KAMARAJ COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)

S.P.G.Chidambara Nadar - C.Nagammal Campus

S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS – 2021

AUTONOMOUS SYLLABUS

CHOICE BASED CREDIT SYSTEM

III TO IV SEMESTER CURRICULUM AND SYLLABI

VISION:

To make the Department of Electronics and Communication Engineering of this Institution the unique of its kind in the field of Research and Development activities in this part of world.

MISSION:

To impart highly innovative and technical knowledge in the field of Electronics and Communication Engineering to the urban and unreachable rural student folks through Total Quality Education.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: To establish a strong foundation in Electronics and Communication Engineering necessary to formulate, model, analyze and solve real time problems.

PEO 2: To inculcate professional skills and life skills for placement or to pursue higher studies in the relevant fields.

PEO 3: To promote research and development activities and solve industrial problems with creative ideas.

PROGRAM OUTCOMES:

After going through the four years of study, the Electronics and Communication Engineering graduates will have the ability to

POs	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem analysis	Identify,formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/Development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1 : Ability to make use of attained technical knowledge in the field of Electronics and Communication Engineering for successful career and qualifying in competitive examinations at the national level.

PSO2 : Ability to develop workable solutions for real time challenges in Electronics and Communication Engineering.

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B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABI FOR SEMESTER III TO IV

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA2202	Transforms and Numerical Solution of Equations	BS	4	3	1	0	4
2	AI2202	Data Structures and Algorithms	ES	3	3	0	0	3
3	EC2205	Circuit Analysis	PC	3	3	0	0	3
4	EC2206	Electronic Devices	PC	3	3	0	0	3
5	EC2207	Signals and Systems	PC	4	3	1	0	4
6	GE2201	Design Thinking	EM	3	3	0	0	3
PRACTICALS								
7	AI2203	Data Structures and Algorithms Laboratory	ES	4	0	0	4	2
8	EC2208	Circuits and Devices Laboratory	PC	4	0	0	4	2
9	EM2202	Interpersonal Skills - Listening and Speaking	EM	2	0	0	2	1
			TOTAL	**30**	**18**	**2**	**10**	**25**

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA2252	Probability and Random Processes	BS	4	3	1	0	4
2	EC2251	Communication Systems[#]	PC	4	2	0	2	3
3	EC2252	Digital Electronics	PC	3	3	0	0	3
4	EC2253	Discrete Time Signal Processing[#]	PC	5	3	0	2	4
5	EC2254	Electronic Circuits	PC	3	3	0	0	3
6	EC2255	Linear Integrated Circuits	PC	3	3	0	0	3
7	GE2251	Quantitative Aptitude	EM	1	1	0	0	1
8	AUD110	Tamils and Technology	AU	1	1	0	0	0
PRACTICALS								
9	EC2256	Analog and Digital Laboratory	PC	3	0	0	3	1
10	EC2257	Linear Integrated Circuits Laboratory	PC	3	0	0	3	1
			TOTAL	**30**	**19**	**1**	**10**	**23**

[#] Theory cum Laboratory Course

Course Code	Course Name	L	T	P	C
MA2202	TRANSFORMS AND NUMERICAL SOLUTION OF EQUATIONS	3	1	0	4

Category: Basic Science Courses

a. Preamble

Fourier analysis allows modelling periodic phenomena which appears frequently in engineering, alternating electric currents or the motion of planets. The idea of Fourier analysis is to represent complicated functions in terms of simple periodic functions, namely cosines and sines. This course aims to developing the ability to formulate an engineering problem in a mathematical form by appropriate numerical approach.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Construct the Fourier series for periodic functions and for function with discrete data.	K3
CO2	Classify and solve the initial and boundary value problems such as wave and heat flow equation.	K3
CO3	Compute the Fourier transforms of standard functions and learn its properties.	K3
CO4	Apply the techniques of Z - transform to get the solutions of difference equations.	K3
CO5	Compute numerical solution of algebraic, transcendental equations and system of linear equations.	K3

c. Course Syllabus **Total : 60 Periods**

FOURIER SERIES **12**

Dirichlet's conditions - General Fourier series - Odd and even functions - Half-range sine and cosine series - Complex form of Fourier series - Parseval's identity - Harmonic Analysis.

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Classification of partial differential equations - Method of separation of variables - Solutions of onedimensional wave equation and one-dimensional heat equation - Steady state solution of two - dimensional heat equation - Fourier series solutions in cartesian coordinates.

FOURIER TRANSFORM **12**

Fourier integral theorem - Fourier transform pair - Sine and cosine transforms - Properties - Transform of elementary functions - Convolution theorem - Parseval's identity.

Z-TRANSFORM **12**

Z-transform - Elementary properties - Initial and final value theorems - Inverse Z-transform - Convolution theorem - Formation of difference equation - Solution of difference equation using Z - transform.

NUMERICAL SOLUTION OF EQUATIONS **12**

Solution of Algebraic and Transcendental equations: Bisection Method - Fixed point iteration method - Newton Raphson method - Solution of linear system of equations: Gauss elimination method - pivoting - Gauss Jordan method - Iterative methods: Gauss Jacobi - Gauss Seidel.

d. Activities

Students shall be exposed to MATLAB programming to find the Fourier transform of the given functions.

e. Learning Resources

Text Books

1. Erwin Kreyszig, 2015. *Advanced Engineering Mathematics*, John Wiley & Sons, Tenth Edition, New Delhi.
2. Grewal, B. S, *Higher Engineering Mathematics*, Khanna Publishers, Forty Fourth Edition, New Delhi, 2017.
3. Sastry, S. S, *Introductory Methods of Numerical Analysis*, PHI Learning, Fifth Edition, 2015.

References

1. Bali, N, Goyal, M, & Watkins, C, *Advanced Engineering Mathematics*, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), Seventh Edition, New Delhi, 2009.
2. Peter, V, O'Neil, *Advanced Engineering Mathematics*, Cengage Learning India Pvt., Ltd., Seventh Edition, New Delhi, 2012.
3. Ramana, B.V, *Higher Engineering Mathematics*, Tata McGraw Hill Co. Ltd., New Delhi, Eleventh Reprint, 2010.

Course Code	Course Name	L	T	P	C
AI2202	DATA STRUCTURES AND ALGORITHMS	3	0	0	3

Category: Engineering Science Courses

a. Preamble

This course enables the students to understand different data structures and how to use them effectively for solving problems. It also enables the students to select an appropriate data structure and develop the real world applications.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Illustrate the basic concepts of List ADT.	K2
CO2	Explain Stack and Queue ADTs.	K2
CO3	Summarize the concepts of non-linear data structures, Trees.	K2
CO4	Outline the concepts of non-linear data structures, Graphs.	K2
CO5	Apply appropriate sorting and searching techniques for problem solving.	K3

c. Course Syllabus **Total : 45 Periods**

INTRODUCTION TO ALGORITHMS AND ADTs **9**

Time and space complexity - Big O, Omega, Theta notation - List ADT - array based implementation, linked list implementation, singly linked lists, circularly linked lists, doubly linked lists, applications of lists.

STACK AND QUEUE **9**

Stack ADT - Operations, Applications, Evaluating arithmetic expressions, Conversion of Infix to postfix expression - Queue ADT - Operations, Circular Queue, Priority Queue, dequeue, applications of queues.

TREES **9**

Tree ADT - tree traversals - Binary Tree ADT - expression trees, applications of trees - binary search tree ADT - AVL Tree - B Tree - Heap - Binary heap - Applications of heap.

GRAPHS **9**

Definition, Representation of Graph, Types of graph, Breadth - first traversal, Depth-first traversal - Topological Sort - Bi-connectivity - Cut vertex - Euler circuits - Applications of graphs.

SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching - Linear Search, Binary Search - Sorting - Bubble sort, Selection sort, Insertion sort, Shell sort, Radix sort - Hashing - Hash Functions, Separate Chaining, Open Addressing, Rehashing, Extendible Hashing.

d. Activities

Students shall be given exposure to understand the nature of a given problem and to explore solutions to real-life problems.

e. Learning Resources

Text Books

1. Weiss, M.A., 1997. *Data Structures and Algorithm Analysis in C*, 2/e. Pearson Education India.
2. Reema Thareja, 2011. *Data Structures Using C*, Second Edition, Oxford University Press.

References

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest & Clifford Stein, 2002. *Introduction to Algorithms*, Second Edition, McGraw Hill.
2. Aho, Hopcroft & Ullman, 1983. *Data Structures and Algorithms*, Pearson Education.
3. Kochan.S.G., 2015. *Programming in C*. Pearson education.
4. Ellis Horowitz, Sartaj Sahni, Susan & Anderson - Freed, 2008, *Fundamentals of Data Structures in C*, Second Edition, University Press.

Course Code	Course Name	L	T	P	C
EC2205	CIRCUIT ANALYSIS	3	0	0	3

Category: Professional Core Courses

a. Preamble

This course promotes students to understand basic concepts of DC and AC circuits behavior and impart knowledge on solving circuit equations using network theorems. It also enables the students to understand the phenomenon of resonance, coupled circuits, transients and the concepts in two port networks.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply the basic circuit laws, mesh and nodal analysis for solving the given electric circuits.	K3
CO2	Solve DC or AC electric circuits using appropriate network theorems and various network reduction techniques.	K3
CO3	Determine frequency response characteristics and associated parameters of resonance circuits, coupled and tuned circuits.	K2
CO4	Determine the transient response of RL, RC and RLC circuits excited by step signal, impulse signal and exponential sources.	K2
CO5	Elucidate the two port networks in terms of Z, Y, h and ABCD parameters and the network topologies.	K3

c. Course Syllabus **Total : 45 Periods**

BASIC LAWS OF DC AND AC CIRCUITS **9**

Network terminologies - AC fundamentals, phase relations in R, L and C circuits, Complex impedance - Ohm's Law - Kirchhoff's laws - Equivalent values of series and parallel connected Resistors, Inductors and Capacitors - Voltage division and Current division rules - Mesh current and Node voltage method of analysis for DC and AC circuits - Wye Delta transformation - Source transformation.

NETWORK THEOREMS FOR DC AND AC CIRCUITS **9**

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Applications of Network theorems.

RESONANCE AND COUPLED CIRCUITS **9**

Series resonance and Parallel resonance - Variation of impedance with frequency, Variation in current through and voltage across L and C with frequency, Bandwidth, Q factor, Selectivity - Self inductance, Mutual inductance, Dot rule, Coefficient of coupling, Analysis of multiwinding coupled circuits: Series, Parallel connection of coupled inductors - Single tuned coupled circuits.

TRANSIENT ANALYSIS **9**

Natural response and Forced response, Transient State and Steady State - Transient response of RC, RL and RLC circuits for excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation.

TWO PORT NETWORKS AND GRAPH THEORY **9**

Two port networks: Z parameters, Y parameters, Hybrid (h) Parameters, Transmission (ABCD) parameters, Interconnection of two port networks, Symmetrical properties of networks. Graphs: Graph of a network, Trees, Co-trees, Twigs, Links, Incidence matrix, Link currents and Tie Set matrix, fundamental cutsets, Cutset schedules and Cutset matrix.

d. Activities

Students shall be given exposure to understand the AC and DC circuits behavior and to solve the electric circuits by framing the circuit equations.

e. Learning Resources

Text Books

1. Charles K. Alexander & Mathew N.O. Sadiku 2015. *Fundamentals of Electric Circuits*, Fifth Edition, 9th Reprint, McGraw Hill.
2. Sudhakar.A & Shyam Mohan, SP 2015. *Circuits and Networks-Analysis and Synthesis*, McGraw Hill.

References

1. William H. Hayt, Jr. Jack E. Kemmerly & Steven M. Durbin, 2016. *Engineering Circuit Analysis*, 8thed, 11th Reprint, McGraw Hill Science Engineering.
2. Joseph Edminister & Mahmood Nahvi, 2016. *Electric Circuits Schaum's Outline Series*, Fifth Edition Reprint, Tata McGraw Hill Publishing Company, New Delhi.
3. A.Bruce Carlson, 2009. *Cicuits: Engineering Concepts and Analysis of Linear Electric Circuits*, Cengage Learning, India Edition.
4. Chakrabarti A, 1999. *Circuits Theory (Analysis and synthesis)*,Dhanpath Rai & Sons, New Delhi.

Course Code	Course Name	L	T	P	C
EC2206	ELECTRONIC DEVICES	3	0	0	3

Category: Professional Core Courses

a. Preamble

This course promotes students to understand basic concepts of various devices, their characteristics and applications to impart knowledge on usage of devices in circuits. It also enables the students to have knowledge in DC power supplies.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the working principle of PN junction diode and its parameters.	K2
CO2	Outline the working principle of BJT and various configuration and models.	K2
CO3	Illustrate the working principle of FET to find equivalent circuits and its parameters.	K2
CO4	Interpret the special semiconductor diodes operation of various power devices and display devices.	K2
CO5	Explain the linear mode power supply and voltage regulators	K2

c. Course Syllabus **Total : 45 Periods**

SEMICONDUCTOR DIODES **9**

PN junction Diodes - Formation of PN junction, working principle, VI characteristics - diode resistance - PN diode currents - diode current equation - transition and diffusion capacitance - voltage breakdown in diodes - Diode models - Diode Circuits

BIPOLAR JUNCTION TRANSISTORS **9**

Principle and Operation of PNP, NPN transistors, Early effect, Current Equation, BJT as a switch and Amplifier, Breakdown Mechanisms of Transistors - Input and Output Characteristics of CE, CB, CC - Ebers Moll Model - Hybrid Model - Multi Emitter Transistor.

FIELD EFFECT TRANSISTORS **9**

Principle and Operation of N channel and P channel JFET, Drain and Transfer Characteristics, Current Equation, Pinch off Voltage and its significance, Breakdown mechanisms of JFET. MOSFET - Characteristics, Threshold voltage, Channel Length Modulation, MOSFET Capacitor, DMOSFET - E-MOSFET Characteristics - Comparison of MOSFET with JFET.

SPECIAL SEMICONDUCTOR DIODES **9**

Zener Diode - Varactor diode - Tunnel diode - Schottky diode - LED - Photo Diode - LCD, LDR, Opto Coupler, Solar Cell. SCR - DIAC - TRIAC.

DC POWER SUPPLIES **9**

HWR, FWR, full-wave bridge rectifier, power supply filters - ripple factor, efficiency analysis - bleeder resistor. Voltage regulation, Zener diode shunt regulator, transistor series regulator, transistor shunt regulator, design of complete DC power supply circuit.

d. Activities

Students shall be given exposure to understand the Devices characteristics and to solve the electric circuits by framing the circuit equations.

e. Learning Resources

Text Books

1. Thomas L. Floyd, 2012. *Electronic Devices,* 9th edition, Pearson Education
2. Donald A Neaman, 2012. *Semiconductor Physics and Devices*, 4th Edition, Tata McGraw Hill.

References

1. R.S.Sedha, 2006. *A Text Book of Applied Electronics*, S.Chand Publications.
2. Ben. G. Streetman & Sanjay Kumar Banerjee, 2015. *Solid State Electronic Devices*, 7th Edition, Pearson Education India.
3. Robert Boylestad & Louis Nashelsky, 2008. *Electron Devices and Circuit Theory*, Pearson Prentice Hall, 10th edition.
4. Yang, 1978. *Fundamentals of Semiconductor devices,* McGraw Hill International Edition.
5. Adel S. Sedra & Kenneth C. Smith, 2017. *Microelectronic Circuits: Theory and Applications*, 7th Edition, Oxford University Press.

Course Code	Course Name	L	T	P	C
EC2207	SIGNALS AND SYSTEMS	3	1	0	4

Category: Professional Core Courses

a. Preamble

This course promotes students to have analytical knowledge in Continuous Time Signals and Discrete Time Signals. It also enables the different frequency domain representation of signals.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Identify the different types of continuous time and discrete time signals/systems.	K3
CO2	Apply Fourier series, Continuous Time Fourier Transform and Laplace transform for the analysis of continuous time signals.	K3
CO3	Make use of Fourier and Laplace transform to analyse continuous time systems.	K3
CO4	Apply Discrete Time Fourier Transform and Z Transform for the analysis of discrete time signals.	K3
CO5	Utilize Fourier and Z transform to analyze discrete time systems.	K3

c. Course Syllabus **Total : 60 Periods**

CLASSIFICATION OF SIGNALS AND SYSTEMS **12**

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids - Classification of signals - Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems - Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

ANALYSIS OF CONTINUOUS TIME SIGNALS **12**

Fourier series for periodic signals - Fourier Transform - properties- Laplace Transforms and properties.

LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS **12**

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

ANALYSIS OF DISCRETE TIME SIGNALS **12**

Baseband signal Sampling - Fourier Transform of discrete time signals (DTFT) - Properties of DTFT - Z Transform & Properties.

LINEAR TIME INVARIANT DISCRETE TIME SYSTEMS **12**

Impulse response - Difference equations - Convolution sum - Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems - DT systems connected in series and parallel.

d. Activities

Students shall be given exposure in MATLAB computing environment to solve Transforms, Convolution and Sampling.

e. Learning Resources

Text Books

1. Oppenheim, A.V, Willsky, A.S, Nawab, S.H. and Hernández, G.M., 2015. *Signals & Systems.* Pearson Education.

References

1. Lathi, B.P., 2009. *Principles of Linear Systems and Signals*, (Vol. 15). Oxford University Press.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, 2007. *Signals & Systems - Continuous and Discrete*, Pearson.
3. John Alan Stuller, 2007. *An Introduction to Signals and Systems*, Thomson.

Course Code	Course Name	L	T	P	C
GE2201	DESIGN THINKING	3	0	0	3

Category: Engineering Science Courses

a. Preamble

This course introduces the various principles of design thinking to achieve an effective design and to examine the implementation of the model or process for its successful operation.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Describe the basic principles of design and various stages of design thinking for better conceiving of idea and refinement.	K2
CO2	Elucidate the concepts of idea generation and refinement.	K3
CO3	Apply various prototype models for solving complex problems.	K3
CO4	Analyze real-time problems for effective design, implementation and operation.	K3
CO5	Device idea/solution towards development of a prototype for a chosen problem of interest.	K4

c. Course Syllabus **Total : 45 Periods**

INTRODUCTION TO DESIGN THINKING **9**

Introduction - Product life cycle - Design Ethics - Design Process - Stages in design thinking: Immersion, Analysis and synthesis, Ideation, Prototyping.

IDEA GENERATION AND REFINEMENT **9**

Basic design - directions - Themes of thinking - Inspiration and references - Brainstorming - Value - Inclusion - Sketching - Presenting ideas - Thinking in images - Thinking in signs - Appropriation - Personification - Visual metaphors - Modification - Thinking in words - Words and language - Thinking in shapes - Thinking in proportions - Thinking in color - Outside the Box.

PROTOTYPING **9**

Developing designs - Types of prototype - Prototyping for Designing Complex Systems - The Efficacy of Prototyping under Time Constraints.

IMPLEMENTATION **9**

Format - Materials - Finishing - Media - Scale - Series/Continuity - Emerging Landscapes of Design - Real-Time Design Interaction Capture and Analysis - Enabling Efficient Collaboration in Digital Design - Spaces Across Time and Distance - Software used in Developing in Virtual Environments.

DESIGN THINKING IN VARIOUS SECTORS **9**

Design & Development of Prototypes for Wall Plastering, Rubber shredding, Separation of Corn seeds, Electric vehicles, Smart gates, Burglar alarm, Tyre pressure monitor, Development of Online Voting System, Online Proctoring System, Online Health Monitoring System, IoT based Home Automation and any other problem of interest in your domain.

d. Learning Resources

Text Books

1. Binder, T, De Michelis, G, Ehn, P, Jacucci, G, Linde, P, and Wagner, I, 2011. *Design Things*, MIT press.
2. Ambrose, G and Harris, P, 2009. *Basics Design: Design thinking*, Bloomsbury Publishing.

References

1. Meinel, C and Leifer, L. (Eds.), 2011. *Understanding Innovation*, Springer.
2. Plattner, H, Meinel, C, and Leifer, L. (Eds.), 2010. *Design thinking: understand-improve- apply*, Springer Science & Business Media.
3. Moran, T. P and Carroll, J. M, 1996. *Design Rationale: Concepts, Techniques, and Use*, L. Erlbaum Associates Inc.
4. Cross, N, 1984. *Developments in Design Methodology*, Chichester: Wiley.

WEB RESOURCES

1. https://www.designsociety.org/downloadpublication/39626/Design+prototyping+of+systems
2. https://www.interaction-design.org/literature/article/5-stages-in-the-design thinking-process

VIDEO LECTURES: (NPTEL OR ANY OTHER VIDEO LECTURES)

1. https://nptel.ac.in/courses/110/106/110106124/#

Course Code	Course Name	L	T	P	C
AI2203	DATA STRUCTURES AND ALGORITHMS LABORATORY	0	0	4	2

Category: Engineering Science Courses

a. Preamble

This course promotes students to bring together the data elements in a logical way which facilitates storing data on computers for efficient use. The course also explores the algorithms that are used to accurately and efficiently execute tasks.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Make use of linear Data structures Array, List, Stack and Queue to solve problems.	K3
CO2	Apply non-linear Data Structures - Trees for problem solving.	K3
CO3	Make use of non-linear Data Structures - Graph for problem solving.	K3
CO4	Utilize various sorting and searching algorithms to solve problems.	K3
CO5	Apply appropriate hash functions in a Hash ADT for collision free data storage and retrieval.	K3

c. Course Syllabus **Total : 60 Periods**

1. Implementation of List ADT using array and linked list
2. Implementation of Stack ADT using array and linked list
3. Application of Stack - Conversion of infix expression into postfix expression
4. Implementation of Queue ADT using array and linked list
5. Implementation of Binary Search Tree ADT
6. Implementation of Graph ADT using adjacency matrix and Graph traversal algorithms
7. Implementation of Linear search and binary search algorithms
8. Implementation of Bubble sort and insertion sort algorithms
9. Implementation of collision techniques in hashing

d. Activities

Students shall be given exposure to build data structures and use them in implementations of abstract data types. The ability of the students is strengthened by making them to apply various data structures and related algorithms to solve real world problems.

e. Learning Resources

Text Books

1. Weiss, M.A, 1997. *Data Structures and Algorithm Analysis in C*, 2nd edition. Pearson Education India.
2. Reema Thareja, 2011. *Data Structures Using C*, Second Edition, Oxford University Press.

References

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest & Clifford Stein, 2002. *Introduction to Algorithms*, Second Edition, McGraw Hill.
2. Aho, Hopcroft & Ullman, 1983. *Data Structures and Algorithms*, Pearson Education.
3. Kochan, S.G., 2015. *Programming in C*. Pearson education.
4. Ellis Horowitz, Sartaj Sahni, Susan & Anderson-Freed, 2008, *Fundamentals of Data Structures in C*, Second Edition, University Press.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Stand alone desktops or Server Supporting with C Compiler	30

Course Code	Course Name	L	T	P	C
EC2208	CIRCUITS AND DEVICES LABORATORY	0	0	4	2

Category: Professional Core Courses

a. Preamble

This course promotes students to understand the concepts of circuit theory in order to find the voltage, current and power responses in circuits having different applications in Engineering. Also this course makes the students to understand the functioning of various electronic devices and their characteristics in different modes of operation.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply basic laws such as Ohm's law, Kirchoff's Voltage law and Kirchoff's current law for the given electric circuits.	K3
CO2	Apply suitable network theorems such as Superposition, Thevenin's, Norton's and Reciprocity for finding the response in the given electric circuits.	K3
CO3	Interpret the response of RL, RC and RLC circuits for the DC and AC inputs.	K2
CO4	Illustrate the working of basic electronic devices such as PN junction diode and Zener diode by plotting its characteristic curves.	K2
CO5	Explain the working of electronic devices such as Transistors, FET and SCR in various modes and configurations.	K2

c. Course Syllabus **Total : 60 Periods**

I. Circuits based Experiments

1. Verifications of KVL & KCL
2. Verifications of Super Position Theorem
3. Verifications of Thevenin & Norton Theorems
4. Verifications of Maximum Power Transfer Theorem

5. Verification of Reciprocity Theorem

6. Determination of Resonance Frequency of Series & Parallel RLC Circuits

7. Transient analysis of RL and RC circuits

II. Devices based Experiments

1. Characteristics of PN Junction Diode

2. Zener diode Characteristics & Regulator using Zener diode

3. Common Emitter input-output Characteristics

4. Common Base input-output Characteristics

5. FET Characteristics

6. SCR Characteristics

7. Clipper and Clamper

d. Activities

Students shall be given exposure to find the response of different types of circuits and to analyse the characteristics of different electronic devices hardware components and open source software such as Every Circuit, Mutisim etc., Based on the gained knowledge, they can be insisted to do mini projects.

e. Learning Resources

Text Books

1. Charles K. Alexander & Mathew N.O. Sadiku, 2015. *Fundamentals of Electric Circuits*, Fifth Edition, 9th Reprint, McGraw Hill.
2. Donald A Neaman, 2012. *Semiconductor Physics and Devices*, 4th Edition, Tata McGraw Hill.

References

1. Sudhakar.A & Shyam Mohan, SP, 2015. *Circuits and Networks-Analysis and Synthesis*, McGraw Hill
2. Chakrabarti A, 1999. *Circuits Theory (Analysis and synthesis)*, Dhanpath Rai & Sons, New Delhi.
3. Thomas L. Floyd, 2012. *Electronic Devices*, 9th edition, Pearson Education.
4. R.S.Sedha, 2006. *A Text Book of Applied Electronics*, S.Chand Publications.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	BC 107, BC 148, 2N2646, BFW10	25 each
2.	1N4007, Zener diodes	25 each
3.	Resistors, Capacitors, Inductors	Sufficient Quantities
4.	Bread Boards	15 Nos
5.	CRO (30MHz)	10 Nos
6.	Function Generators (3MHz)	10 Nos
7.	Dual Regulated Power Supplies (0 - 30V)	10 Nos

Course Code	Course Name	L	T	P	C
EM2202	INTERPERSONAL SKILLS - LISTENING AND SPEAKING	0	0	2	1

Category: Employability Enhancement Courses

a. Preamble

The Course will enable learners to:

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- Improve general and academic listening skills
- Make effective presentations.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Develop their communicative competence in English with specific reference to listening.	K3
CO2	Prepare conversation with reasonable accuracy.	K3
CO3	Apply lexical Chunking for accuracy in speaking.	K3
CO4	Demonstrate their ability to communicate effectively in GDs.	K3
CO5	Explain directions and instructions in academic and business contexts.	K2

c. Course Syllabus **Total : 30 Periods**

LISTENING AS A KEY SKILL **6**

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification - Improving pronunciation- pronunciation basics - stressing syllables and speaking clearly - intonation patterns - conversation starters: small talk.

LISTEN TO A PROCESS INFORMATION **6**

Listen to a process information- give information, as part of a simple explanation -- taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

LEXICAL CHUNKING **6**

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer -accept - decline - take leave - listen for and follow the gist- listen for detail

GROUP DISCUSSION **6**

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade- negotiate disagreement in group work.

GROUP & PAIR PRESENTATIONS **6**

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations.

d. Activities

Students shall be taken to the Language lab for enhancing their listening and speaking skills.

e. Learning Resources

Text Books

1. Brooks, Margret, 2011. *Skills for Success. Listening and Speaking*. Level 4, Oxford University Press, Oxford.
2. Richards, C, Jack and David Bholke, 2010. *Speak Now Level 3*,Oxford University Press, Oxford.

References

1. Bhatnagar, Nitin and Mamta Bhatnagar, 2010. *Communicative English for Engineers and Professionals*, Pearson, New Delhi.
2. Hughes, Glyn and Josephine Moate, 2014. *Practical English Classroom*, Oxford University Press, Oxford.
3. Vargo, Mari, 2013. *Speak Now Level 4*, Oxford University Press, Oxford.
4. Richards, C, Jack, 2006. *Person to Person (Starter)*, Oxford University Press, Oxford.

5. Ladousse, Gillian Porter, 2014. *Role Play*. Oxford University Press, Oxford.

WEB RESOURCES:

1. https://www.cambridge.org/elt/blog/wp-content/uploads/2019/10/Learning-Language-inChunks.pdf
2. https://english.eagetutor.com/english/628-how-to-greet-your-boss-people-in-office.html
3. https://www.groupdiscussionideas.com/group-discussion-topics-with-answers/
4. https://www.bbc.co.uk/worldservice/learningenglish/business/talkingbusiness/unit3presentations/1opening.shtml

Course Code	Course Name	L	T	P	C
MA2252	PROBABILITY AND RANDOM PROCESSES	3	1	0	4

Category: Basic Science Courses

a. Preamble

This course introduces the basic concepts of probability and random variables and highlights their applications in the field of engineering such as speech recognition, image or signal compression and bio medical signal analysis. It enables the students to learn different types of random processes and how to utilise them in analysing the random noise characteristics and randomness of signals in wireless communication systems.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply the concepts of probability distributions to solve engineering problems	K3
CO2	Compute the correlation between two random variables and linear regression equation for a given set of data	K3
CO3	Make use of probability concepts in classifying the random processes	K3
CO4	Interpret the auto correlation and spectral densities of different signals in the random processes	K3
CO5	Apply the concepts of the linear system in communication Engineering	K3

c. Course Syllabus **Total : 60 Periods**

PROBABILITY AND RANDOM VARIABLES **12**

Probability - Conditional probability - Baye's theorem - Random variables - Mathematical Expectations - Moments - Moment generating functions - Distributions: Binomial, Poisson, Geometric, Uniform, Exponential and Normal distribution.

TWO DIMENSIONAL RANDOM VARIABLES **12**

Joint distributions - Marginal and conditional distributions - Covariance - Correlation and linear regression - State central limit theorem - Transformation of Random Variables

12

RANDOM PROCESSES

Classification - Stationary process - Markov process: Markov chain -Transition Probability Matrix - Chapman Kolomogrov Equations: Calculation of n step transition Probability - limiting Probability - Classification of States of a Markov Chain - Poisson process - Properties - Semi random telegraph process - Random telegraph process.

CORRELATION AND SPECTRAL DENSITIES **12**

Auto correlation functions - Cross correlation functions - Properties - Power spectral density - Cross spectral density - Properties.

LINEAR SYSTEMS WITH RANDOM INPUTS **12**

Linear time invariant system - System transfer function - Linear systems with random inputs - Auto correlation and Cross correlation functions of input and output.

d. Activities

Solving discrete and continuous distribution problems using Electronic Spread Sheets and solving Fourier Transform problems using MATLAB.

e. Learning Resources

Text Books

1. Oliver C Ibe, 2014. *Fundamentals of Applied Probability and Random Processes*, Second Edition, Elsevier.
2. Peebles, P.Z, 2002. *Probability, Random Variables and Random Signal Principles*, Fourth Edition, Tata McGraw Hill, New Delhi.

References

1. Cooper, G.R, & McGillem,C.D, 2012. *Probabilistic Methods of Signal and System Analysis*, Third Indian Edition, Oxford University Press, New Delhi.
2. Hwei Hsu, 2014. *Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes*, Third Edition, Tata McGraw Hill Education, New Delhi.
3. Miller, S.L, & Childers, D.G, 2004. *Probability and Random Processes with Applications to Signal Processing and Communications*, Academic Press.
4. Stark, H, & Woods, J.W, 2012**.** *Probability and Random Processes with Applications to Signal Processing*, Fourth Edition, Pearson Education, Asia.
5. Yates, R.D, & Goodman D.J, 2014. *Probability and Stochastic Processes*, Third Edition, Wiley, India,

Course Code	Course Name	L	T	P	C
EC2251	COMMUNICATION SYSTEMS	2	0	2	3

Category: Professional Core Courses

a. Preamble

This course promotes students to have analytical knowledge in analog & digital transmission and reception techniques. It helps to analyze the performance of various detection techniques.

b. Course Outcome (for Theory)

After successful completion of the course, the students will be able to

• CO. No.	Course Outcome	Knowledge Level
CO1	Explain the generation and detection methods of analog modulation schemes with its spectral characteristics.	K2
CO2	Interpret different waveform coding techniques to model the pulse coding systems	K2
CO3	Elucidate the pass band modulation techniques with its performance and the need for equalization.	K2
CO4	Identify problems based on Information theory and Error control coding.	K2
CO5	Illustrate various spread spectrum & multiple access techniques.	K2

Course Outcome (for Laboratory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Construct the analog modulation schemes to visualize its characteristics.	K3
CO2	Demonstrate different waveform coding techniques for modelling the pulse coding systems.	K3
CO3	Practice the pass band modulation techniques and the different methods for ISI free transmission.	K3
CO4	Compare the various error control coding techniques in simulation.	K2
CO5	Analyse the performance of spread spectrum techniques	K4

c. Course Syllabus (for Theory) **Total : 30 Periods**

ANALOG MODULATION **6**

Amplitude Modulation - DSBFC, DSBSC, SSBSC, VSB-SC - Generation & Detection, Mathematical expression PSD, modulators and demodulators - Angle modulation - PM and FM - PSD, modulators and demodulators - Superheterodyne receivers.

WAVEFORM CODING & REPRESENTATION **6**

Low pass sampling -Aliasing, Signal Reconstruction - Quantization -Uniform & non-uniform quantization, Quantization noise -Line coding -PAM, PCM, DPCM, DM, ADMand ADPCM - TDM, FDM

DIGITAL MODULATION AND TRANSMISSION **6**

Geometric Representation of signals - Gram Schmitt Orthogonalization Procedure -Generation, detection, PSD & BER of Coherent BPSK, BFSK, QPSK & QAM -ISI - Pulse shaping - Cosine filters - Eye pattern, Duo binary encoding, equalizers.

INFORMATION THEORY AND CODING **6**

Measure of information - Entropy - Source coding theorem - Shannon-Fano coding, Huffman Coding, Channel capacity - Shannon-Hartley law - Shannon's limit - Error control codes – Linear block codes - Cyclic codes, Syndrome calculation - Convolution Coding, Viterbi decoding.

SPREAD SPECTRUM AND MULTIPLE ACCESS **6**

PN sequences - properties - DSSS - Processing gain, Jamming - FHSS - Synchronisation and tracking - Multiple Access - TDMA, FDMA, CDMA

Course Syllabus (for Laboratory) **Total : 30 Periods**

LIST OF EXPERIMENTS

1. AM Modulator and Demodulator
2. FM Modulator and Demodulator
3. Signal Sampling and Reconstruction
4. Pulse Code Modulation and Demodulation
5. Delta Modulation and Demodulation
6. Time Division Multiplexing
7. FSK Generation and Detection
8. PSK Generation and Detection
9. QPSK Generation and Detection

10. Simulation of Linear Block and Cyclic Error Control coding schemes
11. Simulation of Convolutional coding scheme
12. Simulation of Direct Sequence Spread Spectrum

d. Activities

Students shall be given exposure in simulation software like MATLAB to understand the performance of various analog & digital modulation techniques.

e. Learning Resources

Text Books

1. Simon Haykin, 2014. *Communication Systems*, 4th Edition, Wiley.
2. J.G.Proakis, M.Salehi, 2014. *Fundamentals of Communication Systems*, Pearson Education.

References

1. B.P.Lathi, 2007. *Modern Digital and Analog Communication Systems*, 3rd Edition, Oxford UniversityPress.
2. D.Roody, J.Coolen, 2006. *Electronic Communications*, 4th edition PHI.
3. B.Sklar, 2007. *Digital Communications Fundamentals and Applications*, 2nd Edition Pearson Education.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes, Error control code, FSK, PSK, QPSK	1 (each)
2.	CROs	2
3.	PCs with MATLAB/SCILAB or equivalent software package for simulation experiments	30
4.	Probes	30
5.	Patch cords	100
6.	DSO	8

Course Code	Course Name	L	T	P	C
EC2252	DIGITAL ELECTRONICS	3	0	0	3

Category: Professional Core Courses

a. Preamble

This course promotes students to understand basic concept of boolean functions, combinational and sequential circuits in digital circuit. It also enables the student to understand basic concepts of logic families and programmable devices.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the Boolean functions and various minimization techniques.	K2
CO2	Illustrate the combinational circuits used to perform basic digital operations.	K2
CO3	Develop a synchronous/asynchronous counters and shift registers using sequential logic.	K3
CO4	Implement combinational and sequential logic circuits using Verilog HDL.	K3
CO5	Design combinational circuits using programmable logic devices.	K3

c. Course Syllabus **Total : 45 Periods**

DIGITAL FUNDAMENTALS **9**

Review of Number systems, Logic gates, Boolean algebra, Boolean postulates and laws - De-Morgan's Theorem - Principle of Duality, Simplification using Boolean algebra, Canonical forms - Sum of product and Product of sum - Minimization using Karnaugh map - NAND and NOR Implementation.

COMBINATIONAL CIRCUITS **9**

Realization of combinational logic using gates, Design of combinational circuits:Adder, Subtractor, Parallel adder / Subtractor, Carry look ahead adder, Magnitude Comparator, Code converters, Parity generator and checker, Encoder, Decoder, Multiplexer, Demultiplexer - Function realization using Multiplexer, Decoder.

SEQUENTIAL CIRCUITS **9**

Latches, Flip-Flops - SR, JK, D and T, Master Slave Flip Flops - Shift registers - SISO, SIPO, PISO, PIPO. Binary counters - Synchronous and asynchronous up/down counters, mod - N counter, Counters for random sequence - Johnson counter, Ring counter.

MODELLING OF LOGIC CIRCUITS BY VERILOG HDL **9**

Lexical Conventions, Ports and Modules, Gate Level Modelling, Operators, Data Flow Modelling, Behavioral level Modelling - Modelling of Combinational and Sequential Logic Circuits using Verilog HDL.

LOGIC FAMILIES AND PROGRAMMABLE DEVICES **9**

Introduction to Logic families - RTL, TTL, ECL & CMOS - Basic memory structure - ROM, PROM, EPROM, EEPROM - RAM - Static and dynamic RAM -Programmable Logic Devices - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Implementation of combinational logic circuits using PLA, PAL - FPGA - Basic Architecture.

d. Activities

Students shall be given exposure to understand the combinational and sequential digital circuits and to develop an application by using digital logic.

e. Learning Resources

Text Book

1. M. Morris Mano, Michael D. Ciletti, 2017. *Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog,* 6th Edition, Pearson Education and Synthesis, McGraw Hill.

References

1. Charles H.Roth. 2013. *Fundamentals of Logic Design*, 6th Edition, Thomson Learning.
2. Wakerly J F, 2002. *Digital Design: Principles and Practices*, Prentice-Hall, 2nd Edition.
3. D. D. Givone, 2003. *Digital Principles and Design*, Tata Mc-Graw Hill, New Delhi.
4. Thomas L. Floyd, 2011. *Digital Fundamentals*, 10th Edition, Pearson Education Inc.
5. Stephen Brown and ZvonkoVranesic, 2013. *Fundamentals of Digital Logic with Verilog Design*, Third Edition, McGraw-Hill Higher Education, New Delhi, India.

Course Code	Course Name	L	T	P	C
EC2253	DISCRETE TIME SIGNAL PROCESSING	3	0	2	4

Category: Professional Core Courses

a. Preamble

This course promotes students to learn analog and digital filter design, Effects of quantization in filter design and applications of Digital Signal Processing.

b. Course Outcome (for Theory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Solve Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) of any discrete time sequences.	K3
CO2	Construct Butterworth and Chebyshev IIR filters and convert into digital filters using impulse invariant and bilinear transformation methods.	K3
CO3	Construct FIR filters using Fourier series, windowing and frequency sampling methods.	K3
CO4	Identify the finite word length effects in IIR filters.	K2
CO5	Explain multirate signal processing	K2

Course Outcome (for Laboratory)

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Develop MATLAB code for generating mathematical signals and various signal processing operations.	K3
CO2	Analyze the spectral components present in the discrete time signals using Discrete Fourier Transform.	K4
CO3	Analyze FIR and IIR Filters using MATLAB.	K4
CO4	Describe the architecture of Digital Signal Processor	K2

CO5	Construct various signal processing operations using Digital Signal Processor.	K3

c. Course Syllabus (for Theory) **Total : 45 Periods**

DISCRETE FOURIER TRANSFORM **9**

Review of signals and systems, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT).

INFINITE IMPULSE RESPONSE FILTERS **9**

Characteristics of practical frequency selective filters, Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters, Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain, Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

FINITE IMPULSE RESPONSE FILTERS **9**

Design of FIR filters - symmetric and anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations, polyphase realization

FINITE WORD LENGTH EFFECTS **9**

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

MULTIRATE SIGNAL PROCESSING **9**

Introduction to multirate signal Processing - Decimation, Interpolation - Polyphase decomposition of FIR filter - Multistage implementation of sampling rate conversion - Design of narrowband filters - Applications of Multirate signal Processing - Design of Phase shifters, Subband coding.

Course Syllabus (for laboratory) **Total : 30 Periods**

LIST OF EXPERIMENTS

I. MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences
2. Convolution and Correlation
3. Frequency Analysis using DFT and FFT
4. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrates the filter operations
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filter operations

II. DSP PROCESSOR BASED IMPLEMENTATION

6. Study of architecture of Digital Signal Processor
7. Generation of various signals
8. Design and demonstration of FIR filter for Low pass, High Pass, Band Pass and Band Stop Filtering
9. Design and demonstration of Butterworth and Chebyshev IIR filters for Low pass, High Pass, Band Pass and Band Stop Filtering
10. Implement an Up-sampling and Down-sampling operation in DSP processor

d. Activities

Students shall be given mini project on signal processing in MATLAB

e. Learning Resources (for both Theory and Laboratory)

Text Books

1. Proakis, J.G, 2001. *Digital signal processing: principles algorithms and applications*. Pearson Education India.
2. Ramesh Babu, P, 2015. *Digital Signal Processing*. Scitech Publications.

References

1. Ifeachor, E.C. and Jervis, B.W, 2002. *Digital signal processing: a practical approach*, Pearson Education.

2. Oppenheim, A.V, Schafer, R.W. and Buck, J.R, 2004. *Discrete-Time Signal Processing*, 8th Indian Reprint.
3. Mitra, S.K. and Kuo, Y, 2007. *Digital signal processing: a computer-based approach (Vol. 2),* New York: McGraw-Hill.
4. Andreas Antoniou, 2006. *Digital Signal Processing*, Tata McGraw Hill.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	PCs with Fixed / Floating point DSP Processors (Kit/Add-on Cards)	15 Nos
2.	MATLAB with Simulink and Signal Processing Tool Box or Equivalent Software in desktop systems	15 Nos
3.	Signal Generators (1 MHz)	6 Nos
4.	CRO/DSO (30MHz)	10 Nos

Course Code	Course Name	L	T	P	C
EC2254	ELECTRONIC CIRCUITS	3	0	0	3

Category: Professional Core Courses

a. Preamble

This course aims to develop the skill of analyzing and designing different analog circuits using semiconductor devices. It includes analysis of small-signal model and large-signal model of the semiconductor devices which is the prerequisite for next level courses.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Elucidate the different biasing circuits in amplifiers using BJT and FET.	K2
CO2	Identify the significance of BJT and FET amplifiers using small signal analysis	K2
CO3	Interpret the low, high frequency response of amplifiers and derive cut off frequencies for determining bandwidth.	K2
CO4	Build the power amplifiers and large signal tuned amplifiers for the desired specification.	K3
CO5	Construct sinusoidal oscillator for audio and radio frequency oscillators.	K3

c. Course Syllabus **Total : 45 Periods**

TRANSISTOR BIASING AND STABILITY ANALYSIS **9**

BJT biasing - DC Load line and AC Load line, Quiescent point - Different Types of biasing circuits: Fixed Bias Circuit, Collector to base bias, Voltage divider bias (Self Bias) - Stability Factors - Bias compensation: Diode, Thermistor and Sensistor compensations - Biasing circuits for JFET and MOSFET..

SMALL SIGNAL AMPLIFIERS **9**

Small signal model and operation of BJT, FET and MOSFET amplifiers - Analysis of BJT amplifier, FET, MOSFET amplifiers - Increase in input impedance of BJT amplifiers - Feedback topologies - Effects of feedback on gain, bandwidth, input impedance, output impedance etc - Analysis of negative feedback amplifiers.

FREQUENCY RESPONSE OF AMPLIFIERS **9**

High frequency equivalent circuits of single stage CE (Hybrid - Π model) and MOSFET CS amplifier - Determination of short circuit current gain, cutoff frequency and bandwidth - Bandwidth calculation of multistage amplifiers - Amplifier rise time, sag and their relation to cutoff frequencies. Tuned amplifiers - single tuned, double tuned and Stagger tuned amplifiers. (Qualitative analysis only). Frequency response of tuned amplifiers.

LARGE SIGNAL AMPLIFIERS **9**

Classification of amplifiers - Conversion efficiency of class A transformer coupled class A, class B and distortion in power amplifier - Classification of tuned amplifier - Class C large signal tuned amplifier and its efficiency - Stability of tuned amplifiers and neutralization technique.

OSCILLATORS **9**

Classification - Barkhausen Criterion - General form of an Oscillator - Analysis of LC oscillators - Hartley, Colpitts, Clapp, Tuned collector oscillators. RC oscillators - phase shift, Wien bridge, Twin-T Oscillators. Quartz Crystal Construction, Electrical equivalent circuit of Crystal, Miller and Pierce Crystal oscillators, -Multivibrators, frequency stability of oscillators.

d. Activities

Students shall be exposed to the use of certain concepts of amplifier design in the simulation of transistor amplifiers on any circuit simulation software.

e. Learning Resources

Text Books

1. Donald A Neaman, 2012. *Semiconductor Physics and Devices*, 4th Edition, Tata McGrawHill Inc.
2. Salivahanan and N. Suresh Kumar, 2017**.** *Electronic Devices and Circuits*, 4th Edition, McGraw Hill Education India Private Ltd.

References

1. Millman J, Halkias.C. and Sathyabrada Jit, 2015. *Electronic Devices and Circuits*, 4th Edition, McGraw Hill Education (India) Private Ltd.
2. Robert Boylestad and Louis Nashelsky, 2008. *Electron Devices and Circuit Theory*, Pearson Prentice Hall, 10th edition.

3. Floyd, 2012. *Electronic Devices*, Ninth Edition, Pearson Education.
4. David A. Bell, 2008. *Electronic Devices & Circuits*, 5th Edition, Oxford University Press.
5. Anwar A. Khan and Kanchan K. Dey, 2006. *A First Course on Electronics*, PHI.
6. Rashid M, 2007. *Microelectronics Circuits*, Thomson Learning.

Course Code	Course Name	L	T	P	C
EC2255	LINEAR INTEGRATED CIRCUITS	3	0	0	3

Category: Professional Core Courses

a. Preamble

This course enables the students to understand the importance of operational amplifier (opamp) and design of amplifier, oscillator, multivibrator circuits using opamp. It also promotes the students to understand the applications of opamp.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the basic building blocks of Analog ICs such as Current mirror & Current sources, Voltage sources & Voltage references along with the internal circuitry of op amp-IC 741.	K2
CO2	Utilize the concepts of op amp for developing linear and non linear circuits.	K3
CO3	Explain various types of analog multiplier and PLL ICs with their applications	K2
CO4	Interpret various A/D and D/A converters using operational amplifiers.	K2
CO5	Build various waveform generators and other circuits using operational amplifier, IC 555 and special function ICs.	K3

c. Course Syllabus **Total : 45 Periods**

BASICS OF OPERATIONAL AMPLIFIERS **9**

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, Basic information about op-amps - Ideal Operational Amplifier - General operational amplifier stages - DC and AC performance characteristics, slew rate, Open and closed loop configurations.

APPLICATIONS OF OPERATIONAL AMPLIFIERS **9**

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass, Butterworth filters. Sine-wave generators, Triangular wave generator, Saw-tooth wave generator.

ANALOG MULTIPLIER AND PLL **9**

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell - Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, Applications of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronisation.

ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS **9**

Analog and Digital Data Conversions, D/A converter - specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode- switches for D/A converters high speed sample-and-hold circuits, A/D Converters - specification type - Single Slope type - Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma-Delta converters.

WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS **9**

Multivibrators using opamp, ICL8038 function generator, Timer IC 555- IC Voltage regulators - Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier.

d. Activities

Students can be encouraged to develop simple application projects using the analog ICs such as opamp, timer etc, that they have learnt in this course.

e. Learning Resources

Text Books

1. D.Roy Chudhry, Shail Jain, 2018. *Linear Integrated Circuits*, Fifth Edition, New Age International Pvt. Ltd.

2. S.Salivahanan, V.S.Kanchana Bhaaskaran, 2015. *Linear Integrated Circuits*, Second Edition, TMH.

References

1. R. Coughlin, F. Driscoll, 2000. *Operational Amplifiers and Linear Integrated Circuits*, 6th Edition, PHI publishers.
2. Sergio Franco, 2001. *Design with Operational Amplifiers and Analog Integrated Circuits*, 3rd Edition, Tata McGraw Hill.
3. Ramakant A. Gayakwad, 2008. *Op-amps and linear integrated circuit technology*, Fourth edition, Pearson Education.

Course Code	Course Name	L	T	P	C
GE2251	QUANTITATIVE APTITUDE	1	0	0	1

Category: Employability Enhancement Course

a. Preamble

To develop the thinking ability and problem solving skills of students to compete themselves in placement and competitive examinations.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Apply the concept of profit in real life problems	K3
CO2	Solve the problems by using proportion	K3
CO3	Compute accurate speed, time and distance	K3
CO4	Apply the concept of Time & Speed	K3
CO5	Calculate the work done based on various methods	K3

c. Course Syllabus **Total : 15 Periods**

PROFIT AND LOSS **3**

Profit and Loss - Cost Price, Selling Price, Profit and Loss %, Marked Price, Discount.

RATIO AND PROPORTION **3**

Ratio and Proportion - Ratio, Proportion, Comparison of Ratios, Duplicate, Triplcate Ratio.

TIME, SPEED AND DISTANCE **3**

Time, Speed and Distance - Concept of time, speed and distance, Conversion of units and proportionality, Avearge speed concept.

APPLICATIONS ON TIME, SPEED AND DISTANCE **3**

Problems on trains - Relative speed concept and application. Boats and Streams - Upstream speed, Downstream speed, Speed of stream, Speed of boat.

TIME AND WORK **3**

Time & work - Problems based on time and work, Formulae, Computation of work together, Wages based work problems. Pipes & Cisterns - Inlet-outlet, Part of tank filled, Time based problems.

d. Learning Resources

Text Book

1. Dinesh Khattar, 2019. *Quantitative Aptitude for Competitive Examinations*, Pearson India Education services Pvt Ltd, Fourth Edition, Uttar Pradesh.

References

1. TCY online, 2016. *Reasoning ability and Quantitative Aptitude*, Wiley India Pvt. Ltd, First Edition, New Delhi.
2. Agarwal.R.S, 2011. *Quantitative Aptitude for Competitive Examinations*, S.Chand Limited.
3. Abhijit Guha, 2011. *Quantitative Aptitude for Competitive Examinations*, Tata McGraw Hill, 3rd Edition.

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Course Code	Course Name	L	T	P	C
EC2256	ANALOG AND DIGITAL LABORATORY	0	0	3	1

Category: Professional Core Course

a. Preamble

This course promotes students to design circuits for different analog & digital systems in Engineering.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Design the Various Amplifiers using BJT and FET.	K3
CO2	Construct various wave shaping circuits, Oscillators & Multivibrators.	K3
CO3	Design and Implement Analog Circuits using Spice Software.	K3
CO4	Construct different Combinational and Sequential Circuits.	K3
CO5	Model the combinational and Sequential Circuits using HDL.	K3

c. Course Syllabus **Total: 45 Periods**

I. ANALOG EXPERIMENTS:

1. Frequency Response of CE (with and without negative feedback)and CS amplifiers
2. Darlington Amplifier and single tuned amplifier
3. Differential Amplifiers- Transfer characteristic, CMRR Measurement
4. RC and LC Oscillators
5. Multivibrators
6. Class A and Class B Power Amplifiers
7. Wave Shaping Circuits-Integrator, Differentiator, Clippers, Clampers
8. Spice Simulation of amplifiers, oscillators and Multivibrators

II. DIGITAL EXPERIMENTS:

9. Design and implementation of Half/Full Adder and Subtractor
10. Design and implementation of Code converters
11. Simulate Encoder, Decoder, Multiplexer and Demultiplexer using logic gates
12. Simulation of Shift Registers using Microwind/Logisim

13. Design and Simulate a 4-bit Ripple carry using data flow modelling in Verilog HDL
14. Design and Simulate a 4 to 1 Multiplexer using behavioural modelling in Verilog HDL
15. Design and Simulate JK and D flipflop using Verilog HDL

d. Activities

Students shall be given exposure to design a circuit and analyse its performance through hardware components. Based on the gained knowledge, insisted them to do mini projects.

e. Learning Resources

Text Books

1. Salivahanan and N. Suresh Kumar, 2017. *Electronic Devices and Circuits*, 4th Edition, McGraw Hill Education India Private Ltd.
2. M. Morris Mano and Michael D. Ciletti, 2014. *Digital Design*, 5th Edition, Pearson.

References

1. Millman J, Halkias.C.and Sathyabrada Jit, 2015. *Electronic Devices and Circuits*, 4th Edition, McGraw Hill Education India Private Ltd.
2. Thomas L. Floyd, 2011. *Digital Fundamentals*, 10th Edition, Pearson Education Inc.
3. S.Salivahanan and S.Arivazhagan, 2012. *Digital Electronics*, 1st Edition, Vikas Publishing House Pvt Ltd.
4. Anil K.Maini, 2014. *Digital Electronics*, Wiley.
5. A.Anand Kumar, 2016. *Fundamentals of Digital Circuits*, 4th Edition, PHI Learning Private Limited.
6. Soumitra Kumar Mandal, 2016. *Digital Electronics*, McGraw Hill Education Private Limited.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	CRO/DSO (30MHz)	15 Nos
2.	Signal Generator /Function Generators (3 MHz)	15 Nos
3.	Dual Regulated Power Supplies (0 – 30V)	15 Nos
4.	Standalone desktop PCs with SPICE software	15 Nos
5.	Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	50 Nos
6.	Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers	Sufficient quantities
7.	SPICE Circuit Simulation Software	
8.	IC Trainer Kit	15 Nos
9.	Bread Boards	15 Nos
10.	Seven segment display	15 Nos
11.	Multimeter	15 Nos
12.	IC 7400/ 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 / 74151 / 74147 / 7445 / 7476/7491/ 555 / 7494 / 7447 / 74180 / 7485 / 7473 / 74138 / 7411 / 7474	each 50 Nos

Course Code	Course Name	L	T	P	C
EC2257	LINEAR INTEGRATED CIRCUITS LABORATORY	0	0	3	1

Category: Professional Core Course

a. Preamble

This course promotes students to design circuits for different applications in Engineering and become proficient in PSPICE and MULTISIM software tools to design simple circuits using analog ICs.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Build various nonlinear circuits such as inverting, non-inverting, differential & instrumentation amplifiers, differentiator and Integrator using op-amp IC741.	K3
CO2	Analyze active filters and its characteristics using op-amp IC741.	K4
CO3	Design waveform generating circuits and wave shaping circuits using op-amp and timer ICs.	K3
CO4	Construct DC power supply using LM 317 and IC 723.	K3
CO5	Examine different circuits using ICs in PSPICE software.	K4

c. Course Syllabus **Total : 45 Periods**

I. Design and Analysis of the following circuits

1. Inverting, Non inverting and differential amplifiers.
2. Integrator and Differentiator.
3. Instrumentation amplifier
4. Active low-pass, High-pass and band-pass filters.
5. Astable&Monostablemultivibrators and Schmitt Trigger using op-amp.
6. Phase shift and Wien bridge oscillators using op-amp.
7. Triangular and sawtooth Waveform Generator using op-amp.
8. Astable and monostablemultivibrators using NE555 Timer.
9. PLL characteristics and its use as Frequency Multiplier.
10. DC power supply using LM317 and LM723.

II. Simulation using SPICE and MULTISIM

1. Amplifiers using op-amp
2. Active Filters using op-amp
3. Astable and Monostable Multivibrator using op-amp and NE555 Timer.
4. Implementation of DA converter using MULTISIM
5. Astable & Monostable multivibrators and Schmitt Trigger using op-amp in MULTISIM.

d. Activities

Students shall be given exposure to design application circuits using analog ICs and analyse its performance through hardware components and other softwares such as PSPICE and MULTISIM. Based on the gained knowledge, they will implement simple projects.

e. Learning Resources

Text Books

1. D.Roy Choudhry, Shail Jain, 2018. *Linear Integrated Circuits*, Fifth Edition, New Age International Pvt. Ltd.
2. S.Salivahanan, V.S.Kanchana Bhaaskaran, 2015. *Linear Integrated Circuits*, Second Edition, TMH.

Reference

1. Ramakant A. Gayakwad, 2008. *Op-amps and Linear Integrated Circuit Technology*, Fourth edition, Pearson Education..

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	Description of Equipment	Quantity Required
1.	CRO/DSO (Min 30MHz)	15 Nos
2.	Signal Generator /Function Generators (2 MHz)	15 Nos
3.	Dual Regulated Power Supplies (0 – 30V)	15 Nos
4.	Digital Multimeter	15 Nos
5.	IC Tester	5 Nos
6.	Standalone desktops PC	15 Nos
7.	Components and Accessories	50Nos
8.	Transistors, Resistors, Capacitors, Diodes, Zener diodes, Bread Boards, Transformers, wires, Power transistors, Potentiometer, A/D and D/A convertors, LEDs .	-

S.No.	Description of Equipment	Quantity Required
9.	Op-Amps uA741	30 Nos