Objectives: To learn

- Transforming the given variable coefficient equation (Cauchy’s and Lagrange’s) into the one with constant coefficients.
- Identifying ordinary points, singular points and regular singular points for the given ODE.
- Finding the series solution around a regular singular point.
- Solve the given ODE with variable coefficients by Frobenius method and test the convergence of its series solution.
- Series solutions for Legendre and Bessel differential equations, analyzing the properties of Legendre and Bessel polynomials.
- Differentiation and Integration of complex valued functions.
- Evaluation of integrals using Cauchy’s integral formula.
- Taylor’s series, Maclaurin’s series and Laurent’s series expansions of complex functions.
- Evaluation of integrals using residue theorem.
- Transform a given function from z - plane to w – plane.
- Identify the transformations like translation, magnification, rotation and reflection and inversion.
- Properties of bilinear transformations.

UNIT – I:
Linear ODE with variable coefficients and series solutions(second order only): Equations reducible to constant coefficients-Cauchy’s and Lagrange’s differential equations. Motivation for series solutions, Ordinary point and Regular singular point of a differential equation , Transformation of non-zero singular point to zero singular point. Series solutions to differential equations around zero, Frobenius Method about zero.

UNIT-II
Special Functions : Legendre’s Differential equation, General solution of Legendre’s equation, Legendre polynomials Properties: Rodrigue’s formula – Recurrence relations, Generating function of Legendre’s polynomials – Orthogonality. Bessel’s Differential equation, Bessel functions properties: – Recurrence relations, Orthogonality, Generating function , Trigonometric expansions involving Bessel functions.

UNIT-III:

UNIT-IV:

\[ \int_{-\infty}^{\infty} f(x)dx \] \[ \int_{c}^{c+2\pi} f(\cos \theta, \sin \theta)d\theta \]

UNIT-V:
Conformal mapping: Transformation of z-plane to w-plane by a function, Conformal transformation. Standard transformations- Translation; Magnification and rotation; inversion and reflection,Transformations like \( e^z \), log z, \( z^2 \), and Bilinear transformation. Properties of Bilinear transformation, determination of bilinear transformation when mappings of 3 points are given.

TEXT BOOKS:

REFERENCES:
1) Complex Variables Principles And Problem Sessions By A.K.Kapoor, World Scientific Publishers
2) Engineering Mathematics-3 By T.K.V.Iyengar andD.Krishna Gandhi Etc
3) A Text Book Of Engineering Mathematics By N P Bali, Manesh Goyal
4) Mathematics for Engineers and Scientists, Alan Jeffrey, 6th Edidl. 2013, Chapman & Hall/CRC
6) Mathematics For Engineers By K.B.Datta And M.A S.Srinivas,Cengage Publications

**Outcome:** After going through this course the student will be able to:

- Apply the Frobenius method to obtain a series solution for the given linear 2nd ODE.
- Identify Bessel equation and Legendre equation and solve them under special conditions with the help of series solutions method. Also recurrence relations and orthogonality properties of Bessel and Legendre polynomials.

After going through this course the student will be able to:

a. analyze the complex functions with reference to their analyticity, Integration using Cauchy’s integral theorem,

b. Find the Taylor’s and Laurent series expansion of complex functions

c. The conformal transformations of complex functions can be dealt with ease.
PROBABILITY THEORY AND STOCHASTIC PROCESSES

Objectives:
The primary objective of this course is:
- To provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in signal processing and Communication Engineering.
- To introduce students to the basic methodology of “probabilistic thinking” and to apply it to problems;
- To understand basic concepts of probability theory and random variables, how to deal with multiple random variables, Conditional probability and conditional expectation, joint distribution and independence, mean square estimation.
- To understand the difference between time averages and statistical averages
- Analysis of random process and application to the signal processing in the communication system.
- To teach students how to apply sums and integrals to compute probabilities, means, and expectations.

UNIT-I:
Probability and Random Variable
Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables

UNIT -II:
Distribution & Density Functions and Operation on One Random Variable – Expectations

UNIT-III:
Multiple Random Variables and Operations

UNIT-IV:

UNIT-V:
TEXT BOOKS:

REFERENCE BOOKS:

Outcomes:
Upon completion of the subject, students will be able to compute:
- Simple probabilities using an appropriate sample space.
- Simple probabilities and expectations from probability density functions (pdfs)
- Likelihood ratio tests from pdfs for statistical engineering problems.
- Least-squares & maximum likelihood estimators for engineering problems.
- Mean and covariance functions for simple random processes.
SWITCHING THEORY AND LOGIC DESIGN

Course Objectives:
This course provides in-depth knowledge of switching theory and the design techniques of digital circuits, which is the basis for design of any digital circuit. The main objectives are:

- To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To understand common forms of number representation in digital electronic circuits and to be able to convert between different representations.
- To implement simple logical operations using combinational logic circuits.
- To design combinational logic circuits, sequential logic circuits.
- To impart to student the concepts of sequential circuits, enabling them to analyze sequential systems in terms of state machines.
- To implement synchronous state machines using flip-flops.

UNIT -I:
Number System and Boolean Algebra And Switching Functions: Number Systems, Base Conversion Methods, Complements of Numbers, Codes- Binary Codes, Binary Coded Decimal Code and its Properties, Unit Distance Codes, Alpha Numeric Codes, Error Detecting and Correcting Codes.


UNIT -II:

UNIT -III:

UNIT -IV:

UNIT -V:
Sequential Circuits: Finite state machine-capabilities and limitations, Mealy and Moore models-minimization of completely specified and incompletely specified sequential machines, Partition techniques and Merger chart methods-concept of minimal cover table.
Algorithmic State Machines: Salient features of the ASM chart-Simple examples-System design using data path and control subsystems-control implementations-examples of Weighing machine and Binary multiplier.

TEXT BOOKS:

REFERENCE BOOKS:
3. Digital Logic Design - Ye Brian and HoldsWorth, Elsevier
Course Outcomes:
Upon completion of the course, students should possess the following skills:

- Be able to manipulate numeric information in different forms, e.g. different bases, signed integers, various codes such as ASCII, Gray, and BCD.
- Be able to manipulate simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions.
- Be able to design and analyse small combinational circuits and to use standard combinational functions/building blocks to build larger more complex circuits.
- Be able to design and analyse small sequential circuits and devices and to use standard sequential functions/building blocks to build larger more complex circuits.
Objective:
This course introduces the basic concepts of circuit analysis which is the foundation for all subjects of the Electrical Engineering discipline. The emphasis of this course if laid on the basic analysis of circuits which includes single phase circuits, magnetic circuits, theorems and network topology.

UNIT –I:

UNIT –II:
Single Phase A.C. Circuits: R.M.S. and Average values and form factor for different periodic wave forms, Steady State Analysis of R, L and C (in Series, Parallel and Series Parallel Combinations) with Sinusoidal Excitation, Concept of Reactance, Impedance, Susceptance and Admittance, Phase and Phase difference, Concept of Power Factor, Real and Reactive powers, J-notation, Complex and Polar forms of representation, Complex power.

UNIT –III:

UNIT –IV:
Network Topology: Definitions, Graph, Tree, Basic cutset and Basic Tie set Matrices for Planar Networks, Loop and Nodal methods for analysis of Networks with Dependent & Independent Voltage and Current Sources, Duality & Dual Networks.

UNIT –V:
Network Theorems (With A.C. & D.C): Tellegen’s, Superposition, Reciprocity, Thevinin’s, Norton’s, Maximum Power Transfer, Milliman’s and Compensation theorems for D.C excitations.

TEXT BOOKS:

REFERENCE BOOKS:
2. Electric Circuit Analysis - K.S.Suresh Kumar, Pearson Education.
3. Electrical Circuits - David A.Bell, Oxford University Press.

Outcome:
After going through this course the student gets a thorough knowledge on basics of circuit concepts, electrical parameters, single phase AC circuits, magnetic circuits, resonance, network topology and network theorems with which he/she can able to apply the above conceptual things to real-world problems and applications.
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

II Year B.Tech. ECE-I Sem

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ELECTRONIC DEVICES AND CIRCUITS

Objectives:
This is a fundamental course, basic knowledge of which is required by all the circuit branch engineers. This course focuses:
- To familiarize the student with the principle of operation, analysis and design of Junction diode, BJT and FET transistors and amplifier circuits.
- To understand diode as rectifier.
- To study basic principle of filter circuits and various types.

UNIT-I:

Special Purpose Electronic Devices: Principle of Operation and Characteristics of Tunnel Diode (with the help of Energy Band Diagram), Varactor Diode, SCR and Semiconductor Photo Diode.

UNIT-II:
Rectifiers and Filters: The P-N junction as a Rectifier, Half wave Rectifier, Full wave Rectifier, Bridge Rectifier, Harmonic components in a Rectifier Circuit, Inductor Filters, Capacitor Filters, L- Section Filters, π- Section Filters, Comparison of Filters, Voltage Regulation using Zener Diode.

UNIT-III:

UNIT-IV:

UNIT-V:
Field Effect Transistor and FET Amplifiers


FET Amplifiers: FET Common Source Amplifier, Common Drain Amplifier, Generalized FET Amplifier, Biasing FET, FET as Voltage Variable Resistor, Comparison of BJT and FET.

TEXT BOOKS:
2. Electronic Devices and Circuits – Mohammad Rashid, Cengage Learing, 2013
3. Electronic Devices and Circuits – David A. Bell, 5 Ed, Oxford

REFERENCE BOOKS:

Course Outcomes:
At the end of the course, the student will be able to:
- Understand and Analyse the different types of diodes, operation and its characteristics
- Design and analyse the DC bias circuitry of BJT and FET
- Design biasing circuits using diodes and transistors.
- To analyze and design diode application circuits, amplifier circuits and oscillators employing BJT, FET devices.

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Objectives:
This is a core subject, basic knowledge of which is required by all the engineers. This course focuses on:
- To get an in-depth knowledge about signals, systems and analysis of the same using various transforms.

UNIT-I:
Signal Analysis and Fourier Series
- Signal Analysis: Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.
- Fourier Series: Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series, Dirichlet’s conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum.

UNIT-II:
Fourier Transforms and Sampling
- Sampling: Sampling theorem – Graphical and analytical proof for Band Limited Signals, Types of Sampling - Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to Band Pass sampling.

UNIT-III:
Signal Transmission Through Linear Systems
- Linear System: Impulse response, Response of a Linear System, Linear Time Invariant (LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI system, Filter characteristics of Linear Systems, Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and Rise time.

UNIT-IV:
Convolution and Correlation of Signals
- Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution, Convolution property of Fourier Transforms, Cross Correlation and Auto Correlation of functions, Properties of Correlation function, Energy density spectrum, Parseval’s Theorem, Power density spectrum, Relation between Auto Correlation function and Energy/Power spectral density function, Relation between Convolution and Correlation, Detection of periodic signals in the presence of Noise by Correlation, Extraction of signal from noise by filtering.

UNIT-V:
Laplace Transforms and Z-Transforms

TEXT BOOKS:
1. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.

REFERENCE BOOKS:

**Course Outcomes:**
Upon completing this course the student will be able to:
- Represent any arbitrary signals in terms of complete sets of orthogonal functions and understands the principles of impulse functions, step function and signum function.
- Express periodic signals in terms of Fourier series and express the spectrum and express the arbitrary signal (discrete) as Fourier transform to draw the spectrum.
- Understands the principle of linear system, filter characteristics of a system and its bandwidth, the concepts of auto correlation and cross correlation and power Density Spectrum.
- Can design a system for sampling a signal.
- For a given system, response can be obtained using Laplace transform, properties and ROC of L.T.
ELECTRONIC DEVICES AND CIRCUITS LAB

PART A: (Only for Viva-voce Examination)

Electronic Workshop Practice (In 3 Lab Sessions):
1. Identification, Specifications, Testing of R, L, C Components (Color Codes), Potentiometers, Switches (SPDT, DPDT, and DIP), Coils, Gang Condensers, Relays, Bread Boards, PCB’s
2. Identification, Specifications and Testing of Active Devices, Diodes, BJT’s, Low power JFET’s, MOSFET’s, Power Transistors, LED’s, LCD’s, SCR, UJT.
3. Study and operation of
   i) Multimeters (Analog and Digital)
   ii) Function Generator
   iii) Regulated Power Supplies
   iv) CRO.

PART B: (For Laboratory Examination – Minimum of 10 experiments)
1. Forward & Reverse Bias Characteristics of PN Junction Diode.
2. Zener diode characteristics and Zener as voltage Regulator.
3. Input & Output Characteristics of Transistor in CB Configuration and h-parameter calculations.
4. Input & Output Characteristics of Transistor in CE Configuration and h-parameter calculations.
5. Half Wave Rectifier with & without filters.
6. Full Wave Rectifier with & without filters.
7. FET characteristics.
12. SCR characteristics.
13. UJT Characteristics

PART C: Equipment required for Laboratories:
1. Regulated Power supplies (RPS) -0-30 V
2. CRO’s -0-20 MHz
3. Function Generators -0-1 MHz
4. Multimeters
5. Decade Resistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital) -0-20 µA, 0-50µA, 0-100µA, 0-200µA, 0-10 mA.
8. Voltmeters (Analog or Digital) -0-50V, 0-100V, 0-250V
9. Electronic Components -Resistors, Capacitors, BJT’s, LCDs, SCRs, UJTs, FETs, LEDs, MOSFETs, Diodes- Ge& Si type, Transistors – NPN, PNP type)
Note:
- All the experiments are to be simulated using MATLAB or equivalent software
- Minimum of 15 experiment are to be completed

List of Experiments:

1. Basic Operations on Matrices.
2. Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.
3. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
4. Finding the Even and Odd parts of Signal/Sequence and Real and Imaginary parts of Signal.
5. Convolution between Signals and sequences.
6. Auto Correlation and Cross Correlation between Signals and Sequences.
8. Computation of Unit sample, Unit step and Sinusoidal responses of the given LTI system and verifying its physical realizability and stability properties.
9. Gibbs Phenomenon
10. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.
12. Locating the Zeros and Poles and plotting the Pole-Zero maps in S-plane and Z-Plane for the given transfer function.
17. Verification of Weiner-Khinchine Relations.