ImplementEthernetLANusingn(6-10)nodes.Comparethethroughputby changing the error rate and datarate.
4. ImplementEthernetLANusingnnodesandassignmultipletraffictothenodes andobtaincongestionwindowfordifferentsources/destinations.
5. ImplementESSwithtransmissionnodesinWirelessLANandobtainthe performanceparameters.
6. Implementation of Link state routingalgorithm.

PART-B: Implement the following inC/C++

1. Write a program for a HLDC frame to perform the following.

i) Bitstuffing

ii) Characterstuffing.

2.Writeaprogramfordistancevectoralgorithmtofindsuitablepathfor transmission.

3. Implement Dijkstra's algorithm to compute the shortest routingpath.
4. Forthegivendata,useCRC-CCITTpolynomialtoobtainCRCcode.Verifythe program for thecases
   a. Withouterror
   b. Witherror
5. ImplementationofStopandWaitProtocolandSlidingWindowProtocol
6. Writeaprogramforcongestioncontrolusingleakybucketalgorithm.

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

- Illustrate the operations of network protocols and algorithms using C programming.
- Utilize the network simulator for learning and practice of networking algorithms.
- Build the network with different configurations to measure the performance parameters.
- Develop the data link and routing protocols using C programming.
- Develop wired and wireless LAN protocol using network simulator

Conduct of Practical Examination:

- Alllaboratoryexperimentsaretobeincludedforpractical examination.
- Forexaminationonequestionfromsoftwareandonequestionfromhardwareor onlyonehardwareexperimentsbasedonthecomplexitytobeset.
- Students are allowed to pick one experiment from thelot.
- Strictlyfollowtheinstructionsasprintedonthecoverpageofanswerscriptfor breakup ofmarks.
- ChangeofexperimentisallowedonlyonceandMarksallottedtotheprocedure part to be madezero.

6th Semester Open Electives Syllabus for the courses offered by EC/TC Board:

DATA STRUCTURE USING C++

B.E VI Semester (Open Elective)

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

Course Code	15EC661	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 HrsperModule)	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to

- Explainfundamentalsofdatastructuresandtheirapplicationsessentialfor programming/problemsolving
- Analyze Linear Data Structures: Stack, Queues,Lists
- Analyze Non Linear Data Structures:Trees
- Assessappropriatedatastructureduringprogramdevelopment/ProblemSolving

Module -1

INTRODUCTION:Functionsandparameters,Dynamicmemoryallocation,Recursion. LINEAR LISTS: Data objects and structures, Linear list data structures, Array Representation, Vector Representation, Singly Linked lists and chains. L1,L2

Module -2

ARRAYS AND MATRICS: Arrays, Matrices, Special matrices, Sparse matrices.

STACKS:Theabstractdatatypes,ArrayRepresentation,LinkedRepresentation, Applications-Parenthesis Matching & Towers of Hanoi. L1, L2,L3

Module -3

QUEUES: The abstract data types, Array Representation, Linked Representation, Applications-Railroad car arrangement.

HASHING: Dictionaries, Linear representation, Hash table representation. L1, L2, L3

Module -4

BINARYANDOTHERTREES:Trees,Binarytrees,Propertiesandrepresentationof binarytrees,Commonbinarytreeoperations,BinarytreetraversaltheADTbinary tree, ADT binary tree and the class linked binary tree. L1, L2,L3

Module -5

Priority Queues : Linear lists, Heaps, Applications-Heap Sorting.
SearchTrees:Binarysearchtreesoperationsandimplementation,BinarySearch trees with duplicates. 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,operationsandalgorithmsandSparsematricesandHashing
- UnderstandnonLineardatastructurestreesandtheirapplications
- Designappropriatedatastructuresforsolvingcomputingproblems
- Analyze the operations of Linear Data structures: Stack, Queue and Linked List and theirapplications

Text Book:

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

Reference Books:

1. Data structures, Algorithms, and applications in C++, SartajSahni, Mc. Graw Hill,2000.
2. Object Oriented Programming with C++, E.Balaguruswamy, TMH, 6th Edition, 2013.
3. Programming in C++, E.Balaguruswamy. TMH, 4th,2010.

POWER ELECTRONICS

B.E., VI Semester (Open Elective)
[As per Choice Based Credit System (CBCS) scheme]

Subject Code	15EC662	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours / Module)	Exam Hours	03
CREDITS – 03			

Course Objectives: This course will enable students to

- Understand the working of various powerdevices.
- Studyandanalysisofthyristorcircuitswithdifferenttriggeringtechniques.
- Learntheapplicationsofpowerdevicesincontrolledrectifiers,convertersand inverters.
- Study of power electronics circuits under differentload conditions.

Module-1	RBT Level
Introduction - Applications of Power Electronics, Power Semiconductor Devices,ControlCharacteristicsofPowerDevices,typesofPowerElectronic Circuits. Power Transistors: Power BJTs: Steady state characteristics. Power MOSFETs: device operation, switching characteristics, IGBTs: device operation, output and transfer characteristics. (Text 1)	L1, L2
Module-2	
Thyristors - Introduction, Principle of Operation of SCR, Static Anode- Cathode Characteristics of SCR, Two transistor model of SCR, Gate CharacteristicsofSCR,Turn-ONMethods,Turn-OFFMechanism,Turn-OFF Methods: Natural and Forced Commutation – Class A and Class B types, GateTriggerCircuit:ResistanceFiringCircuit,Resistancecapacitancefiring circuit. (Text 2)	L1, L2, L3
Module-3	
Controlled Rectifiers - Introduction, principle of phase controlled converter operation, Single phase full converters, Single phase dual converters. AC Voltage Controllers - Introduction, Principles of ON-OFF Control, PrincipleofPhaseControl,Singlephasecontrolwithresistiveandinductive loads. (Text 1)	L1, L2, L3
Module-4	
DC-DC Converters - Introduction, principle of step-down operation and it's analysiswithRLload,principleofstep-upoperation,Step-upconverterwith aresistiveload,Performanceparameters,Converterclassification,Switching moderegulators:Buckregulator,Boostregulator,Buck-BoostRegulators. (Text 1)	L1, L2

Module-5	
Pulse Width Modulated Inverters- Introduction, principle of operation, performance parameters, Single phase bridge inverters, voltage control of single phase inverters, current source inverters, Variable DC-link inverter, Boostinverter. (Text1)	L1, L2

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

- Describethecharacteristicsofdifferentpowerdevicesandidentifythe applications.
- Illustrate the working of DC-DC converter and invertercircuit.
- Determinetheoutputresponseofathyristorcircuitwithvarioustriggering options.
- Determinetheresponseofcontrolledrectifierwithresistiveandinductiveloads.

Evaluation of Internal AssessmentMarks:

ItissuggestedthatatleastafewexperimentsofPowerElectronicsareconductedbythe students for better understanding of the course. This activity can be considered forthe evaluation of 5 marks out of 20 Internal assessment marks, reserved for the other activities.

Question paper pattern:

- The question paper will have tenquestions
- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)fromeach module.
- EachfullquestionwillhavesubquestionscoveringallthetopicsunderamoduleThestudentswillhavetoanswer5fullquestions,selectingonefullquestionfrom eachmodule

Text Book:

1. Mohammad H Rashid, Power Electronics, Circuits, Devices and Applications, 3rd/4thEdition, Pearson Education Inc, 2014, ISBN:978-93-325-1844-5.
2. M.DSinghandKBKhanchandani,PowerElectronics,2ndEdition,TataMc-Graw Hill, 2009, ISBN:0070583897.

Reference Books:

4. L.Umanand,PowerElectronics,EssentialsandApplications,JohnWileyIndia Pvt. Ltd,2009.
5. Dr.P.S.Bimbhra,"PowerElectronics",KhannaPublishers,Delhi,2012.
6. P.C.Sen,"ModernPowerElectronics",SChand&CoNewDelhi,2005.

DIGITAL SYSTEM DESIGN USING VERILOG

B.E., VI Semester (Open Elective)
[As per Choice Based Credit System (CBCS) scheme]

Subject Code:	15EC663	IA Marks: 20
Number of Lecture Hours/Week:	03	Exam Marks: 80
Total Number of Lecture Hours:	40 (08 Hrs per module)	Exam Hours: 03
CREDITS – 03		

Course objectives: This course will enable students to:

- Understand the concepts of VerilogLanguage.
- Designthedigitalsystemsasanactivityinalargersystemsdesigncontext.
- Studythedesignandoperationofsemiconductormemoriesfrequently used in application specific digitalsystem.
- InspecthoweffectivelyIC'sareembeddedinpackageandassembledin PCB's for differentapplication.
- DesignanddiagnosisofprocessorsandI/Ocontrollersusedinembeddedsystems.

Module -1	RBT Level
Introduction and Methodology: DigitalSystemsandEmbeddedSystems,Real-WorldCircuits,Models,Design Methodology (1.1, 1.3 to 1.5 ofText). Combinational Basics: Combinational Components and Circuits, Verification of Combinational Circuits.(2.3 and 2.4 ofText) Sequential Basics: Sequential Datapaths and Control Clocked Synchronous Timing Methodology (4.3 up to 4.3.1,4.4 up to 4.4.1 ofText).	L1, L2, L3
Module -2	
Memories: Concepts, Memory Types, Error Detection and Correction (Chap 5 of Text).	L1, L2, L3
Module -3	
Implementation F abrics: 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 ofText).	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:

- Apply the knowledge of digital fundamentals with combinational and Sequential circuits to design the Digital System
- Identify different semiconductor memory used in application specific digital systems
- Make use of the knowledge of embedded systems in small microcontrollers, larger CPUs/DSPs, or hard or soft processor cores.
- Inspect different types of processor and I/O controllers that are used in embedded system.

- Develop Verilog model for sequential circuits and Inspect the test pattern generation.

Question paper pattern:

- The question paper will have tenquestions.
- EachfullQuestionconsistingof16marks.Therewillbe2fullquestions(witha maximum of Three sub questions from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfrom eachmodule.

Text Book:

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

B.E E&CE EIGTH SEMESTER SYLLABUS

Wireless Cellular and LTE 4G Broadband

B.E., VIII Semester, Electronics &Communication Engineering/ Telecommunication Engineering
[As per Choice Based Credit System (CBCS) scheme]

Subject Code	15EC81	IA Marks	20
Number of Lecture	04	Exam Marks	80
Total Number	50 (10 Hours / Module)	Exam Hours	03

CREDITS – 04

Course Objectives : This course will enable students to:

- UnderstandthebasicsofLTEstandardizationphasesandspecifications.
- ExplainthesystemarchitectureofLTEandE-UTRAN,thelayerofLTE, based on the use of OFDMA and SC-FDMAprinciples.
- AnalyzetheroleofLTEradiointerfaceprotocolstosetup,reconfigureand release the Radio Bearer, for transferring the EPSbearer.
- AnalyzethemainfactorsaffectingLTEperformanceincludingmobilespeed and transmissionbandwidth.

Module – 1	RBT Level
Key Enablers for LTE features : OFDM, Single carrier FDMA, Single carrierFDE,ChannelDependentMultiuserResourceScheduling,Multi antennaTechniques,IPbasedFlatnetworkArchitecture,LTENetwork Architecture. (Sec 1.4- 1.5 ofText). Wireless Fundamentals: Cellular concept, Broadband wireless channel (BWC), Fading in BWC, Modeling BWC – Empirical and Statisticalmodels,MitigationofNarrowbandandBroadbandFading (Sec 2.2 – 2.7ofText).	L1, L2
Module – 2	
Multicarrier Modulation : OFDM basics, OFDM in LTE, Timing and Frequency Synchronization, PAR, SC-FDE (Sec 3.2 – 3.6 of Text). OFDMA and SC-FDMA: OFDM with FDMA,TDMA,CDMA, OFDMA, SC-FDMA, OFDMA and SC-FDMA in LTE (Sec 4.1 – 4.3, 4.5 of Text). Multiple Antenna Transmission and Reception: Spatial Diversity overview, Receive Diversity, Transmit Diversity, Interference cancellation and signal enhancement, Spatial Multiplexing, Choice betweenDiversity,InterferencesuppressionandSpatialMultiplexing (Sec 5.1 – 5.6 of Text).	L1, L2
Module – 3	
Overview and Channel Structure of LTE : Introduction toLTE, Channel Structure of LTE, Downlink OFDMA Radio Resource,Uplink	L1, L2

SC-FDMA Radio Resource(Sec 6.1 – 6.4 of Text). . Downlink Transport Channel Processing: Overview, Downlink shared channels, Downlink Control Channels, Broadcast channels, Multicast channels, Downlink physical channels, H-ARQ on Downlink(Sec 7.1 – 7.7 of Text).	
Module – 4	
Uplink Channel Transport Processing: Overview, Uplink shared channels, Uplink Control Information, Uplink Reference signals, Random Access Channels, H-ARQ on uplink (Sec 8.1 – 8.6 of Text). Physical Layer Procedures: Hybrid – ARQ procedures, Channel Quality Indicator CQI feedback, Precoder for closed loop MIMO Operations, Uplink channel sounding, Buffer status Reporting in uplink, Scheduling and Resource Allocation, Cell Search, Random AccessProcedures,PowerControlinuplink(Sec9.1-9.6,9.8,9.9,9.10 Text).	L1, L2
Module – 5	
Radio Resource Management and Mobility Management : PDCP overview, MAC/RLC overview, RRC overview, Mobility Management, Inter-cell Interference Coordination(Sec 10.1 – 10.5of Text).	L1, L2

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

- 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:

- The Question paper will have tenquestions.
- Each full Question consisting of 16marks
- There will be 2 full Questions (with a maximum of Three sub questions) from eachmodule.
- Each full question will have sub questions covering all the topics under a module.
- The Students will have to answer 5 full Questions, selecting one full Question from eachmodule.

Text Book:

Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed,
'FundamentalsofLTE',PrenticeHall,CommunicationsEngg.andEmerging Technologies.

Reference Books :

1. LTE for UMTS Evolution to LTE-Advanced' HarriHolma and AnttiToskala, Second Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.
2. 'EVOLVED PACKET SYSTEM (EPS) ; THE LTE AND SAE EVOLUTION OF 3G UMTS' by Pierre Lescuyer and Thierry Lucidarme, 2008, John Wiley & Sons, Ltd. PrintISBN:978-0-470-05976-0.
3. 'LTE – The UMTS Long Term Evolution ; From Theory to Practice' by StefaniaSesia,IssamToufik,andMatthewBaker,2009JohnWiley&Sons Ltd, ISBN978-0-470-69716-0.

Web Link and Video Lectures:

1. https://www.coursera.org/courses?query=wireless
2. https://www.classcentral.com/course/wireless-communications-7503

FIBER OPTICS and NETWORKS

B.E., VIII Semester, Electronics &CommunicationEngineering

[As per Choice Based Credit System (CBCS)]

Subject Code	15EC82	IA Marks	20
Number of Lecture Hours/Week	4	Exam Marks	80
Total Number of Lecture Hours	50(10 Hours / Module)	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable students to:

- Learnthebasicprincipleofopticalfibercommunicationwithdifferent modes of lightpropagation.
- Understandthetransmissioncharacteristicsandlossesinopticalfiber.
- Studyofopticalcomponentsanditsapplicationsinopticalcommunication networks.
- Learnthenetworkstandardsinopticalfiberandunderstandthenetwork architectures along with itsfunctionalities.

Module -1	RBT Level
Optical fiber Communications: Historical development, The general system, Advantages of optical fiber communication, Optical fiber waveguides: Ray theory transmission, Modes in planarguide,Phaseandgroupvelocity,Cylindricalfiber:Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effectiverefractive 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, Fiber connectors, Fiber couplers. (Text 2)	L1, L2
Module -3	
Opticalsources:EnergyBands,DirectandIndirectBandgaps, LightEmittingdiodes:LEDStructures,LightSourceMaterials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant frequencies, Laser DiodestructuresandRadiationPatterns:Singlemodelasers. Photodetectors: Physical principles of Photodiodes, Photodetector noise, Detector response time. Optical Receiver: Optical Receiver Operation: Error sources,	L1, L2

Front End Amplifiers, Receiver sensitivity, Quantum Limit. (Text 1)	
Module -4	
WDM Concepts and Components: Overview of WDM: Operational Principles of WDM, WDM standards, Mach-Zehnder Interferometer Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings, Active Optical Components, Tunable lightsources, 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 nodeand switchingelements,Wavelengthdivisionmultiplexednetworks, 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 routingnetworks:Routingandwavelengthassignment,Optical switching networks: Optical circuit switched networks, packet switched networks, Multiprotocol Label Switching, Optical burst switching networks, Optical network deployment: Long-haul networks, Metropoliton area networks, Accessnetworks, Local area networks. (Text 2)	L1, L2

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

- Classify and explain the working of optical fiber with different modes of signal propagation.
- Utilize the concepts of transmission characteristics to obtain the losses in optical fiber communication.
- Identify the construction and working principle of optical connectors, multiplexers and amplifiers.
- Analyze the constructional features and the characteristics of optical sources and detectors.
- Examine the networking aspects of optical fiber and describe various standards associated with it.

Question Paper pattern:

- The Question paper will have tenquestions.
- Each full Question consisting of 16marks
- There will be 2 full Questions (with a maximum of Three sub questions) from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module.
- The Students will have to answer 5 full Questions, selecting one full Question from eachmodule.

Text Book s:

1. Gerd Keiser , Optical Fiber Communication, 5th Edition, McGraw Hill

Education(India) Private Limited, 2015. ISBN:1-25-900687-5.
2. John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3

Reference Book :
JosephCPalais,FiberOpticCommunication,PearsonEducation,2005, ISBN:0130085103

Web Link and Video Lectures:
1. https://www.classcentral.com/tag/fiber-optics
2. https://swayam.gov.in/nd1_noc20_ph07/preview

Micro Electro Mechanical Systems

B.E., VIII Semester, Electronics &Communication Engineering/ Telecommunication Engineering

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

Subject Code	15EC831	IA Marks	20
Number ofLecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Understandoverviewofmicrosystems,theirfabricationand applicationareas.
- Working principles of several MEMSdevices.
- DevelopmathematicalandanalyticalmodelsofMEMSdevices.
- Know methods to fabricate MEMSdevices.
- Various application areas where MEMS devices canbe used.

Module 1	RBT Level
Overview of MEMS and Microsystems: MEMS andMicrosystem, 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, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis.	L1,L2,L3
Module 4	

Scaling Laws in Miniaturization:Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer.	L1,L2,L3
Module 5	
Overview of Micromanufacturing: Introduction, Bulk Micromanufacturing,SurfaceMicromachining,TheLIGAProcess, Summary on Micromanufacturing.	L1,L2

Course Outcomes: After studying this course, students will be ableto:

- AppreciatethetechnologiesrelatedtoMicroElectroMechanicalSystems.
- UnderstanddesignandfabricationprocessesinvolvedwithMEMS devices.
- AnalysetheMEMSdevicesanddevelopsuitablemathematicalmodels
- Know various application areas for MEMSdevice

Question paper pattern:

- Thequestionpaperwillhave10fullquestionscarryingequalmarks.
- Eachfullquestionconsistsof16markswithamaximumofThreesub questions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopics of themodule
- Thestudentswillhavetoanswer5fullquestions,selectingonefull question from eachmodule.

Text Book:

Tai-Ran Hsu, MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering, 2nd Ed, Wiley.

Reference Books:

1. HansH.Gatzen,VolkerSaile,JurgLeuthold,MicroandNano Fabrication: Tools and Processes, Springer,2015.
2. Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, MicroelectromechanicalSystems(MEMS),CenageLearning.

SPEECH PROCESSING

B.E., VIII Semester, Electronics & Communication Engineering/ Telecommunication Engineering

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

Subject Code	15EC832	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Numberof Lecture Hours	40 (8 Hours / Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course enables students to:

- Introduce the models for speechproduction
- Developtimeandfrequencydomaintechniquesforestimatingspeechparameters
- Introduce a predictive technique for speechcompression
- Providefundamentalknowledgerequiredtounderstandandanalysespeech recognition, synthesis and speaker identificationsystems.

Modules

Module-1	RBT Level
Fundamentals of Human Speech Production: The Process of Speech Production, Short-Time Fourier Representation of Speech, The Acoustic Theory of Speech Production, Lossless Tube Models of the Vocal Tract, Digital Models for Sampled Speech Signals	L1, L2
Module-2	
Time -Domain Methods for Speech Processing: Introduction to Short- Time Analysis of Speech, Short-Time Energy and Short-Time Magnitude, Short-Time Zero-Crossing Rate, The Short-Time Autocorrelation Function, The Modified Short-Time Autocorrelation Function, The Short-Time Average Magnitude DifferenceFunction.	L1, L2
Module-3	
Frequency Domain Representations: Discrete-Time Fourier Analysis, Short-Time Fourier Analysis, Spectrographic Displays, Overlap Addition(OLA),MethodofSynthesis,FilterBankSummation(FBS)Methodof Synthesis, Time-Decimated Filter Banks, Two-Channel Filter Banks, Implementation of the FBS Method Using the FFT, OLA Revisited, Modifications of theSTFT.	L1, L2
Module-4	
The Cepstrum and Homomorphic Speech Processing: Homomorphic Systems for Convolution, Homomorphic Analysis of the Speech Model, Computing the Short-Time Cepstrum and Complex Cepstrum of Speech, Homomorphic Filtering of Natural Speech, Cepstrum Analysis of All-Pole Models, Cepstrum Distance Measures.	L1, L2, L3
Module-5	
Linear Predictive Analysis of Speech Signals: Basic Principles of Linear	L1, L2,

Predictive Analysis, Computation of the Gain for the Model, Frequency Domain Interpretations of Linear Predictive Analysis, Solution of the LPC Equations, The Prediction Error Signal, Some Properties of the LPC Polynomial A(z), Relation of Linear Predictive Analysis to Lossless Tube Models, Alternative Representations of the LP Parameters.	L3

Course outcomes: Upon completion of the course, students will be able to:

- Modelspeechproductionsystemanddescribethefundamentalsofspeech.
- Extract and compare different speechparameters.
- Choose an appropriate speech model for a givenapplication.
- Analysespeechrecognition,synthesisandspeakeridentificationsystems

Question paper pattern:

- The question paper will have tenquestions.
- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Each full question will have sub questions covering all the topics under a module.Thestudentswillhavetoanswer5fullquestions,selectingonefull question from eachmodule.

Text Book :

Theory and Applications of Digital Speech Processing- Rabiner and Schafer, Pearson Education 2011

Reference Books:

3. Fundamentals of Speech Recognition- Lawrence Rabiner and Biing-Hwang Juang, Pearson Education,2003.

4. Speech and Language Processing–An Introduction to Natural Language Processing, Computational Linguistics, andSpeechRecognition- Daniel Jurafsky and James H Martin, Pearson Prentice Hall2009.

Radar Engineering
B.E., VIII Semester, Electronics & Communication Engineering/
Telecommunication Engineering
[As per Choice Based Credit System (CBCS) scheme]

Subject Code	15EC833	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (8 Hours / Module)	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Understand the Radar fundamentals and analyze the radarsignals.
- Understand various technologies involved in the design of radar transmitters and receivers.
- LearnvariousradarslikeMTI,DopplerandtrackingradarsandtheircomparisonModules

Modules	RBT Level
Module-1	
Basics of Radar: Introduction, Maximum Unambiguous Range, Radar Waveforms,Definitionswithrespecttopulsewaveform-PRF,PRI,DutyCycle, Peak Transmitter Power, Average transmitterPower. Simpleformofthe RadarEquation,RadarBlockDiagramandOperation, RadarFrequencies,ApplicationsofRadar,TheOriginsofRadar,Illustrative Problems. (Chapter 1 ofText)	L1, L2, L3
Module-2	
The Radar Equation: Prediction of Range Performance, Detection of signal in Noise, Minimum Detectable Signal, Receiver Noise, SNR, Modified Radar Range Equation, Envelope Detector — False Alarm Time and Probability, Probability of Detection, Radar Cross Section of Targets: simple targets – sphere, cone-sphere, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems. (Chapter 2 of Text, Except 2.4, 2.6, 2.8 & 2.11)	L1, L2, L3
Module-3	
MTI and Pulse Doppler Radar: Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweep to Sweep subtraction and Delay Line Canceler,MTIRadarwith– PowerAmplifierTransmitter,DelayLineCancelers — Frequency Response of Single Delay- Line Canceler, Blind Speeds, Clutter Attenuation, MTI Improvement Factor, N- Pulse Delay-Line Canceler, Digital MTI Processing – Blind phases, I and Q Channels, Digital MTI Dopplersignalprocessor,MovingTargetDetector-OriginalMTD.(Chapter3: 3.1, 3.2, 3.5, 3.6 ofText)	L1, L2, L3
Module-4	
Tracking Radar: TrackingwithRadar-TypesofTrackingRadarSystems,MonopulseTracking- Amplitude Comparison Monopulse (one-and two-coordinates), Phase ComparisonMonopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan	L1, L2, L3

Tracking Radar, Tracking in Range, Comparison of Trackers. (Chapter 4: 4.1, 4.2, 4.3 of Text)	
Module-5	
The Radar Antenna: Functions of The Radar Antenna, Antenna Parameters, Reflector Antennas and Electronically Steered Phased array Antennas. (Chapter 9: 9.1, 9.2 9.4, 9.5 ofText) Radar Receiver: The Radar Receiver, Receiver Noise Figure, Super HeterodyneReceiver,DuplexersandReceiversProtectors,RadarDisplays. (Chapter 11 of Text)	L1, L2, L3

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

- Identify the fundamentals of radar ,tracking and antennas
- Make use of the radar equation and process digital MTI with its applications
- Utilize principle of doppler frequency shift and explain tracking radar antennas
- Develop tracking radar and sequential lobbing
- Analyze radar antenna parameters and tracking range

Question paper pattern:

- The question paper will have tenquestions.
- Each full Question consisting of 16marks
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsundera module.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfrom eachmodule.

Text Book:

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

Reference Books:

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

MACHINE LEARNING

B.E., VIII Semester, Electronics & Communication Engineering/ Telecommunication Engineering

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

Subject Code	15EC834	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (8 Hours / Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- IntroducesomeconceptsandtechniquesthatarecoretoMachineLearning.
- Understand learning and decisiontrees.
- Acquireknowledgeofneuralnetworks,Bayesiantechniquesandinstantbased learning.
- Understand analytical learning and reinforcedlearning.

Modules	
Module-1	RBT Level
Learning:DesigningLearningsystems,PerspectivesandIssues,Concept Learning, Version Spaces and Candidate Elimination Algorithm, Inductive bias.	L1, L2
Module-2	
Decision Tree and ANN: Decision Tree Representation, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree. Neural Network Representation, Perceptrons, Multilayer Networks and Back Propagation Algorithms.	L1, L2
Module-3	
Bayesian and Computational Learning: Bayes Theorem, Bayes Theorem Concept Learning, Maximum Likelihood,Minimum Description LengthPrinciple,BayesOptimalClassifier,GibbsAlgorithm,NaïveBayes Classifier.	L1, L2
Module-4	
Instant Based Learning and Learning set ofrules: K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-BasedReasoning. SequentialCoveringAlgorithms,LearningRuleSets,LearningFirstOrder Rules, Learning Sets of First Order Rules.	L1, L2
Module-5	
Analytical Learning and Reinforced Learning: Perfect Domain Theories,ExplanationBasedLearning,Inductive-AnalyticalApproaches, FOCL Algorithm, ReinforcementLearning.	L1, L2
Course outcomes: At the end of the course, students should be able to:	

- Build the fundamental concepts of Machine learning.
- Make use of the underlying mathematical relationships within and across Machine Learning algorithms.
- Identify the paradigms of supervised and un-supervised learning.
- Develop a real world problem and apply the learned techniques of Machine Learning to solve the problem.
- Inspect Perfect Domain Theories, Inductive-Analytical Approaches and Reinforcement Learning.

Question paper pattern:

- The question paper will have tenquestions.
- Each full question consists of 16marks.
- Therewillbe2fullquestions(withamaximumofThreesubquestions)from eachmodule.
- Each full question will have sub questions covering all the topics under a module.Thestudentswillhavetoanswer5fullquestions,selectingonefull question from eachmodule.

Text Book:

Machine Learning-Tom M. Mitchell, McGraw-Hill Education, (INDIAN EDITION), 2013.

Reference Books:

1. Introduction to Machine Learning- EthemAlpaydin, 2nd Ed., PHI Learning Pvt. Ltd.,2013.
2. The Elements of Statistical Learning- T. Hastie, R. Tibshirani, J. H. Friedman, Springer; 1st edition,2001.

NETWORK AND CYBER SECURITY

B.E., VIII Semester, Electronics & Communication Engineering

[As per Choice Based credit System (CBCS) Scheme

Subject Code	15EC835	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- KnowaboutsecurityconcernsinEmailandInternetProtocol.
- Understand cyber securityconcepts.
- List the problems that can arise in cybersecurity.
- Discuss the various cyber security framework.

Module-1	RBT Level
Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH) (Text 1: Chapter 15)	L1, L2
Module-2	
E-mail Security: Pretty Good Privacy, S/MIME, Domain keys identified mail (Text 1: Chapter 17)	L1, L2
Module-3	
IP Security: IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP), Combining security Associations Internet Key Exchange. Cryptographic Suites(Text 1: Chapter 18)	L1, L2
Module-4	
Cyber network security concepts : Security Architecture, antipattern: signature based malware detection versus polymorphic threads, document driven certification and accreditation, policy driven security certifications. Refactored solution: reputational, behavioural and entropy based malware detection. The problems: cyber antipatterns concept, forces in cyber antipatterns, cyber anti pattern templates, cyber security antipattern catalog (Text-2: Chapter1 & 2)	L1, L2, L3
Module-5	
Cyber network security concepts contd. : Enterprise security using Zachman framework Zachmanframeworkforenterprisearchitecture,primitivemodels versuscompositemodels,architecturalproblemsolvingpatterns, enterprise workshop, matrix mining, mini patterns for problem solvingmeetings. Case study: cyber security hands on – managing administrations	L1, L2, L3

and root accounts, installing hardware, reimaging OS, installing system protection/ antimalware, configuring firewalls (Text-2: Chapter 3 & 4).	

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

- Explain network securityprotocols
- Understand the basic concepts of cybersecurity
- Discuss the cyber securityproblems
- Explain Enterprise SecurityFramework
- Applyconceptofcybersecurityframeworkincomputersystem administration

Question paper pattern:

- Thequestionpaperwillhave10fullquestionscarryingequalmarks.
- Eachfullquestionconsistsof16markswithamaximumofThreesub questions.
- Therewillbe2fullquestionsfromeachmodulecoveringallthetopicsof themodule
- Thestudentswillhavetoanswer5fullquestions,selectingonefull question from eachmodule.

Text Books :

1. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325- 1877-3.
2. ThomasJ.Mowbray,"CyberSecurity–ManagingSystems,Conducting Testing, and Investigating Intrusions",Wiley.

Reference Books :

1. CryptographyandNetworkSecurity,BehrouzA.Forouzan,TMH,2007.
2. CryptographyandNetworkSecurity,AtulKahate,TMH,2003.