PROGRAMME AND COURSE STRUCTURE WITH CREDIT DISTRIBUTION

FOR

UG Degree Programmes with Single Major

IN

ELECTRONICS

(w.e.f. 2023-2024)

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN 722155

STRUCTURE IN ELECTRONICS (UG Degree Programmes with Single Major)

SEMESTER–I

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ELE/101/MJC-1	Basic Circuit Theory and Network Analysis Basic Circuit Theory and Network Analysis Lab	3 1	10	25 15	50	3	NA	2
S/ELE/102/MN-1	Basic Circuit Theory and Network Analysis Basic Circuit Theory and Network Analysis Lab	3 1	10	25 15	50	3	NA	2
S/ELE/103/MD-1	Network Analysis and Analog Electronics	3	10	40	50	3	NA	NA
ACS/104/AEC-1	Compulsory English: Literature and Communication	2	10	40	50	2	NA	NA
S/ELE/105/SEC-1	Programming with MATLAB/Scilab Lab	3	10	40	50	NA	NA	6
ACS/106/VAC-1	Environmental Studies	4	10	40	50	4	NA	NA
Total in Semester - I		20	60	240	300	15		10

N.B. MJC – Major Course, MN – Minor; MD – Multidisciplinary; AEC- Ability Enhancement Course; SEC- Skill Enhancement Course; VAC- Value Added Course.

Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER–II

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ELE/201/MJC-2	Mathematics Foundation for Electronics	4	10	40	50	3	NA	
S/ELE/202/MN-2	Mathematics Foundation for Electronics	4	10	40	50	3	NA	
S/ELE/203/MD-2	Digital System Design	3	10	40	50	3	NA	NA
ACS/204/AEC-2	MIL-1 (Santali/Sanskrit/ Bengali)	2	10	40	50	2	NA	NA
S/PHY/205/SEC-2	Circuit Modelling using SPICE Lab	3	10	40	50	NA	NA	6
ACS/206/VAC-2	Any one of the following: A: Health and Wellness B: Compulsory English: Literature and Communication C: Basics of Indian Constitution D: Arts and Crafts of Bengal E: Historical Tourism in West Bengal.	4	10	40	50	4	NA	NA
ACS/207/INT-1	Internship	4*		50	50	NA	NA	NA
Total in Semester - II		20+4*	60	240	300	15		10
TOTAL IN FIRST IN		40+4*	120	480	600			

N.B. MJ – Major, MN – Minor; MD – Multidisciplinary; AEC- Ability Enhancement Course; SEC- Skill Enhancement Course; VAC- Value Added Course; INT- Internship; 4*- Additional

Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

* Certificate course in Electronics will be awarded to a student if he or she completes Internship of 4 credits in addition to total 40 credits in Semester I & II.

SEMESTER-I

MJCT-1: Basic Circuit Theory and Network Analysis

F.M. = 50 (Theory-25, Practical –15, Internal Assessment –10)

Course Learning Objectives

- To study the basic circuit concepts in a systematic manner suitable for analysis and design.
- To study and analyze the transient and steady-state response of circuits.
- To analyze electric circuits using network theorems and two-port parameters.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Study basic circuit concepts in a systematic manner suitable for analysis and design.
- CO2: Understand transient analysis.
- CO3: Determine AC steady state response.
- CO4: Analyze the electric circuit using network theorems.
- CO5: Understand the two–port network parameters.

Unit-1 (10 Lectures)

Basic Circuit Concepts: Resistors: Fixed and Variable resistors, Color coding of resistors, Inductors-Self and mutual inductance, Energy stored in an inductor, Inductance in series and parallel and its applications, Capacitors-Various types of capacitors, Fixed and Variable capacitor, Energy stored in a capacitor, capacitors in series and parallel and its applications, Voltage and Current Sources-Ideal and Practical, Dependent Sources

Unit-2 (14 Lectures)

Circuit Analysis: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Linear Circuits, Principle of Duality, Star-Delta Conversion
DC Transient Analysis: RC Circuit- Charging and discharging, RL Circuit-Growth and Decay of current, Time Constant in RL and RC Circuits, DC Response of Series RLC Circuits.

Unit-3 (20 Lectures)

AC Circuit Analysis: Sinusoidal Voltage and Current source, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values, Voltage-Current relationship in Resistor, Inductor and Capacitor, Complex Impedance, Phasor, Phase relationship between current and voltage in RL and RC circuit.
Power in AC Circuits: True and apparent power, wattles current, Power factor.
Sinusoidal Circuit Analysis: RL, RC and RLC Circuits, Resonance of Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth.

Unit-4 (16 Lectures)

Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem.
Two Port Network Parameters: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) parameters.

Suggested Books:

1. S.A.Nasar, Electric Circuits, Schaum's outline series,Tata McGraw Hill(2004)
2. M. Nahvi and J.Edminister, Electrical Circuits, Schaum's Outline Series, Tata McGraw-Hill. (2005)
3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
4. W.H. Hayt, J.E.Kemmerly, S.M.Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005)
5. Alexander and M.Sadiku, Fundamentals of Electric Circuits, Tata McGraw Hill (2008)

MJCP-1: Basic Circuit Theory and Network Analysis Lab

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Verify the network theorems and operation of typical electrical circuits.
- CO2: Choose the appropriate equipment for measuring electrical quantities and verify the same for different circuits.
- CO3: Prepare the technical report on the experiments carried.

List of Experiments:

1. Verification of Kirchhoff's Law
2. Verification of Thevenin's Theorem
3. Verification of Superposition Theorem
4. Verification of Maximum Power Transfer Theorem
5. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor (Q) (d) Bandwidth

MNT-1: Basic Circuit Theory and Network Analysis

F.M. = 50 (Theory-25, Practical –15, Internal Assessment –10)

Course Learning Objectives

- To study the basic circuit concepts in a systematic manner suitable for analysis and design.
- To study and analyze the transient and steady-state response of circuits.
- To analyze electric circuits using network theorems and two-port parameters.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Study basic circuit concepts in a systematic manner suitable for analysis and design.
- CO2: Understand transient analysis.
- CO3: Determine AC steady state response.
- CO4: Analyze the electric circuit using network theorems.
- CO5: Understand the two–port network parameters.

Unit-1 (10 Lectures)

Basic Circuit Concepts: Resistors: Fixed and Variable resistors, Color coding of resistors, Inductors-Self and mutual inductance, Energy stored in an inductor, Inductance in series and parallel and its applications, Capacitors-Various types of capacitors, Fixed and Variable capacitor, Energy stored in a capacitor, capacitors in series and parallel and its applications, Voltage and Current Sources-Ideal and Practical, Dependent Sources

Unit-2 (14 Lectures)

Circuit Analysis: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Linear Circuits, Principle of Duality, Star-Delta Conversion
DC Transient Analysis: RC Circuit- Charging and discharging, RL Circuit-Growth and Decay of current, Time Constant in RL and RC Circuits, DC Response of Series RLC Circuits.

Unit-3 (20 Lectures)

AC Circuit Analysis: Sinusoidal Voltage and Current source, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values, Voltage-Current relationship in Resistor, Inductor and Capacitor, Complex Impedance, Phasor, Phase relationship between current and voltage in RL and RC circuit.
Power in AC Circuits: True and apparent power, wattles current, Power factor.
Sinusoidal Circuit Analysis: RL, RC and RLC Circuits, Resonance of Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth.

Unit-4 (16 Lectures)

Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem.
Two Port Network Parameters: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) parameters.

Suggested Books:

6. S.A.Nasar, Electric Circuits, Schaum's outline series,Tata McGraw Hill(2004)

7. M. Nahvi and J.Edminister, Electrical Circuits, Schaum's Outline Series, Tata McGraw-Hill. (2005)
8. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
9. W.H. Hayt, J.E.Kemmerly, S.M.Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005)
10. Alexander and M.Sadiku, Fundamentals of Electric Circuits, Tata McGraw Hill (2008)

MNP-1: Basic Circuit Theory and Network Analysis Lab

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Verify the network theorems and operation of typical electrical circuits.
- CO2: Choose the appropriate equipment for measuring electrical quantities and verify the same for different circuits.
- CO3: Prepare the technical report on the experiments carried.

List of Experiments:

6. Verification of Kirchhoff's Law
7. Verification of Thevenin's Theorem
8. Verification of Superposition Theorem
9. Verification of Maximum Power Transfer Theorem
10. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor (Q) (d) Bandwidth

MDT-1: Network Analysis and Analog Electronics (Credits: Theory-03)

F.M. = 50 (Theory-40, Internal Assessment –10)

Course Learning Objectives

- To impart knowledge of basic concepts in Electronics
- To provide the knowledge and methodology necessary for building electronics circuits.
- The practical exposure enables students to learn circuit implementations and troubleshooting.

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

- CO1: Analyze the electric circuit using network theorems.
- CO2: Illustrate about rectifiers, transistor based amplifiers and its biasing.

Unit-1 (15 Lectures)

Circuit Analysis: Concept of Voltage and Current Sources, Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Mesh Analysis, Node Analysis, Star and Delta Networks, Star-Delta Conversion, Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem.

Unit-2 (15 Lectures)

Semiconductor Diode and its applications: PN junction diode and characteristics, ideal diode and diode approximations. Block diagram of a Regulated Power Supply, Rectifiers: HWR, FWR - center tapped and bridge FWRs. Circuit diagrams, working and waveforms, ripple factor & efficiency (no derivations).Filters: circuit diagram and explanation of shunt capacitor filter with waveforms.
Zener diode regulator: circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.

Unit-3 (20 Lectures)

Bipolar Junction Transistor: Construction, principle & working of NPN transistor, terminology. Configuration: CE, CB, CC. Definition of α, β and γ and their interrelations, leakage currents.
Transistor biasing: Need for biasing, Fixed Bias, Collector to Base Bias, Voltage Divider Bias and Emitter Bias, Circuits and Working, DC Load Line and Operating (Q) Point, Thermal Runaway, Stability and Stability factor.
BJT Amplifiers: Small Signal Analysis of Single Stage CE Amplifier, and h-Parameter equivalent circuit, Frequency Response, Input and Output Impedance, Current and Voltage Gains, Barkhausen Criterion for Sustained Oscillations.

Unit-4 (10 Lectures)

Unipolar Devices: JFET, Construction, Working and I-V Characteristics (Output and Transfer), Pinch-off Voltage, MOSFET, MOS Capacitor, Channel Formation, Threshold Voltage (Ideal and Real), Current-Voltage Relation, Depletion and Enhancement Type MOSFET.

Suggested Books:

1. Electronic Devices and circuit theory, R. Boylstead, L. Nashelsky, 9th Edition (2013),PHI.
2. Engineering Circuit Analysis, Hyat, Kemmerly and Durbin, Tata McGraw Hill.
3. Basic Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshrestaand D.C Gupta -TMH.

4. Network Analysis and Synthesis, Kuo, Wiley.
5. Electronic Circuits: Analysis and Design, Neamen, Tata McGraw Hill.

SECP-1: Programming with MATLAB/Scilab (Credits: 03)
F.M. = 50 (Practical - 40, Internal Assessment – 10)

Course Learning Objectives

- To Impart the Knowledge to the students with MATLAB/Scilab software.
- To provide a working introduction to the MATLAB/Scilab technical computing environment.
- Introduce students the use of a high-level programming language

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

- CO1: Able to use MATLAB/Scilab for interactive computations.
- CO2: Familiar with memory and file management in MATLAB/Scilab.
- CO3: Able to generate plots and export this for use in reports and presentations.
- CO4: Able to program scripts and functions using the MATLAB/Scilab development environment.
- CO5: Able to use basic flow controls (if-else, for, while).
- CO6: Familiar with strings and matrices and their use.

MATLAB/Scilab Basics: The MATLAB/Scilab environment-Command Window, Command History Window, Workspace, Current Directory, Editor Window, Help feature, Types of Files – M-files, MAT files, Some useful MATLAB/Scilab commands,

Constants, Variables, Expressions and control structures: Character set, Data types, Constants and variables, Operators, Hierarchy of operators, Built-in-functions, Loops (for, nested for, while), Branches (if, switch), Break, Continue.

Matrices and vectors: Scalars and vectors, Entering data in Matrices, Matrix manipulations, Generation of special matrices, Matrix and array operations.

Input and Output statements: Assignment statement and variable declaration, Interactive Output commands (format, disp), Formatted input/output functions.

MATLAB/Scilab Graphics: Two dimensional plots, Multiple plots, Style options, Legend, Subplots, Specialized 2-D plots (polar, area, bar, barh, hist, rose, pie, stairs, stem, compass etc.), Three dimensional plots (plot3, bar3, barh3, pie3, stem3, meshgrid, mesh, surf, contour etc.).

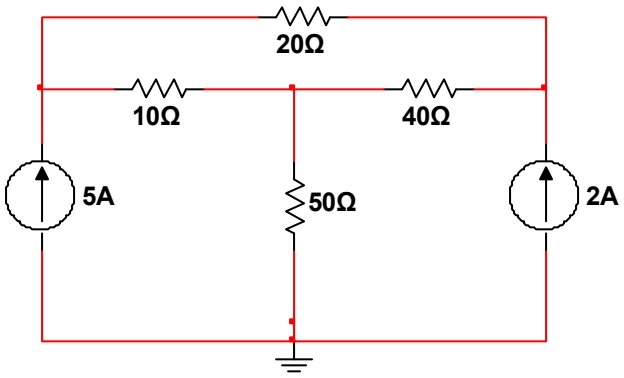
MATLAB/Scilab applications in computational mathematics: Solution of simultaneous linear algebraic equations, Finding eigen values and eigen vectors of a matrix, Solution of Non-Linear Linear Algebraic equations, Solution of ordinary differential equations.

Suggested Books

1. Mastering MATLAB, Duane C. Hanselman, Bruce L. Littlefield, Pearson, 2012.
2. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Rudra Pratap, 2009.
3. MATLAB and Its Applications in Engineering, Raj Kumar Bansal, Ashok K. Goel, Manoj Kumar Sharma, Raj Kumar Bansal, Ashok K. Goel, Manoj Kumar Sharma, Pearson Education, 2009.
4. Introduction to Scilab: For Engineers and Scientists, Sandeep Nagar, Apress; 2017.
5. SCILAB (A Free Software to MATLAB), H. Ramachandran. A.S. Nair, S. Chand

List of Experiments:

1. Script file in MATLAB/Scilab to find the roots of a quadratic equation.
2. MATLAB/Scilab script file to find the node voltages using the nodal analysis.



3. Program to solve the set of linear system of equations using the matrix method:

$$x + 2y + 3z = 9$$
$$2x - y + 3z = 8$$
$$3x + 0y - z = 3$$

4. User-defined MATLAB/Scilab function for the following math function:

$$y(x) = 0.6x^3 e^{-0.47x} + 1.5x^2 e^{-0.6x}$$

The input to the function is x and the output is y. Write the function such that x can be a vector (use element-by-element operations).
(*a*) Use the function to calculate $y(-2)$ and $y(4).$
(*b*) Use the function to make a plot of the function y(x) for $-4 \le x \le 8.$.

5. MATLAB/Scilab program to evaluate the function for any two user-specified values x and y. The function is defined as follows:

$$f(x, y) = x + yx \ge 0 \wedge y \ge 0$$
$$x + y^2 x \ge 0 \wedge y < 0$$
$$x^2 + yx < 0 \wedge y \ge 0$$
$$x^2 + y^2 x < 0 \wedge y < 0$$

6. MATLAB/Scilab script file to calculate the factorial of a given number.
7. MATLAB/Scilab script file that divide the figure window into four sub-windows and plot the following functions using different styles:

a) Plot v vs i where $v = 4 * i$ and i=1, 2, 3, 4 on the upper left portion
b) Plot y vs x where $y = x^2$ and x = 1,2,3,4 on the upper right portion
c) Plot $\sin(t)$ vs t for $t = 0 : 2\pi$ in step $t = \pi/60$ on the lower left portion
d) Plot $\cos(t)$ vs t for $t = 0 : \frac{\pi}{30} : 2\pi$ on the lower right portion

8. Write the expected return of the following commands or functions with example:
   a) fprintf/ceil(x)
   b) ones/input
   c) size/poly
   d) axis/legend

9. Solve the first order ODE and verify your result with MATLAB/Scilab (any one)

$$i.\,4\frac{dx}{dt}+3x=t^2+\cos(t),\ with\ initial\ condition\ x(0)=3.$$

$$ii.\,4\frac{dx}{dt}+3x=1\ with\ initial\ condition\ x(0)=3.$$

10. The current flowing through the semiconductor diode is given by the equation $i_D=I_o\left(e^{\frac{qv}{KT}}-1\right)$ where the symbols have their usual meanings. Let the leakage current I_0 of the diode is 2.0 μA. Write a program to calculate the current flowing through this diode for all voltages from -1.0 V to + 0.6 V, in 0.1 V steps. Repeat this process for the following temperatures: 75°F, 100°F, and 125°F. Create a plot of the current as a function of applied voltage, with the curves for the three different temperatures appearing as different colours.

SEMESTER-II

MJCT-2: Mathematics Foundation for Electronics (Credits: Theory-04)

F.M. = 50 (Theory - 40, Internal Assessment –10)

Course Learning Objectives

The purpose of this course is to provide students with the skills and knowledge to perform calculations for solution of problems related to various topics they would study in their programme, particularly the use of ordinary differential equations. The course aims to prepare students with the mathematical tools they would require while solving transient circuits in power electronics and problem solving in Electromagnetic Theory.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Use mathematics as a tool for solving/modeling systems in electronics
- CO2: Solve non-homogeneous linear differential equations of any order using a variety of methods, solve differential equations using power series and special functions
- CO3: Understand methods to diagonalize square matrices and find eigen values and corresponding eigenvectors for a square matrix, and check for its diagonalizability
- CO4: Familiarize with the concept of sequences, series and recognize convergent, divergent, bounded, Cauchy and monotonic sequences.
- CO5: Perform operations with various forms of complex numbers to solve equations

Unit–1 (14 Lectures)

Ordinary Differential Equations and Power Series solution of differential equations: Basic concepts, different types of Differential Equations, Constant and variable co-efficient type, First Order ordinary Differential Equations, Second order homogeneous and non-homogeneous Differential Equations, Different solution techniques as applied to physical problems-like thermal, electrical systems, Solution by Frobenious Power series method, Partial Differential equation and solution by separation of variable methods-wave equation and its solution.

Special functions: Error functions, Gamma function, Beta function and its characteristics, Evaluation of Gamma function of some arguments, Relation between Gamma and Beta functions.

Unit-2 (10 Lectures)

Matrices: Introduction to Matrices, Rank of Matrices, Different techniques for solution of a System of Linear Algebraic Equations. Eigen Values and Eigen Vectors, Linear Transformation, Properties of Eigen Values and Eigen Vectors, Diagonalization, Inversion, Powers of a Matrix, Classification of different types of Real and Complex Matrices.

Unit-3 (8 Lectures)

Sequences and series: Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series-conditions and methods.

Unit-4 (12 Lectures)

Complex Variables and Functions: Complex Variable, Complex Function, Continuity, Differentiability, Analyticity. Cauchy-Riemann(C-R) Equations, Harmonic and Conjugate Harmonic Functions, Exponential Function, Trigonometric Functions, Line Integral in Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivative of Analytic Functions, Zeroes and Poles, Singular points and poles, Residue integration method, Residue integration of real Integrals, Residue as a pole of

order m, Evaluation of simple complex integrals.

Unit-5 (10 Lectures)

Vector Analysis: Definitions and notations: Basic operations vector addition, multiplication by scalar, Product of Vectors – Scalar (dot) & Vector (cross), important identities, Vectors Calculus -differentiation and integration of vectors, gradient, Divergence, Curl, Important theorems – Gauss', Stokes, Green's theorems (statement and explanation only).

Unit - 6 (6 Lectures)

Fourier Series: Set of functions – linear independence and completeness, Fourier's theorem statement only), Analysis of simple waveforms using Fourier series.

Suggested Books

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley India(2008)
2. Murray Spiegel, Seymour Lipschutz, John Schiller, Outline of Complex Variables, Schaum Outline Series,Tata McGraw Hill (2007)
3. R.K.Jain,and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
4. C.R.Wylie and L.C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)
5. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)

MNT-2: Mathematics Foundation for Electronics (Credits: Theory-04)

F.M. = 50 (Theory - 40, Internal Assessment –10)

Course Learning Objectives

The purpose of this course is to provide students with the skills and knowledge to perform calculations for solution of problems related to various topics they would study in their programme, particularly the use of ordinary differential equations. The course aims to prepare students with the mathematical tools they would require while solving transient circuits in power electronics and problem solving in Electromagnetic Theory.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Use mathematics as a tool for solving/modeling systems in electronics
- CO2: Solve non-homogeneous linear differential equations of any order using a variety of methods, solve differential equations using power series and special functions
- CO3: Understand methods to diagonalize square matrices and find eigen values and corresponding eigenvectors for a square matrix, and check for its diagonalizability
- CO4: Familiarize with the concept of sequences, series and recognize convergent, divergent, bounded, Cauchy and monotonic sequences.
- CO5: Perform operations with various forms of complex numbers to solve equations

Unit–1 (14 Lectures)

Ordinary Differential Equations and Power Series solution of differential equations: Basic concepts, different types of Differential Equations, Constant and variable co-efficient type, First Order ordinary Differential Equations, Second order homogeneous and non-homogeneous Differential Equations, Different solution techniques as applied to physical problems-like thermal, electrical systems, Solution by Frobenious Power series method, Partial Differential equation and solution by separation of variable methods-wave equation and its solution.

Special functions: Error functions, Gamma function, Beta function and its characteristics, Evaluation of Gamma function of some arguments, Relation between Gamma and Beta functions.

Unit-2 (10 Lectures)

Matrices: Introduction to Matrices, Rank of Matrices, Different techniques for solution of a System of Linear Algebraic Equations. Eigen Values and Eigen Vectors, Linear Transformation, Properties of Eigen Values and Eigen Vectors, Diagonalization, Inversion, Powers of a Matrix, Classification of different types of Real and Complex Matrices.

Unit-3 (8 Lectures)

Sequences and series: Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series-conditions and methods.

Unit-4 (12 Lectures)

Complex Variables and Functions: Complex Variable, Complex Function, Continuity, Differentiability, Analyticity. Cauchy-Riemann(C-R) Equations, Harmonic and Conjugate Harmonic Functions, Exponential Function, Trigonometric Functions, Line Integral in Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivative of Analytic Functions, Zeroes and Poles, Singular points and poles, Residue integration method, Residue integration of real Integrals, Residue as a pole of order m, Evaluation of simple complex integrals.

Unit-5 (10 Lectures)

Vector Analysis: Definitions and notations: Basic operations vector addition, multiplication by scalar, Product of Vectors – Scalar (dot) & Vector (cross), important identities, Vectors Calculus -differentiation and integration of vectors, gradient, Divergence, Curl, Important theorems – Gauss', Stokes, Green's theorems (statement and explanation only).

Unit - 6 (6 Lectures)

Fourier Series: Set of functions – linear independence and completeness, Fourier's theorem statement only), Analysis of simple waveforms using Fourier series.

Suggested Books

6. E. Kreyszig, Advanced Engineering Mathematics, Wiley India(2008)
7. Murray Spiegel, Seymour Lipschutz, John Schiller, Outline of Complex Variables, Schaum Outline Series,Tata McGraw Hill (2007)
8. R.K.Jain,and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
9. C.R.Wylie and L.C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)
10. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)

MDT-2(Theory): Digital System Design (Credits: Theory-03)

F.M. = 50 (Theory - 40, Internal Assessment – 10)

Course Learning Objectives

As there is lot of industrial and research based job opening in the area, the course offers a hands-on in designing digital systems on hardware (fabrication) and testing with a holistic approach to the subject, making students ready for the industry or research.

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

- CO1: Understand and represent numbers in powers of base and converting one from the other
- CO2: Understand basic logic gates, concepts of Boolean algebra and techniques
- CO3: Analyze and design combinatorial as well as sequential circuits

Unit-1 (15 Lectures)

Number System and Codes: Decimal, Binary, Octal and Hexadecimal Number Systems, Base Conversions, 1's and 2's Complements, Representation of Signed and Unsigned Numbers, BCD Code, Grey Codes, Binary, Octal and Hexadecimal Arithmetic, Addition, Subtraction by 2's Complement Method, Multiplication.

Boolean algebra and Logic gates: Boolean algebra- Positive and negative logic. Boolean laws. De Morgan's theorems, simplification of Boolean expressions-SOP and POS. Logic gates-Basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map-3 and 4 variable expressions. Characteristics of logic families: Fan In and Fan out, power dissipation and noise Immunity, propagation delay.

Unit-2 (10 Lectures)

Combinational logic analysis and design: Half and Full Adder, Half and Full Subtractor, 4-Bit Binary Adder and Subtractor, Multiplexers, Demultiplexers, Encoder, Decoder, Code Converter (Binary to BCD and Vice Versa).

Unit-3 (15 lectures)

Sequential logic design: Latches, Flip flop, SR, JK, D and T Flip Flops, Truth Table, Excitation Table and Excitation Equation, Clocked (Level and Edge Triggered) Flip Flops, Preset and Clear Operations, Race around conditions in JK flip flop, Master-Slave JK Flip Flop.

Shift Registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers.

Counters: Ripple, Ring, Synchronous, Asynchronous, Decade and Modulo-N Counters, Excitation Table and Excitation Equation.

Unit 4 (20 Lectures)

D-A and A-D Conversion: 4-Bit Binary Weighted and R-2R D-A Converter, Circuit and Working, Accuracy and Resolution, A-D Conversion Characteristics, Successive Approximation ADC. (Mention of relevant ICs for all).

Suggested Books:

1. M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia(1994)
3. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, PHI(2000)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

SECP-2: Circuit modeling using SPICE Lab (Credits: 03)
F.M. = 50 (Practical - 40, Internal Assessment – 10)

Objectives: The objectives of this lab course are to make the student practically gain knowledge of about simulation of various circuits using SPICE software.

Outcome: At the end of the course, the student will be able to simulate various circuits using SPICE software.

Introduction: Introduction to Spice software, file types, netlist commands.

Basic Analysis: DC, AC, Transient. Analog behavioral models (ABM): equations setup, voltage/current/ frequency dependent sources.

Circuit Modelling: I-V characteristic, Temperature Effects, Iterative solution of simple series circuit, Solution of simple series circuit using an equation solver, Spice solution of simple series circuit, Spice I-V Characteristic, Spice I-V Characteristic with temperature dependence, Thevenin solution, Diode Models, Diode Circuits, Rectifier, Clipping, Zener Circuit, Spice AC, DC, transient, and bias point simulations.

Suggested Books:

1. Introduction to Spice Using OrCAD for Circuits and Electronics, M.H. Rashid, Pearson, 2015.
2. SPICE: A Guide to Circuit Simulation and Analysis Using Spice, P. W. Tuinenga, PHI, 1995.

List of Experiments:

1. Determine currents for the given DC circuit by mesh analysis
2. Simulate the DC Circuit for determining all the node voltages
3. Verification of Thevenin's theorem
4. Verification of Norton's theorem
5. Verification of Maximum Power Transfer Theorem for DC circuit
6. Find out the transient response and parametric analysis by simulation of RLC circuits
7. Transient Analysis of 1^{st} order circuit