SYLLABUS

III Semester (Electronic & Communication Engineering)

3EC4-01: Electronic Devices & Circuits	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

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

CO-1: Understand the basic concepts of semiconductor physics
CO-2: To analyze various diodes and its applications.
CO-3: To Design and analyze various diodes and its applications.
CO-4: To understand BJT and FET configurations.
CO-5: To design and analyze BJT and FET amplifiers.

Sr. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	**01**
2.	**Fundamental of Semiconductor Physics** General Material Properties & Crystal Structures, Classifications of Semiconductors, Fermi-Dirac Distribution Function, Density of State, Equilibrium Carrier Concentration Of Holes/Electrons in Intrinsic/Extrinsic Semiconductors, Drift/Diffusion Equations, Generation/ Recombination, Carrier Lifetime, Continuity Equation, Elements of Quantum Mechanics,	**07**
3.	**Diode & its Applications** Junction Terminologies, Qualitative and Quantitative Analysis of Diode (Poisson Equation, space charge, built-in potential, depletion width), ideal diode volt-ampere equation, Avalanche and Zener breakdown, diode capacitances, reverse recovery transients, Diode based circuits, clippers, clampers, voltage multipliers, half/full wave rectifiers, diode as gate, Zener diode voltage regulators, Small Signal Model of Diode.	**07**
4.	**Bipolar junction Transistors** Terminology, Simplified Structure, Electrostatics, General Operation Considerations, Performance Parameters, I-V characteristics of CE/CB/CC configuration, Ebers-Moll Model, base width modulation, Load Line Analysis, DC Operating Points, Need of Biasing, Fixed Bias Circuits, Self-Bias Circuits, Voltage Divider Bias Circuits, Stability Factor, Thermal	**09**

	Runaway, Thermal Stability.	
5.	**Field Effect Transistors** Introduction to FET, Bias stability in FET, Different FET Configuration, Analysis of CS, CG and CD Configuration, Voltage Biasing Techniques, MOS capacitor, Depletion Mode and Inversion, MOSFET Operation and Enhancement Mode of MOSFET, derivation of I-V Characteristics of MOSFETs.	**08**
6.	**Low Frequency Small Signal Amplifiers** BJT as an amplifier, small signal models of BJT, CE/CC/CB amplifiers, emitter degeneration, multistage amplifiers, low frequency analysis of amplifiers, Miller Theorem, JFET/MOSFET as an amplifier, small signal models of JFET/MOSFET, CS/CD/CG amplifiers, source degeneration.	**08**
	Total	**40**

Suggested Books:

1. J. Millman and C. Halkias, Integrated Electronics, TMH
2. Boylestad & Nashelsky, Electronic Devices and Circuit Theory, Pearson Education
3. A. Sedra and K. Smith, Microelectronic Circuits, Oxford University Press
4. B. Razavi, Fundamentals of Microelectronics, Wiley
5. B. G. Streetman and S. K. Banarjee, Solid State Electronic Devices, Pearson/PHI
6. Donald Neamen, Semiconductor Physics & Devices, TMH
7. D. A Neaman, Microelectronics: Circuit Analysis & Design, TMH

3EC4-02: Digital Electronics	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

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

CO-1: Understand the basics of number systems and logic gates.

CO-2: Explain finite state model and minimization techniques

CO-3: Know structure and design of combinational and sequential logic circuits.

CO-4: Understand the concept different logic families.

S. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	**1**
2.	**Number System, Codes and Logic Gates:** Arithmetic of Nonconventional Number System, Weighted Codes, Binary codes, Code Conversion, Error Correction/Detection Codes, BCD codes, Fixed point & floating point Number System. Basic, Exclusive and Universal Gates, Hazardous in the circuits.	**8**
3.	**Logic Simplification and Minimization Techniques:** Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Tabulation Method.	**7**
4.	**Combinational Logic Circuits Design:** Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Magnitude Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Logic Implementation using combination blocks.	**8**
5.	**Sequential Logic Circuits Design:** Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of Synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation	**8**
6.	**Logic Families and PLD Concept:** TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing. Basics of HDL (VHDL/Verilog) , Syntax and Semantics of HDL. Concept of Programmable logic devices like FPGA.	**8**

	Logic implementation using programmable devices.	
	Total	**40**

Suggested Books:

1. M. Morris Mano: Digital Design, Third Edition, Prentice Hall
2. R. P. Jain: Modern Digital Electronics, Third Edition, TMH
3. Taub and Schilling: Digital Integrated Electronics, McGRAW HILL
4. Sandige: Digital concept Using standard ICs
5. R. J. Tocci: Digital Systems: Principles and Applications, Fourth Edition, Prentice Hall

3EC4-03: Network Theory	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

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

CO-1: Understand the concept of different network theorems.

CO-2: Analyze different type of electric circuit in transient time domain.

CO-3: Understand network functions in S plane.

CO-3: Study and analyze the two port network with different parameters and their interconnection. Analyze their application to different network.

CO-4: Understand Laplace Transformation and its applications.

Sr. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**01**
2.	**Basic Concepts**: Active and passive elements, Concept of ideal and practical sources, Ohm's law, Source transformation, Kirchoff's laws, Analysis of networks by Mesh and Node voltage methods with independent and dependent sources. **Graph Theory:** Graph of network, Tree, Incidence matrix, Cut-sets, f-circuits analysis and f-cut set analysis, Duality, Methods of obtaining dual network.	**08**
3.	**Network Theorems:** Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem and Tellegen's theorem. Analysis of networks with and without dependent AC and DC sources.	**09**
4.	**Two Port networks:** Definition, Open circuit impedance, Short circuit admittance, Hybrid and Transmission parameters and their evaluation for simple circuits, Relationships between parameter sets. Image impedance, Image transfer function.	**08**
5.	**Network Synthesis:** Hurwitz polynomial, Positive real functions, reactive networks. Separation property for reactive networks. The four-reactance function forms, Specification for reactance function. Foster form of reactance networks. Cauer form of reactance networks. Synthesis of R-L and R-C networks in Foster and Cauer forms.	**08**

6.	**Transient Analysis using Laplace Transformation:** Laplace transformation, Laplace transformation of impulse, step, ramp, sinusoidal signals and shifted functions. Initial and Final value theorems. Special signal waveforms with Laplace transform and applications to circuit operations.	**08**
	Total	**42**

Suggested Books:

1. Engineering Circuit Analysis, William H. Hayt et al, Mc Graw Hill Publications.
2. Network Analysis, M. E. Vanvalkenburg, Pearson Publications.
3. Fundamentals of Electric Circuits, Charles K. et al, Mc Graw Hill Publications.
4. A. Chakarvorty, Circuit Theory, Publisher Dhanpat Rai & Co. (Pvt.) Ltd.
5. Engineering Circuit Analysis, J David Irwin et al, Wiley India.
6. Electric Circuits, Mahmood Nahvi, Mc Graw Hill.
7. Introduction to Electric Circuits, Richard C Dorf and James A Svoboda Wiley.

3EC4-04: Signals & Systems	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Familiarization with sampling and processing of various signals.
CO-2: Ability to compute various transform analysis of LTI System.
CO-3: Analyze the Fourier Series for continuous and discrete time signals.
CO-4: Analyze the Fourier transform for continuous and discrete time signals.
CO-5: Evaluate the signals and systems using Z and Laplace Transforms.
CO-6: Understand the concept and application of sampling.

Sr. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	**01**
2.	**Representations of Signals, Classifications of Signals** – Continuous Time, Discrete Time, Comparison among analog, Digital and Discrete Signals, Signal properties: Periodicity, Absolute integrability. Some special signals of importance: Unit Step, Unit Impulse, Sinusoid and the Complex Exponential. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.	**08**
3.	**Operations on Signals and Systems:** Addition, subtraction, multiplication and division of the signals, parallel and series combinations of the systems, cascading of the systems, impulse response characterization and convolution integral for CT- LTI system, signal responses to CT LTI system, properties of convolution, LTI system response properties from impulse response, Examples. Impulse response characterization and convolution sum, Causal signal response to DT-LTI systems. Properties of convolution summation, Impulse response of DT-LTI system. DT-LTI system properties from Impulse response. System analysis from difference equation model.	**07**
4.	**Fourier Series and Fourier Transform:** Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series. Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum. Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform, Fourier Transforms	**08**

	involving Impulse function and Signum function	
5.	**Laplace and z-transforms:** Laplace Transforms, Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Properties, Relation between Laplace and Fourier Transform of a signal. Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms.	**08**
6.	**Sampling & reconstruction:** The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.	**08**
	Total	**40**

Suggested Books:

1. Signals and Systems by Alan V. Oppenheim, Alan S. Wilsky and Nawab, Prentice Hall
2. Signals and Systems by K. Gopalan, Cengage Learning (India Edition)
3. Signals and Systems by Simon Haykin and Bary Van Veen, Wiley- India Publications
4. Linear Systems and Signals by B. P. Lathi, Oxford University Press

3EC4-05: Electronics Measurement and Instrumentation	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

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

CO-1: Understand basic concepts of measurement.
CO-2: Understand the behavior of electronic measuring instruments.
CO-3: Familiarization with CRO and working principal.
CO-4: Understand digital instruments and of analog to digital conversion techniques.
CO-5: Concepts of Strip chart recorder and Magnetic Tape recorder.

Sr. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	**01**
2.	**Fundamentals of Measurement:** Need of Instrumentation, General Measurement System, Classification of Instruments, Static and Dynamic characteristics of instruments, Error: limiting error, Types of Errors. Loading effect: Input impedance and admittance of load & output impedance and admittance of source, loading effects of series and shunt connected instruments, Calibration.	**06**
3.	**Electronic Measuring Instruments:** Electronic Voltmeter, Electronic Multimeters, Component Measuring Instruments: Q meter, Vector Voltmeter, Vector Impedance meter, RF Power & Voltage Measurements, Introduction to shielding & grounding	**06**
4.	**Oscilloscope:** Introduction, General purpose oscilloscope Block Diagram, Cathode Ray Tube, deflection sensitivity, front panel controls, Oscilloscope Probes, Dual trace CRO, ALT and CHOP modes, measurement of electrical parameters like voltage, current, frequency and phase, frequency measurement by Lissajous pattern and Z-modulation. Digital Storage oscilloscope block diagram, sampling rate, bandwidth, roll mode.	**07**
5.	**Digital Instruments:** Introduction to digital instruments, Advantages of Digital instruments over Analog instruments, Block diagram, principle of operation, Accuracy of digital instruments, Need of ADC, ADC types like Flash, Counter, SAR and Dual-Slope, ADC Specifications, Need of DAC, DAC types like Weighted-Resistor and R-2R ladder, DAC Specifications, Its applications in digital instruments like Digital Multimeter, Digital Kilo	**08**

	Watt Hour meter, Digital Clamp meter.	
6.	**Recording Instruments:** Concept and classification of recorder, Basic Strip chart recorder Types of Strip chart recorder- XY Recorder, Magnetic Tape recorder, Different marking mechanism in recorder, Application of recorders	**07**
	Total	**30**

Suggested Books

1. Sawhney A. K., Electrical and Electronics Measurements and Instruments, Dhanpat Rai & Co. 2nd Editon.
2. W. D. Cooper & A. D. Helfrick, 'Electronic Instrumentation and Measurement Techniques', PHI, 4th edition, 1987.
3. David Bell, 'Electronic Instrumentation and Measurements', PHI, 2nd edition.
4. Anand M. M. S., 'Electronic Instruments and Instrumentation Technology', PHI, 02nd edition, 2004.
5. Kalsi H. S., 'Electronic Instrumentation', TMH, 3rd edition, 2010.
6. R. Subburaj, ' Calibration the Foundation for ISO 9000 and TQM
7. Bouwens A. J., 'Digital Instrumentation', McGraw-Hill, 2nd edition

3EC3- 06: Advanced Engineering Mathematics-I	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Objectives: This course aims to impart knowledge of fundamental concepts of numerical analysis, probability & statistics and an introduction to partial differential equations and Fourier series.

Course Outcomes: Upon successful completion of the course the students will be able to

CO-1: Study the numerical interpolations for equal and unequal intervals, numerical differentiation, integration and solving ordinary differential equations by numerical methods.

CO-2: Study the solution of polynomials, algebraic and transcendental by numerical methods including linear equations.

CO-3: Compute the discrete and continuous random variables, probability distributions, expectations, moments, MGF, mean and variances.

CO-4: Define and explain the different statistical distributions like Binomial, Poisson, Normal, Uniform, and Exponential distributions and compute the method of least squares, correlation and regression.

CO-5: Study the theory of partial differential equations by using the separation of variables.

CO-6: Study and understand the Fourier series, half range Fourier sine and cosine series

S. No.	**Contents**	**Hours**
1	**Numerical Analysis–**1: Finite differences and operators, interpolation by using Newton's forward and backward difference formula. Gauss's forward and backward interpolation formula. Stirling's formula. Newton's divided difference and Lagrange's interpolation for unequal intervals. Numerical differentiation. Numerical integration by Trapezoidal rule and Simpson's 1/3 and 3/8 rules. Numerical solution of ordinary differential equations by Euler's method modified Euler's methods, Runge- Kutta method and Milne's PC methods.	10
2	**Numerical Analysis–2**: Solution of polynomials, algebraic and transcendental equations by using the Bisection method, Newton-Raphson method and Regula-Falsi method. Solution of systems of linear equations by using LU decomposition and Gauss elimination method.	7

3	**Probability and Statistics-1:** Discrete and continuous random variables, probability distribution function, mathematical expectations, moments, moment generating functions, mean and variance, cumulant generating function.	6
4	**Probability and Statistics-2:** Binomial distribution, Poisson distribution, Normal distribution, curve fitting, correlation and regression.	9
5	**Fourier Series**: Periodic functions, Fourier series, change of intervals, half range Fourier sine and cosine series, Parseval's theorem. **Partial Differential Equations:** Classification of second order partial differential equations, separation of variables: One dimensional Heat and Wave equations, Two dimensional Laplace equations.	8
	Total	40

Suggested Books:

1. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Fifth Edition, Naros Publishing House, (2016).
2. H.K. Dass, Advanced Engineering Mathematics, 22nd Edition, S. Chand, (2018).
3. Erwin O. Kreyszig, Advanced Engineering Mathematics,, Tenth Edition, Wiley India P Ltd, (2015)
4. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists Academic Press, (2009).
5. K. E. Atkinson, An Introduction to Numerical Analysis (2nd edition), Wiley-India, (1989).

3EC4-20: Electronic Devices & Circuits Lab.	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Understand the working of diodes, special purpose diodes, their characteristics and circuits.

CO-2: Analyze the transistor circuits and their characteristics.

CO-3: Application of diodes and transistors, working on mini projects.

S. No.	**Name of Experiments** Practical are to be performed on the bread-boards only.
1.	Study of Active/Passive Components
2.	Study of Oscilloscope, Function Generator, Multimeter, Power Supply
3.	To draw Diode Characteristic
4.	To draw Zener Diode Characteristics
5.	Use Diode as Clipper/Clamper and draw the response
6.	Design the Rectifiers and Filters circuits using diodes
7.	Use Zener as a voltage Regulator
8.	Draw the BJT Characteristics and show cut off, active and saturation region
9.	To draw the input and output characteristics of FET.
10.	Draw the characteristics of Common Emitter amplifier
11.	Draw the characteristics of Common source amplifier
12.	Mini Project

3EC4-21: Digital Electronics Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Define different types of logic gates, identify their ICs and verify their truth table.
CO-2: Design various adders and subtractors.
CO-3: Realization of multiplexers using logic gates.
CO-4: Design and counters and shift registers
CO-5: Realization of combinational and sequential circuits in VSM and VHDL.

S. No.	Name of Experiments
1.	Realization of Basic/ Exclusive Logic Gates using Universal Logic Gate.
2.	Verification of operation of Full Adder and Full Subtractor.
3.	Design & verification of 4-bit binary adder/subtractor using binary adder IC.
4.	Realization of operation of full adder and full subtractor using IC 74151/74153 MUX.
5.	Design & verification of full adder and full subtractor using an inverted output 3 to 8 line decoder.
6.	Design and verification of operation of a BCD Adder using IC 7483.
7.	Realization of 4 X 1 MUX using basic logic gates.
8.	Verification of operation of BCD to Seven segment code conversion using IC 7447.
9.	Verification of Truth Tables of SR, D and Master Slave JK Flip flops.
10.	Design of BCD ripple counter.
11.	Design of Universal Shift Register.
12.	Implementation of Basic Combinational and sequential circuits using VSM (Virtual System Modeling)
13.	Implementation of Basic Combinational and sequential circuits using VHDL

3EC4-22: Electronic Measurement & Instrumentation Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Understand the characteristics of temperature transducers.

CO-2: Examine the characteristics of photo transducers, Displacement transducers etc.

CO-3: Design signal conditioning circuits for transducers.

S. No.	Name of Experiments
1.	Measure earth resistance using fall of potential method.
2.	Plot V-I characteristics and measure open circuit voltage and short circuit current of a solar panel
3.	Measurement of the distance with the help of ultrasonic transmitter and receiver
4.	Measurement of displacement with the help of LVDT.
5.	Draw the characteristics of the following temperature transducers (a) RTD (Pt-100) (b) Thermistors.
6.	Draw the characteristics between temperature and voltage of a K type thermocouple.
7.	Measurement of strain/ force with the help of strain gauge load cell.
8.	Study the working of Q-meter and measure Q of coils.
9.	Measurement of voltage, Frequency and phase using CRO
10.	Study and implementation of Analog to digital conversion (use suitable IC e.g.0809)
11.	Study and implementation of Digital to Analog conversion (use suitable IC e.g.0808)

3EC4-23: Signals & Systems Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Familiarization & working with MATLAB Tool.
CO-2: Generations and operations on different signals/sequences.
CO-3: Working with FT, IFT, LT and z-transforms in Matlab.
CO-4: Working with distribution and density functions of random variables.

Recommended Tool: MATLAB software.

S.No	Name of Experiment
1	Basic Operations on Matrices
2	Generation of Various Signals and Sequence
3	Operation on Signals and Sequences
4	Convolution Between Signals and Sequences
5	Auto Correlation and Cross Correlation
6	Fourier Transforms and Inverse Fourier Transform
7	Laplace Transforms
8	Z-Transforms
9	Generation of Random Numbers
10	Distribution and Density Functions of Standard Random Variables

SYLLABUS

IV Semester (Electronic & Communication Engineering)

4EC4-01: Applied Electronics	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Understand different topologies of feedback amplifier and design them.

CO-2: Analyze different type of oscillators and design them.

CO-3: Develop the basic understanding of amplifier designing and its analysis using hybrid pie model. Also analyze amplifier operation at low and high frequency and its frequency responses.

CO-4: Inspect and analyze different type of tuned amplifier

CO-5: Demonstrate different type of large signal amplifier and design and analyze them.

Sr. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	**01**
2.	**High Frequency Amplifiers :-** Classification of Amplifiers, Distortion in Amplifiers, Frequency Response of An Amplifier, Hybrid π Model, CE Short Circuit Current Gain, High Frequency Response of a CE Stage, Gain Bandwidth Product, Emitter Follower at High Frequencies, Common Source and Common Drain Amplifier at High Frequencies. Analysis of Multistage Amplifiers at high frequency.	**09**
3.	**Feedback Amplifiers: -** Representation of Amplifiers, Feedback Concept, Transfer Gain with Feedback, Characteristics of Negative Feedback Amplifiers. I/O Impedance in Feedback Amplifiers, Analysis of Amplifiers having Voltage Series, Current Series, Current Shunt and Voltage Shunt Feedback, General Analysis of Multistage Feedback Amplifiers, Effect of Negative Feedback on Bandwidth, Frequency Response of Feedback Amplifiers.	**08**
4.	**Oscillators:-** Stability Criterion, Sinusoidal Oscillators, Barkhausen	**08**

	Criterion, Analysis and design of RC Phase Shift (MOSFET/ BJT) Oscillator, Wien Bridge Oscillators. Resonant Circuit Oscillators, General form of Oscillator Circuit (Hartley and Colpitts Oscillator), Crystal Oscillators, Multivibrators.	
5.	**Large Signal Amplifiers:-** Class A, B, AB, and C Power Amplifiers, Class B/AB Push – Pull Amplifiers, Complementary Symmetry Push-Pull Amplifier, Heat Sinks, Power Output, Efficiency, Crossover Distortion and Harmonic Distortion.	**07**
6.	**Differential Amplifiers:-** Differential amplifiers, AC/DC Analysis of Various Differential Amplifiers using BJT/MOSFET, CMRR and I/O Resistances, Current source/sink, Current Mirrors using MOSFET/BJT, Widlar Current Source.	**07**
	Total	**40**

Suggested Books

1. J. Millman and C. Halkias, Integrated Electronics, TMH
2. A. Sedra and K. Smith, Microelectronic Circuits, Oxford University Press
3. B. Razavi, Fundamentals of Microelectronics, Wiley
4. D. A Neaman, Electronic Circuits: Analysis & Design, TMH
5. D. A Neaman, Microelectronics: Circuit Analysis & Design, TMH
6. R. L. Boylestad & L. Nashelsky, Electronic Devices and Circuit Theory, Pearson Education

4EC4-02: Microprocessor & Microcontroller	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Concept and architecture of 8085.
CO-2: Instruction set and assembly language programming.
CO-3: Interfacing with I/O Devices.
CO-4: Concept and architecture of 8051 Microcontroller.
CO-5: Programming and application of 8051 Microcontroller.

Sr. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	**01**
2.	**Introduction and architecture of 8085:** Microprocessor Architecture & Operations, Memory, I/O Device, Memory and I/O Operations, , Address, Data And Control Buses, Pin Functions, Demultiplexing Of Buses, Generation Of Control Signals, Instruction Cycle, Machine Cycles, T-States, Memory Interfacing.	**07**
3.	**Instruction set and assembly language programming:** Introduction to 8085 assembly language programming, Instruction Set, Addressing modes, Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, macro RTL and micro RTL flow chart of instructions, Code Conversion, BCD Arithmetic and 16-Bit Data operations	**08**
4.	**Interfacing with I/O Devices:** Interfacing Concepts, Ports, Interfacing of I/O Devices, Interrupts in 8085, Programmable Interrupt Controller 8259A, Programmable Peripheral Interface 8255A, 8257 (DMA Controller), 8253/8254 (Programmable Interval Timer).	**08**
5.	**Introduction and architecture of 8051 Microcontroller:** Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.	**08**

6.	**Programming and application of 8051 Microcontroller:** Programming Timer interrupts, programming external hardware interrupts, Programming the serial communication interrupts, Programming 8051 timers and counters.	**08**
	Total	**40**

Suggested Books

1. Hall D.V., "Microprocessor and Interfacing-Programming and Hardware", 2nd Ed., Tata McGraw-Hill Publishing Company Limited, 2008.
2. Gaonkar R.S., "Microprocessor Architecture, Programming and Applications", 5th Ed., Penram International, 2007.
3. Stewart J, "Microprocessor Systems- Hardware, Software and Programming", Prentice Hall International Edition,1990
4. Short K. L., "Microprocessors and Programmed Logic", 2nd Edition , Pearson Education, 2008
5. Kenneth. J. Ayala. The 8051 microcontroller , 3rd edition, Cengage learning, 2010
6. The 8051 Microcontrollers, Architecture and programming and Applications -K. Uma Rao, Andhe Pallavi, Pearson, 2009.

4EC4-03: Analog Communication	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

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

CO-1: Understand the basic behavior of LTI systems.
CO-2: Analyze the Fourier Series for continuous and discrete time signals.
CO-3: Analyze the Fourier transform for continuous and discrete time signals.
CO-4: Study of Receivers and its practical application in analog communication.
CO-5: Understand the use of sampling for analog communication

Sr. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	**01**
2.	**Amplitude Modulation:** Introduction to communication system, Need for modulation, Frequency Division Multiplexing, Amplitude Modulation, Definition, Time domain and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves: Square law detector, Envelop detector, Double side band-suppressed carrier modulators, time domain and frequency domain description, Generation of DSB-SC Modulated waves, SSB and VSB signals.	**08**
3	**Angle Modulation:** Basic concepts, Phase modulation, Frequency Modulation, Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, Wide band FM, Transmission bandwidth of FM Wave - Generation of FM Waves, Detection of FM , Balanced Frequency discriminator, Zero crossing detector, Phase locked loop, Comparison of FM and AM.	**07**
4.	**Noise:** Resistive Noise Source (Thermal), Arbitrary noise Sources, Effective Noise Temperature, Average Noise Figures, Average Noise Figure of cascaded networks, Narrow Band noise, Quadrature representation of narrow band noise & its properties. Noise in Analog communication Systems: Noise in DSBSC and SSB Systems, Noise in AM System, Noise in Angle Modulation System, Threshold effect in Angle Modulation System, Pre-	**07**

	emphasis and de-emphasis.	
5.	**Receivers:** Types of Radio Receiver, Tuned radio frequency receiver, Super heterodyne receiver, RF section and characteristics - Frequency tuning and tracking, Intermediate frequency, AGC, FM Receiver, Comparison with AM Receiver, Amplitude limiting.	**06**
6.	**Pulse modulation:** Sampling theorem, sampling process, Quantization process, quantization noise, Types of Pulse modulation, PAM, PWM, and PPM: Generation and demodulation of pulse modulated signals, Time Division Multiplexing. PCM, μLaw and A- law compressors. Line codes, Noise in PCM, DPCM, DM, delta sigma modulator, ADM.	**08**
	Total	**37**

Suggested Books:

1. Simon Haykins, Communication Systems, Wiley & Sons, 4th Edition.
2. Taub & Schilling, Principles of Communication Systems, TMH.
3. B.P. Lathi, Modern Digital and Analog Communications, Oxford.
4. George Kennedy and Bernard Davis, Electronics& Communication Systems.

4EC4-04: Electromagnetic Field Theory	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

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

CO-1: Understand basics of electric and magnetic fields.
CO-2: Time varying fields and maxwell's equations.
CO-3: Concept of Uniform plane wave.
CO-4: Concept of transmission line equations and its application.
CO-5: TE and TM modes in rectangular and Circular wave guides.

Sr. No.	Contents	Hours
1	**Introduction:** Objective, Scope and Outcome of the course	01
2	**Review Of Electric And Magnetic Fields:** Coulomb's law, electric field intensity, field due to a continuous volume charge distribution, field of a line charge, field of a sheet of charge, electric flux density, Gauss's law and applications, electric potential, the dipole, current density, continuity of current, metallic conductors, conductor properties and boundary conditions, the method of images, the nature of dielectric materials, boundary conditions for perfect dielectric materials, capacitance of two wire line, Poisson's and Laplace's equations, uniqueness theorem. Biot-Savart law, Ampere's law, magnetic vector potentials, force on a moving charge, differential current element, force and torque on a closed circuit, the boundary conditions, the magnetic circuit, potential energy and forces on magnetic materials.	09
3	**Time Varying Fields And Maxwell's Equations**: Faraday's law, Maxwell's equations in point form and integral form Maxwell's equations for sinusoidal variations, retarded potentials.	07
4	**The Uniform Plane Wave**: Wave motion in free space and perfect dielectrics, plane waves in lossy dielectrics, Poynting vector and power considerations, propagation in good conductors, skin effect, reflection of uniform plane waves, SWR.	07
5	**Transmission Lines And Waveguides:** The transmission line equations, graphical methods, Smith chart, Stub Matching, Time domain and frequency domain analysis. TE, TM and TEM waves, TE and TM modes in rectangular	09

	and Circular wave guides, cut-off and guide wavelength, wave impedance and characteristic impedance, dominant modes, power flow in wave guides, excitation of wave guides, dielectric waveguides.	
	Total	**33**

Suggested Books:

1. Matthew N.O. Sadiku and S.V. Kulkarni, "Principles ofElectromagnetics"6th edition, Oxford University Press.
2. E. C. Jordan and K. G. Balmain, Electromagnetic Waves and Radiating Systems, PHI, 3rd Ed..
3. David & Chang, Field and Wave Electromagnetics, Addison Wesley, 3rd Ed..
4. W. H. Hayt, Engineering Electromagnetics, JR. Tata Mc-Graw Hill Edition, Fifth edition.

4EC4-05: Data Structure &Algorithms	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Understanding the fundamental analysis and time complexity for a given problem.
CO2: Articulate linear & non data structures and legal operations permitted on them.
CO3: Applying a suitable algorithm for searching and sorting.
CO4: Understanding graph algorithms, operations, and applications and the importance of hashing.
CO5: Application of appropriate data structures to find solutions to practical problems

S. No.	Contents	Hours
1	**Introduction to Algorithms and Analysis:** Fundamentals of algorithm analysis, Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth, Algorithm efficiency – best case, worst case, average case, Analysis of non-recursive and recursive algorithms.	8
2	**Linear Data Structures:** Array- 1D and 2D array, Stack - Applications of stack: Expression Evaluation - Conversion of Infix to postfix and prefix expression, Tower of Hanoi. Queue - Types of Queues: Circular Queue, Double Ended Queue (deQueue), Applications – Priority Queue using Arrays - List - Singly linked lists – Doubly linked lists - Circular linked lists, Applications -Polynomial Addition/Subtraction	8
3	**Sorting and Search Techniques:** Sorting Algorithms: Basic concepts, Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell Sort, Heap Sort, Merge Sort, Counting Sort, External Sorting, Internal Sorting, Stable & Unstable Sorting. Searching: Linear Search, Binary Search.	8
4	**Trees:** Terminology, Binary Tree – Terminology and Properties, Tree Traversals, Expression Trees – Binary Search Trees – operations in BST – insertion, deletion, Searching. AVL Trees-Insertion, deletion and Rotation in AVL Trees	7
5	**Graphs & Hashing:** Basic definition and Terminology – Representation of Graph – Graph Traversal: Breadth First Search (BFS), Depth First Search	9

	(DFS) - Minimum Spanning Tree: Prim's, Kruskal's- Single Source Shortest Path: Dijkstra's Algorithm. Hashing: Introduction, open hashing-separate chaining, closed hashing - linear probing, quadratic probing, double hashing, random probing, rehashing, Recent Trends in Data Structures and Algorithms	
	Total	**40**

Suggested Books:

1. Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms , Third edition, MIT Press, 2009.
2. Ellis Horowitz, S. Sahni, Freed, "Fundamentals of Data Structures in C",2nd edition,2015.
3. Y. Langsam, M. J. Augenstein and A. M. Tanenbaum, ―Data Structures using C, Pearson Education Asia, 2004.
4. Seymour Lipschutz, Data Structures, Schaum's Outlines Series, Tata McGraw-Hill
5. Simplified approach to Data Structures, Vishal Goyal, Lalit Goyal and Pawan Kumar, Shroff publications and Distributors.

4EC3-06: Advanced Engineering Mathematics-II	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

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

CO-1: To understand the concepts and to solve the problems of Laplace transform along with their properties and applications to ODE and PDE.

CO-2: To understand the concepts and to solve the problems of Fourier transform along with their properties.

CO-3: To study and understand the concepts of Z- transform along with their properties.

CO-4: To study the techniques of complex variables together with other concepts and properties of an analytic function, complex integration, classification of singularities, calculus of residues and evaluation of integrals.

S. No.	Contents	Hours
1.	**Laplace Transform**: Definition of Laplace transform, properties of Laplace transform and examples, Laplace transform of Unit step, Dirac delta and periodic functions, inverse Laplace transforms, properties of inverse Laplace transform, inverse Laplace transform by partial fraction method, convolution theorem, solving ODEs and PDEs by Laplace transforms method.	**12**
2.	**Fourier Transform**: Fourier transform, Fourier sine and cosine transform, properties and formulae, inverse Fourier transform, convolution theorem, application of Fourier transforms to one-dimensional heat and wave equations only.	**8**
3.	**Z-Transform:** Introduction, definition of the Z-transform and examples, basic operational properties of Z-Transform, inverse Z-transform and examples	**8**
4.	**Complex Analysis-I**: Analytic functions, Cauchy-Riemann equations, harmonic functions, construction of analytic function, complex line integral, Cauchy theorem, Cauchy integral formula.	**6**
5.	**Complex Analysis-II**: Taylor and Laurent's theorem, zeros and singularities, residues at poles and infinity, Cauchy residue theorem, evaluation of definite integrals	**6**
	Total	**40**

Suggested Books:

1. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Fifth Edition, Narosa Publishing House, (2016).
2. H.K. Dass, Advanced Engineering Mathematics, 22nd Edition, S. Chand, (2018).
3. Erwin O. Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Pvt. Ltd, (2015)
4. Lokenath Debnath and Dambaru Bhatta, Integral Transforms and Their Applications, Third Edition, CRC Press, Taylor and Francis Group, A Chapman and Hall Book, (2015).
5. M.R. Spiegel, Complex Variables-Schaum's Outline series 2 edition, The Mc-Graw Hill, (2009).
6. E.T. Copson, An introduction to the theory of complex variables, Oxford University Press, (1935).

4EC4-20: Applied Electronics Lab.	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Design and experiment with various amplifiers and oscillators circuits using BJTs and FETs

CO-2: Design Multivibrator circuit using BJT/FET

CO-3: Implement Mini Project related to amplifiers/Oscillators.

Practical are to be performed using the bread-boards and SPICE simulators.

S. No.	List of Experiments
1.	Study and design a single stage RC coupled amplifier and obtain its frequency response curve.
2.	Study and design a double stage RC coupled amplifier and obtain its frequency response curve.
3.	Study and design a differential amplifier and measure its differential and common mode output voltages.
4.	Study and design Voltage Series Feedback amplifier and obtain its frequency response characteristics with and without feedback.
5.	Study and design Current Series Feedback amplifier and obtain its frequency response characteristics with and without feedback.
6.	Study and design RC phase shift oscillator using BJT/FET
7.	Study and design Wein Bridge oscillator using BJT/FET
8.	Study and design Hartley/Colpitt oscillator using BJT
9.	Study and design Push-Pull Amplifier and obtain its efficiency.
10.	Study and design Astable Multivibrator using BJT/FET
11.	Mini Project.

4EC4-21: Microprocessor & Microcontroller Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: To understand the working of a microprocessor/controller.

CO-2: To learn to program a processor using assembly language.

CO-3: Implement Mini Project related to amplifiers.

S. No.	List of Experiments
Following exercises has to be performed on 8085	
1	Study the hardware, functions, memory structure, Instruction set and operation of 8085 microprocessor kit.
2	Write an assembly language program to Add/Subtract two 8-bit/16-bit number.
3	Write an assembly language program to Data transfer/Exchange from one memory block to another in forward and reverse order.
4	Write an assembly language program to generate a square wave of 1khz frequency on the SOD pin of 8085. Operating frequency of 8085 is 3 kHz.
5	Write an assembly language program to perform following conversion: (i) BCD to ASCII (ii) BCD to Hexadecimal.
6	Write an assembly language program for Sorting of array(Ascending/Descending), Searching a number in array, find largest/smallest number in array and to generate Fibonacci series.
Following exercises has to be performed on Microcontroller 8051	
7	Write an assembly language program to transfer/exchange of data from location A to location B.
8	Write an assembly language program to sort an array in ascending/descending order.
9	Write an assembly language program to perform the addition/subtraction/multiplication of two 16-bit numbers.
10	Write an assembly language program to perform logical operations AND, OR, XOR on two eight bit numbers.

4EC4-22: Analog Communication Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

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

CO-1: Demonstrate generation of continuous wave analog modulation techniques and its demodulation process.

CO-2: To learn practical aspects of TDM and FDM.

CO-3: Demonstrate generation of analog pulse modulation techniques and its demodulation process..

S.No.	Name of Experiment
1	Amplitude modulation and demodulation.
2	DSB-SC Modulator & Detector
3	SSB-SC Modulator &Detector (Phase Shift Method)
4	Frequency modulation and demodulation.
5	Analysis of AM and FM signals in frequency domain using Spectrum analyzer
6	Pre-emphasis & de-emphasis.
7	Time Division Multiplexing & De multiplexing.
8	Frequency Division Multiplexing & De multiplexing.
9	Verification of Sampling Theorem
10	Pulse Amplitude Modulation & Demodulation
11	Pulse Width Modulation & Demodulation
12	Pulse Position Modulation & Demodulation

4EC4-23: Computer Programming Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes: Upon successful completion of the course/Lab the students will be able to

CO1: Be able to design and analyze the time and space efficiency of the data structure.
CO2: Understand the concept of static & Dynamic memory management
CO3: Be capable to identity the appropriate data structure for given problem.
CO4: Have practical knowledge on the applications of data structures

S.No.	Name of Experiment
1	Write a program to find the mean and the median of the numbers stored in an array.
2	Write a program to insert one element in an array and delete an element from an- array.
3	Write a program to Linear & Binary search for a number in an array.
4	Write a program to store the marks obtained by 10 students in 5 courses in a two-dimensional array.
5	Write a program to implement single linked list, including insertion, deletion and searching in the linked list.
6	Write a program to print the elements of a linked list in reverse order without disturbing the linked list.
7	Write a program to reverse a linked list.
8	Write a program to add two polynomials using linked lists.
9	Write a program to implement a doubly linked list including insertion, deletion and searching in the linked list.
10	Write a program to implement a stack using an array and linked list.
11	Write a program to implement a queue using an array and linked list.
12	Write a program to implement a circular queue using an array.
13	Write a program to implement a priority queue using a linked list.
14	Write a program to implement a double-ended queue using a linked list.
15	Write a program to implement different types of sorting. (Bubble, Insertion, Quick, Selection, Merge, Heap)
16	Write a program to construct a binary tree and display its preorder, inorder and postorder traversals.
17	Write a program to perform insertion, deletion and searching in Binary Search Tree.
18	Write a program to construct a graph.

19	Write a program to calculate the distance between two vertices in a graph.
20	Write a program to calculate the distances between every pair of vertices in a graph.
21	Write a program to construct a minimal spanning tree of a graph.

Suggested Books:

- Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms , Third edition, MIT Press, 2009.
- Ellis Horowitz, S. Sahni, Freed, "Fundamentals of Data Structures in C",2nd edition,2015.
- Y. Langsam, M. J. Augenstein& A. M. Tanenbaum, Data Structures using C, Pearson Edu. Asia, 2004.
- Data Structures – Lipshutz TMH