MALNAD COLLEGE OF ENGINEERING, HASSAN
(An Autonomous Institution Affiliated to VTU, Belagavi)

Autonomous UG Program

Syllabus
of
III and IV Semester (SECOND YEAR 2022 ADMITTED BATCH)

Academic Year 2023-24

DEPARTMENT OF
ELECTRONICS & COMMUNICATION ENGINEERING

THIRD SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
BSC	22MA301	Linear Algebra and Integral Transforms	**3-2-0**	4	5
PCC	22EC302	Analog Electronic Circuits	3-0-0	3	3
PCC	22EC303	Digital Electronics	3-0-0	3	3
PCC	22EC304	Network Analysis (integrated)	3-0-2	4	5
ESC	22ESC305*	Linear ICs and Applications	3-0-0	3	3
PCCL	22EC306	Digital Electronics Laboratory	0-0-2	1	2
UHV	22SCR	Social Connect and Responsibility	0-0-2	1	2
AEC/SEC	22AEC307*	Analog Electronics and Linear Integrated Circuits Laboratory using PSPICE	0-0-2	1	2
			Total	20	25

Course Category:
PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course(Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **SDA**: Skill Development Activity, **ESC**: Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course
***Note:** AEC and ESC courses are chosen by the internal BOS

Engineering Science Course (ESC/ETC/PLC)			
22ESC304	Digital System Design using Verilog	22ESC306	Computer Organization and Architecture
22ESC305*	Linear ICs and Applications*	22ESC307	Applied Numerical methods
Ability Enhancement Course – III			
22AEC307*	Analog Electronic and Linear Integrated Circuits Lab using PSPICE*	22AEC308	Digital Engineering Course (NASSCOM)
22AEC309	Simulink Programming Basics	22AEC310	IOT for Smart Infrastructure

FOURTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PCC	22EC401	Analog Communication and Switching Systems	3-0-0	3	3
PCC	22EC402	Electromagnetic Field Theory and Transmission lines	3-2-0	4	5
PCC	22EC403	Signals and systems (Integrated)	3-0-2	4	5
PCC	22EC404	Microwave Communication	3-0-0	3	3
ESC*	22ECS405*	ARM Embedded Systems	3-0-0	3	3
PCCL	22EC406	Communication Lab	0-0-2	1	2
AEC */ SEC	22AEC407*	Embedded Systems Laboratory	0-0-2	1	2
BSC	2BEEC408	Biology For Engineers	1-0-0	1	2
UHV	22UHV	Universal human values	1-0-0	1	1
			Total	**21**	**27**

Ability Enhancement Course / Skill Enhancement Course - IV			
22ECS402	Electronic Devices	22ECS403	Lab VIEW Programming
22ECS404	PCB Design	22ECS405*	ARM Embedded Systems
Engineering Science Course (ESC/ETC/PLC)			
22AEC407*	Embedded Systems Laboratory	22AEC408	Operating Systems
22AEC409	Industrial Electronics	22AEC410	Engineering Statistics and Linear Algebra

***Note:** AEC and ESC courses are chosen by the Internal BOS members.

FIFTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PCC	22EC501	Hardware Description Language	3-0-0	3	3
PCC	22EC502	Modern Control Systems	3-0-0	3	3
PCC	22EC503	Antenna and Wave Propagation	3-0-0	3	3
PCC	22EC504	Digital Communication (Integrated)	3-0-2	4	5
PCC	22EC505	Hardware Description Language Laboratory	0-0-2	1	2
PEC	22EC5XX	Professional Elective Course	3-0-0	3	3
AEC	22RIP	Research Methodology and IPR	2-2-0	3	4
MC	22EVS	Environmental Studies	2-0-0	2	2
			Total	**22**	**25**

Professional Elective Course	
22EC511	Operating Systems
22EC512	Data Structures using C++
22EC513	Object Oriented Programming
22EC514	Artificial Neural Networks
22EC515	Digital Image Processing

***Note:** AEC and ESC courses are chosen by the Internal BOS members.

SIXTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PCC	22EC601	Entrepreneurship and Management	3-0-0	3	3
PCC	22EC602	VLSI Circuits (Integrated)	3-0-2	4	5
PCC	22EC603	Digital Signal Processing	3-2-0	4	5
PCC	22EC604	Optical Fiber Communication	3-0-0	3	3
PEC	22EC6XX	Professional Elective Course	3-0-0	3	3
OEC	22OEEC6X	Open Elective Course (Institution level)	**3-0-0**	3	3
OEC	22SW	*Swayam NPTEL	0-1(A)-0	A	-
AEC/ SDC	22AEC602	Digital Signal Processing Laboratory	0-0-2	1	2
			Total	**21**	**24**

Ability Enhancement Course / Skill Enhancement Course-V			
22AEC601	Automotive Electronics	22AEC602	DSP Laboratory
22AEC603	Introduction to E-Vehicles	22AEC604	Soft Computing

***Note** :AEC and ESC courses are chosen by the Internal BOS members.

Professional Elective Course

PE	22EC651	Machine Learning	3-0-0	3
PE	22EC652	Information theory and Cryptography	3-0-0	3
PE	22EC653	Object Oriented Programming using Python	3-0-0	3
PE	22EC654	Satellite Communication	3-0-0	3
PE	22EC655	Artificial Intelligence		

Open Elective Course

OE	22OEEC61	MEMS	3-0-0	3
OE	22OEEC62	Embedded System Design	3-0-0	3
OE	22OEEC63	Wireless Communication	3-0-0	3
OE	22OEEC64	Neural Networks and Fuzzy Logic	3-0-0	3

SEVENTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PCC	22EC701	MEMS and NANO Technology	3-0-2	4	5
PCC	22EC702	Wireless Communication (integrated)	3-0-2	4	5
PCC	22EC703	Multimedia Communication	3-0-0	3	3
PI	22EC704	Main Project work Phase1	0-0-3	3	6
PEC	22EC7XX	Professional Elective Course	3-0-0	3	3
OEC	22OEECX	Open Elective Course	**3-0-0**	3	3
			Total	**20**	**25**

Professional Elective Course

PE	22EC741	5G Technology	3-0-0	3
PE	22EC742	Advanced VLSI	3-0-0	3
PE	22EC743	Soft Computing	3-0-0	3
PE	22EC744	Network Security	3-0-0	3

Open Elective Course

OE	22OEEC71	Sensors and Actuators	3-0-0	3
OE	22OEEC72	Quantum Information Theory	3-0-0	3
OE	22OEEC73	Digital Image Processing	3-0-0	3
OE	22OEEC74	Big Data Analysis	3-0-0	3

EIGHTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PI	22EC8XX	Professional Elective Course	3-0-0	3	3
PI	22PROJ	Main Project work Phase2	0-0-3	3	6
INT	22INT	Internship (Industry/Research) (14-20weeks)	0-0-10	10	20
			Total	**16**	**29**

Professional Elective Course (Online courses)	
22EC811: Automotive Electronics	22EC813: Deep Learning
22EC812: Quantum Information Theory	22EC814: Low Power VLSI

Year	Semester	Credits	Total Credits
I Year	1	20	40
	2	20	
II Year	3	20	41
	4	21	
III Year	5	22	43
	6	21	
IV Year	7	20	36
	8	16	
Total		**160**	**160**

ANALOG ELECTRONIC CIRCUITS

Course Code :22EC302 **LTPC: 3-0-0-3**
Exam Hours : 3 Hours / Week: 3
SEE : **50 Marks** Total hours: 40

Course Objective: The objective of the course is to learn modeling and designing of analog electronic circuits using diodes, BJTs, MOSFETs and MOS differential pair.

Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, the student shall be able to:

COs	Statement	POs
1.	Identify the current-voltage characteristics of diodes, MOSFETs, and BJTs.	1
2.	Apply the knowledge of MOSFETs and BJTs to design different circuits.	1,2,3,5
3.	Analyze the parameters of different analog electronic circuits and their applications.	1,2
4.	Comprehend MOSFET amplifiers, BJT amplifiers and differential amplifiers.	2, 5

Course Contents:

MODULE-1	Teaching Hours
Introduction to Analog Devices:- Introduction, The Ideal Diode, Current–Voltage Characteristic, Terminal Characteristics of Junction Diodes, The Forward-Bias Region, The Reverse-Bias Region, The Breakdown Region **MOS Field-Effect Transistors (MOSFETs):** Introduction, Device Structure, Operation with Zero Gate Voltage, Creating a Channel for Current Flow, Applying a Small v_{DS}, Operation as $v_{DS}$is Increased, Operation for $v_{DS} \geq V_{OV}$: Channel Pinch-Off and Current Saturation. [Self learning: The *p*-Channel MOSFET] **Bipolar Junction Transistors (BJTs):** Introduction, Device Structure and Physical Operation: Simplified Structure and Modes of Operation, Operation of the npn Transistor in the Active Mode, Structure of Actual Transistors, Operation in the Saturation Mode.	**10**
MODULE-2	
Current–Voltage Characteristics of MOSFET: Circuit Symbol, The i_D–v_{DS} Characteristics, The i_D–v_{GS} Characteristic, Finite Output Resistance in Saturation, Characteristics of the p-Channel MOSFET, Current–Voltage Characteristics of BJT: Circuit Symbols and Conventions, Graphical Representation of Transistor Characteristics. MOSFET Circuits at DC, BJT Circuits at DC.	**10**
MODULE-3	
Differential Amplifiers: Introduction, The MOS Differential Pair: Operation with a Common-Mode Input Voltage, Operation with a Differential Input Voltage, Large-Signal Operation, Small-Signal Operation, The Differential Amplifier with Current-Source Loads, The BJT Differential Pair: Basic Operation, Input Common-Mode Range, Large-Signal Operation, Small-Signal Operation, Common-Mode Rejection: The MOS Case, The BJT Case.	**10**
MODULE-4	
Feedback Amplifiers: General Feedback Structure: Signal-flow diagram, The closed loop gain, The Loop gain. Some Properties of Negative Feedback. Four Basic Feedback topologies: Series-Shunt, Series-Series, Shunt-Shunt, Shunt-Series Amplifier. **Power Amplifiers**: Introduction, Classification, Class A, Class B and Class AB-Operation, Transfer Characteristics, Signal Waveforms, Power Dissipation, Power Conversion Efficiency.	**10**

Text Book:

1. **Adel S. Sedra Kenneth C. Smith,** "Microelectronic Circuits, Theory and Applications", 7th Edition, Oxford university press, 2009.

Reference Books:

1. **BehzadRazavi**"Fundamentals of Microelectronics", 2nd Edition, Wiley India Pvt. Ltd., 2014.
2. **Robert L. Boylestad and Louis Nashelsky,** "Electronic Devices And Circuits Theory", 10th Edition, Pearson, 2012.

Activity:

Activity Number	Activity Name	Description	Marks	POs
1	**Analysis of Analog and Linear integrated circuit.**	Simulation of analog and linear integrated circuits using MULTISIM live circuit simulator or LTspice software. Verify manual calculation and simulation results.	**10**	**2,5,9,**
2	**Circuit design and implementation**	Design and implementation of analog and linear integrated circuits.	**10**	**2,5,9,**

List of experiments for the activities.

1. Design an op-amp monostablemultivibrator without any triggering circuit, to produce a ±11V,1ms output pulse.
2. Design a noninverting amplifier to have a voltage gain of approximately 66. The applied input signal amplitude is to be 15 mV.
3. Design an inverting amplifier to have a voltage gain of 50 and the output voltage amplitude is to be 2.5 V.
4. A direct-coupled noninverting amplifier with a ± 25 mV input is to produce a ± 5 V output. Design the circuit with suitable resistance values.
5. Design a three-input inverting summing amplifier circuit and show how it can be converted into an averaging circuit.
6. Design Schmitt trigger circuit to determine UTP and LTP, Given V_f=0.7V, ±Vcc=15V
7. A direct-coupled inverting amplifier with a ± 20 mV input is to have a voltage gain of 200. Design the circuit with suitable resistance values.
8. Design a non saturating precision half wave rectifier to produce a 2V peak output from a 1MHz sine wave input with a 0.5V peak value, Vcc=±15V.
9. Design of oscillator using BJT/MOSFET for different frequencies. Design of amplifier using BJT/MOSFET.

Articulation Matrix

Course Outcomes	Program Outcomes												Program Specific Outcomes	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√													
CO2	√	√	√		√									
CO3	√	√												
CO4		√			√									

DIGITAL ELECTRONICS

Course Code :22EC303 **LTPC: 3-0-0-3**
Exam Hours : 3 Hours / Week : 3
SEE : **50 Marks** Total hours: 40

Course Objective: This course will enable students to understand the functions of different logic gates and simplify the Boolean equations using different techniques, analyze and design combinational and sequential Logic circuits.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Apply various simplification techniques for solving Boolean functions.	1, 2
2.	Analyze the fundamental logic functions and logic building blocks of MSI circuits.	1, 2, 9
3.	Design combinational logic circuits using relevant building blocks and programmable logic devices.	1, 2, 3, 5, 9
4.	Design sequential logic circuits by understanding the characteristics of various flip-flops.	1, 2, 3, 5, 9

Course Contents:

MODULE-1	Teaching Hours
Simplification of Boolean Functions: Minterm canonical form and m-notation, Maxterm canonical form and M-notation, Map method-2, 3, 4 and 5 variables, Product and sums simplification, Don't care conditions, 4 and 5 variable Tabulation method, Single Variable Entered Karnaugh map [excluding don't care expression]. **[Self Learning:** NAND and NOR implementation]	**10 Hours**
MODULE-2	
Combinational Circuits Design and Analysis: Parallel adder, Parallel subtractor, Carry look ahead adder, BCD adder, magnitude comparator, encoder, priority encoder, decoder, multiplexer, de-multiplexer, Arithmetic circuits and code converters using Multiplexers and Decoders.	**10 Hours**
MODULE-3	
Programmable Logic Devices and Flip-Flops: Introduction to Programmable Logic Devices, ROM (Read Only Memory), Programmable Logic Arrays (PLA), Programmable Array Logic (PAL), Basic Bistable element, Latches and Flip Flops, Characteristic equations of Flip-Flops, Triggering of Flip Flops, Flip Flop Excitation Tables, Flip-Flop conversions.	**10 Hours**
MODULE-4	
Sequential Circuits Design and Analysis: Registers using SR and D Flip-flop, Universal Shift Registers, Ripple and Synchronous Counters (excluding Ring and Johnson counter), Design of Synchronous Counters and MOD-N Synchronous Counters using D, T, SR and JK flip-flops, Analysis of Clocked Sequential Circuits, Sequence Detector.	**10 Hours**

TEXT BOOKS:

1. **M. Morris Mano,** "Digital Logic and Computer Design", 4th edition Pearson India, 2016.
2. **Donald D. Givone,** "Digital Principles and Design", McGraw Hill, 2012.
3. **John M Yarbrough, "Digital Logic: Applications and Design", Thomson Learning, 2001.**

REFERENCE BOOKS:

1. **R P Jain, "Modern Digital Electronics", McGraw Hill, 4th edition, 2009.**
2. **Charles H Roth Jr. and Larry L. Kinney, "Fundamentals of logic design", Cengage Learning, 6th Edition, 2010**

MOOC/NPTEL COURSES:

1. https://nptel.ac.in/courses/117106086
2. https://www.digimat.in/nptel/courses/video/108105113/L27.html

ACTIVITIES

Activity Number	Activity Name	Description	Marks	POs
1	**Poster Presentation**	Simulation of analog and linear integrated circuits using MULTISIM live circuit simulator or LTspice software. Verify manual calculation and simulation results.	**10**	**1, 9**
2	**Simulation of Digital Circuits**	Design and implementation of analog and linear integrated circuits.	**10**	**3,5,9**

1. **Poster Presentation (Max. Marks: 10)**
   a. **Objective:** To enable the students to identify the need/requirement of digital building blocks in various engineering applications.
   b. **Example Topic but not limited to**
      a. Mobile Phone
      b. Smart Card
      c. Digital Cathode Ray Oscilloscope
      d. Digital Watch
      e. Traffic lights
      f. Elevator
      g. Fitness trackers
      h. Smart Watch
      i. Digital Voltmeter
      j. Digital Ammeter
      k. Digital Multimeter
      l. Low-Cost File Alarm Circuit
      m. Digital Object Counter
      n. Digital Panel Meter
      o. Digital IC Tester
      p. Audio Meter
      q. Digital Combinational Lock
      r. Distance Measuring
   c. **Plan of Action:**
      - The poster presentation must be done in a group of 2 students.
      - Each group must prepare a title that relates to any engineering discipline and the title must emulate any real-world situation.
      - Submit the title of the poster presentation by the end of week 2 to the respective faculty.
      - Poster presentation to be presented at the end of week 4.
      - Students have to be able to take a complex topic and demonstrate their understanding of it by summarizing the main points in both visual and oral presentations.
      - To prepare for their presentations students to do background reading on a topic of their choosing.
      - They are required to prepare a visual poster presentation of their topic that incorporates graphic elements and a short-written summary of their topic. In class, students are required to give a five-minute oral presentation using their poster to illustrate their talk.

- They must then answer questions from their classmate and instructor.
- The final element of this assignment requires students to evaluate the work of their classmates and to ask questions about the topics other students present.

2. Simulation of Digital Circuits (Max. Marks: 10)

a. Objective: To allow the student to conduct various experiments without any constraints on place or time, in contrast to the constraints of real labs.

b. List of Circuits but not limited to:

a. Synchronous Counters
b. Asynchronous Counters
c. Flip-Flops
d. Multiplexer
e. De-multiplexer
f. Encoder
g. Decoder
h. Adders
i. Subtractors
j. Comparators
k. Code Converters
l. Flip-Flop Conversion
m. Parity Generators and Checkers
n. Statement Problems

c. Plan of Action:

- The virtual lab activity to be carried out individually using the open-source simulation tools, but not limited to, like Logisim, Multisim
- Students can choose circuits either from the lab experiments or from the theory component. One circuit per student.
- Virtual lab report to be presented at the end of week 10.
- **REPORT:** Report layout is as follows: –Aim–Components required –simulation tool used – circuit-truth table –Result.

Articulation Matrix

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√												
CO2	√	√							√					
CO3	√	√	√		√				√					
CO4	√	√	√		√				√					

NETWORK ANALYSIS (Integrated)

Course Code :22EC304 **LTPC: 3-0-2-4**
Exam Hours : 3 Hours / Week: 5
SEE : **50 Marks** Total hours: 65

Course Objective: To enable the students to analyze electrical networks using complex time domain and frequency domain approaches.

Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Apply the knowledge of basic network concepts, laws and simplify the network using source transformation, shifting and reduction techniques.	1, 2, 5
2.	Apply various network theorems and network graph theory in solving the problems related to electrical circuits.	1, 2, 5
3.	Determine the parameters of series and parallel resonant circuits, two-port network parameters, the transient response of different circuits and solutions of circuits using Laplace Transform.	1, 2, 5
4.	Reinforce theory and techniques taught in the classroom through experiments using suitable simulation software and hardware components in the laboratory.	1, 2,5,9

Course Contents:

MODULE-1	Teaching Hours
Basic Concepts: Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Source transformations & source shift, Star & delta transformation, Concepts of super node and super mesh.	**10 Hours**
MODULE-2	
Network Topology: Graph of a network, Concept of tree and co-tree, incidence matrix, cut-set schedule, tie-set schedule, Formulation of equilibrium equations in matrix form, Solution of resistive networks, Principle of duality. **Network Theorems:** Superposition, Thevenin's and Norton's theorems, Maximum Power transfer theorem	**10 Hours**
MODULE-3	
Resonance: Series and parallel resonance, frequency response of series and Parallel circuits, Q –factor, Bandwidth (relevant derivations and numerical problems). **Two Port Networks:** Two ports and impedance parameters, admittance, hybrid and transmission parameters, Circuit analysis of two-port networks.	**10 Hours**
MODULE-4	
Laplace Transform: Laplace transform and its Applications: Step Ramp, Impulse, Solution of networks using Laplace transform, Initial value and final value theorem **Behavior and Initial Conditions:** The behavior of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations(only numerical problems).	**10 Hours**

TEXT BOOKS:

1. **M. E. Van Valkenburg, "Network Analysis", PHI / Pearson Education, 3rd Edition, 2015.**
2. **A. Bruce Carlson, "Circuits", Brooks/Cole, 1st edition, 2008.**
3. **Schaum's Easy outline of Electric Circuits, 1st edition, 2020, McGraw Hill.**

REFERENCE BOOKS:

1. **Roy Choudhury**, "Networks and systems", 2nd edition, New Age International Publications, 2006.
2. **Hayt, Kemmerly and Durbin**, "Engineering circuit analysis", TMH, 6th Edition, 2002.

MOOC/NPTEL COURSES:

1. **https://onlinecourses.nptel.ac.in/noc22_ee07/preview**
2. **https://www.coursera.org/courses?query=network%20analysis**
3. **https://www.mooc-list.com/tags/network-analysis**

PRACTICAL COMPONENT OF NETWORK ANALYSIS(Integrated Lab)

Conduct the following experiments using suitable simulation software and the same is verified with hardware components.

Sl. No.	Experiments
1.	Verification of Kirchhoff's laws
2.	Superposition Theorem-verification
3.	Thevenin's Theorem-verification
4.	Norton's Theorem-verification
5.	Maximum Power Transfer Theorem-verification
6.	RLC series resonance circuits-Frequency response-Determination of Q and Band Width.
7.	RLC parallel resonance circuits-Frequency response-Determination of Q and Band Width.

ACTIVITIES

1. **Continuous Evaluation (Max. Marks:10):**
   a. **Objective:** To record and document the results of experiments conducted
   b. **Plan of Action:**
      - Each student must maintain observation and record for documenting the results.
      - Each experiment documented in the record must contain aim of the experiments, components required, circuit, theory related to the experiment, theoretical calculation and results obtained.
      - Each experiment will be evaluated and will be averaged to 10 marks.

2. **Lab CIE (Max. Marks:10)**
   a. **Objective:** To conduct the experiments on the theoretical problems in the lab.
   b. **Plan of Action:**
      - Each student will be given an experiment to conduct.
      - Students must perform theoretical calculations followed by practical conduction of the experiment after getting approval from the concerned course faculty.
      - Document the results obtained and compare the theoretical and practical results.

Articulation Matrix

Course Outcomes	Program Outcomes												Program Specific Outcomes	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√			√									
CO2	√	√			√									
CO3	√	√			√									
CO4	√	√			√				√					

LINEAR ICs and APPLICATIONS

CourseCode:22ESC305 **LTPC:3-0-0-3**

ExamHours:**3** Hours/Week:**3**

SEE:**50Marks** Totalhours:**40**

Course Objective: The objective of the course is to have thorough understanding of linear integrated circuits and its applications.

Course Outcomes (COs) {with mapping shown against the Program Outcomes(POs)}Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Analyze DC and AC amplifiers using op-amp characteristics and the need of voltage regulators, PLL system in Op-amp applications	1,2,3
2.	Apply operational amplifiers in linear and nonlinear applications	1, 2, 3
3.	Design first & second order Low Pass, High Pass, Band Pass, Band Stop Filters and Voltage Regulators using Op-Amp	1, 2, 3
4.	Design and implementation of analog and linear integrated circuits using various simulators like multisim /Pspice software	1,2,3, 5.9,10

Course Contents:

MODULE-1	Teaching Hours
Op-Amps as DC Amplifiers :IC Operational Amplifier, Voltagefollower,Non-invertingand inverting amplifiers; Op-Amp parameters – Ideal and practical operational amplifiers, Input outputand supply voltages, Offset voltages and currents, Input and output impedances, Slew rate andfrequencylimitations.Direct-coupledVoltageFollower,Direct-coupledNon-invertingAmplifiers, Direct-coupled Inverting amplifiers, Summing amplifiers, Difference amplifier.	**10Hours**
MODULE-2	
Op-Amps as AC Amplifiers & Op-Amp linear applications: Capacitor couple d Non-inverting Amplifiers, Capacitor coupled Inverting amplifiers, Setting the upper cut-off frequency, Instrumentation amplifier, Differentiating circuits ,Integrating circuits,Precisionhalf-waverectifiers,Precisionfull-waverectifiers.	**10Hours**
MODULE-3	
Op-AmpSignalGenerators&Filters: Voltageleveldetectors,InvertingSchmitttriggercircuit, Non-inverting Schmitttrigger circuit,Astable-multivibrator,Monostable-multivibrator,Triangularwavegenerator,555TimerMonostable. Filtertypesandcharacteristics,First-Orderactivefilters,Second-Orderfilters,Band-Passfilters,Notchfilters.	**10Hours**
MODULE-4	
VoltageRegulators,DAC&PLL: Voltageregulatorbasics,IClinearvoltageregulators-723IC Regulator, Analog/DigitalConversionBasics,Digital-to-AnalogConversion,BasicPhase-LockedLoopSystem,PLL Components.	**10Hours**

TextBook:

1. **DavidA.Bell,"Operational Amplifiers and Linear IC's",3rd edition,Oxford University Press2011.**

ReferenceBooks:

1. **RamakantAGayakwad**,"Op Amps and Linear Integrated Circuits", 4thEdition,PearsonEducation,2015.
2. **D.RoyChoudhuryandShailB.Jain,**"LinearIntegratedCircuits",4thedition,NewAgeInternational(P) Ltd, 2010.

MOOCs/NPTEL
https://nptel.ac.in/courses/108108111
https://youtu.be/J_YH_Reb_GM
https://youtu.be/clTA0pONnMs

Activity Number	Activity Name	Description	Marks	POs	PSOs
1	**Analysis of Analog and Linear integrated circuit.**	Simulation of analog and linear integrated circuits using MULTISIM live circuit simulator or LTspice software. Verify manual calculation and simulation results.	**10**	**1, 2, 3, 5, 9, 10**	**2**
2	**Circuit design and implementation**	Design and implementation of analog and linear integrated circuits.	**10**	**1,2,3, 5,9,10**	**2**

List of experiments for the activities.

- Design an op-amp monostable multivibrator without any triggering circuit, to produce a ±11V,1ms output pulse.
- Design a noninverting amplifier to have a voltage gain of approximately 66. The applied input signal amplitude is to be 15 mV.
- Design an inverting amplifier to have a voltage gain of 50 and the output voltage amplitude is to be 2.5 V.
- A direct-coupled noninverting amplifier with a ± 25 mV input is to produce a ± 5 V output. Design the circuit with suitable resistance values.
- Design a three-input inverting summing amplifier circuit and show how it can be converted into an averaging circuit.
- Design Schmitt trigger circuit to determine UTP and LTP, Given V_f=0.7V, ±Vcc=15V
- A direct-coupled inverting amplifier with a ± 20 mV input is to have a voltage gain of 200. Design the circuit with suitable resistance values.
- Design a non saturating precision half wave rectifier to produce a 2V peak output from a 1MHz sine wave input with a 0.5V peak value, Vcc=±15V.
- Design of oscillator using BJT/MOSFET for different frequencies.
- Design of amplifier using BJT/MOSFET.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√	√											
CO2	√	√	√											
CO3	√	√	√											
CO4	√	√	√		√				√	√				

DIGITAL ELECTRONICS LABORATORY

Course Code :22EC306 **LTPC: 0-0-2-1**

Exam Hours : 3 Hours / Week : 2

SEE: **50 Marks**

Course Objective: The students will have hands-on experience to design and build combinational circuits and sequential circuits.

Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}

Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Use the basic logic gates and various reduction techniques of digital logic circuit.	1, 2, 3, 5
2.	Design combinational and sequential circuits.	1, 2, 3, 5, 9
3.	Design and implement hardware circuit to test performance and application.	1, 2, 3, 5, 9

Course Contents:

Exp No.	Experiment Title
1.	(i) Realization of parallel adder/ Subtractor using 7483 chip. (ii) BCD to Excess-3 code conversion and vice versa.
2.	MUX/DEMUX – use of 74153, 74139 for arithmetic circuits and code converter.
3.	Realization of One bit comparator and study of 7485 magnitude comparator.
4.	Truth table verification of Flip-Flops: (i) JK Type (ii) T type (iii) D type (iv) SR type and (v) JK Master slave.
5.	Realization of 3 bit counters as a sequential circuit and MOD – N counter design (7476, 7490, 74192, 74193).
6.	(i) Shift left; Shift right, SIPO, SISO, PISO, PIPO operations using 7495S (ii) Design and testing Ring counter/Johnson counter using 7495S.

REFERENCE BOOK:

1. **Soumitra Kumar Manal,** "Digital Electronics Principle and Application", TMH, 2009 Edition.

ACTIVITIES

1. **Documentation (Max. Marks:10):**
   a. **Objective:** To record and document the results of experiments conducted.
   b. **Plan of Action:**
      - Each student must maintain observation and record for documenting the results.
      - Each experiment documented in the record must contain aim of the experiments, components required, circuit, theory related to the experiment, theoretical calculation and results obtained.
      - Each experiment will be evaluated and will be averaged to 10 marks.

Lab CIE (Max. Marks:20)

a. **Plan of Action:**
   - Each student will be given an experiment to conduct.
   - Students must show the expected result followed by practical conduction of the experiment after getting approval from the concerned course faculty.
   - Document the results obtained and compare the expected and practical results.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√	√		√									
CO2	√	√	√		√				√					
CO3	√	√	√		√				√					

ANALOG ELECTRONIC AND LINEAR INTEGRATED CIRCUITS LABORATORY USING PSPICE

Course Code :22AEC307 **LTPC: 0-0-2-1**
Exam Hours : 3 Hours / Week : 2
SEE: **50 Marks**

Course Objective: Students will have hands on experience to design and build several electronic circuits and study their performance and also simulate using P-spice software.
Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Design and test various analog electronic circuits using non-linear components and compare with experimental results in the Laboratory with theoretical analysis.	2, 4
2.	Design and test various analog electronic circuits using OPAMP and compare with experimental results in the Laboratory with theoretical analysis.	2, 4
3.	Design and verify analog electronic circuits using P-spice software	2, 4, 5

Course Contents:

Exp No.	Experiment Title
I	**Hardware Experiments**
1.	Design of a RC-Coupled single stage BJT amplifier and determination of gain versus frequency response.
2.	Design and testing of BJT-RC Phase shift oscillator for given audio frequency.
3.	Design and testing of FET – Colpitt's oscillator for Radio frequencies.
4.	Design and testing of a Crystal oscillator.
5.	OP-Amp applications: Inverting and non inverting amplifier, Summer and Subtractor.
6.	MOSFET characteristics, Design and testing of MOSFET amplifier circuit.
7.	Triangular wave generator and A stable multi vibrator using OPAMP.
II	**Using P-Spice software**
1.	OP-Amp applications: Inverting and non inverting amplifier
2.	OP-Amp applications: Summer and Subtractor.
3.	Rectifier Circuits: Half-wave and Full-wave Rectifier.
4.	Design of a RC-Coupled single stage BJT amplifier.
5.	Design Zener voltage regulator circuit.

REFERENCE BOOK:

1. **S. Poornachandra Rao. B Sasikala, "Hand Books of Experiments in Electronics and Communication Engineering", Vikas Publication, 2008.**

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1		√		√										
CO2		√		√										
CO3		√		√	√									

IV Semester

ANALOG COMMUNICATION AND SWITCHINGSYSTEMS

Course Code :22EC401 **LTPC:3-0-0-3**
Exam Hours : 3 Hours/Week :3
SEE:**50Marks** Total hours : 40

Course Objective: To learn the basic principles of underlying operation and design of analog communication and switching systems.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)} Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Develop the concept of analog modulation techniques.	1
2.	Design various modulation techniques.	2,3,5
3.	Apply the knowledge of switching systems to evaluate their performance	1,2
4.	Analyze the role for the control of switching systems and signaling schemes in telecommunications engineering.	1,2

Course Contents:

MODULE-1	Teaching Hours
Analog Modulation-I: Time and Frequency domain description, Generation and Detection of AM waves, DSBSC Modulation: Time and Frequency domain description, Generation and coherent Detection. Single side band modulation: Time and Frequency Domain description.	**10Hours**
MODULE-2	
Analog Modulation-II: Generation and Detection VSB techniques, comparison of modulation techniques, Frequency division multiplexing, and Single tone Frequency modulation. Angle Modulation Generation of FM wave–Direct and Indirect methods, demodulation of FM – balanced discriminator method.	**10Hours**
MODULE-3	
Traffic : Unit of traffic, congestion, Measurement and modeling of traffic, Lost call systems, Queuing systems. **Time division switching:** Space and time switching, Time division switches networks(TSN), non blocking networks, Grades of service of Time division switching networks.	**10Hours**
MODULE-4	
Control of Switching systems: Introduction, call-processing functions, common control, reliability, avai Laboratory ility and security, stored program control. **Signaling:** Introduction, customer line signaling, FDM carrier systems, PCM signaling.	**10Hours**

TEXTBOOKS:

1. **Simon Haykin**," An introduction to Analog and Digital communications",2nd edition,JohnWiley, 2009.
2. **JE Flood**, "Telecommunications Switching Traffic & Networks", Pearson education,2002.

REFERENCEBOOKS:

1. **John CBellamy**" Digital telephony", Wiley India 3rd Edition,2000.
2. **Thygarajan and Viswanathan**"Principle of telecommunication and switching",PHI2004.

Activities		
Sl. No	**Max. Marks**	**List**
1*	10	1. Implementation of AM modulators (a) AM modulator using Square law (b) AM modulator using switching 2. Implementation of AM demodulations (c) Square law detector (d) Envelope detector 3. Implementation of DSBSC modulators (e) Balanced Modulator (f) Ring modulator 4. Implementation of DSBSC demodulations (g) Coherent (h) Non-coherent 5. Generation of SSB 6. Generation of VSB 7. Generation of FM (i) Direct Method (j) Indirect Method 8. Implementation of FDM 9. Implementation of TDM
2	5	Assignment on Switching systems
3	5	Quiz

*** Implementation using LT spice / MATLAB simulation tool**

Articulation Matrix

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√													
CO2		√	√		√									
CO3	√	√												
CO4	√	√												

ELECTROMAGNETIC FIELD THEORY AND TRANSMISSION LINES

Course Code: 22ECS402 **LTPC: 3-0-0-3**
Exam Hours: 3 **Hours/Week: 3**
SEE: 50 Marks **Total hours: 40**

Course Objective: The objective of this course is to introduce the concepts of Electromagnetic field Theory, Maxwell's equations and their applications, Propagation of Uniform plane waves in different media and fundamentals of transmission lines.

Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)} Upon completion of the course, students shall be able to:

COs	Statement	POs
1	Apply the fundamental concepts of static, time varying Electro-Magnetic fields, various laws, and analytical methods to solve field theory problems.	1, 2
2	Apply the theory of electric and magnetic fields and solve problems using Maxwell's equations.	1, 2
3	Analyse the nature of EM waves, their propagation in different media and Poynting theorem.	1, 2
4	Develop the transmission line parameters using mathematical models and smith chart.	1, 2, 3

Course Contents:

MODULE-1	Teaching Hours
Electrostatic fields: Coulomb's law and its applications. Different types of charge distributions. Electric field due to different charge distributions, electrical potential at a point, potential difference, potential gradient, Gauss's law, divergence theorem, Poisson's and Laplace equations.	**10 Hours**
MODULE-2	
Steady magnetic fields: Biot-Savart's law, Amperes circuit law, Stokes theorem, magnetic flux and magnetic flux density, scalar and vector potentials, Faradays law. **Maxwell's equations**: Maxwell's equations in time varying fields, differential and integral forms of Maxwell's equations, Maxwell's equation for static fields and free space, Proof of Maxwell's equations and retarded potentials.	**10 Hours**
MODULE-3	
Electromagnetic Wave Propagation: Uniform plane wave, General solution of uniform plane wave equation, wave propagation in free space and conducting medium, wave propagation in good dielectrics, Depth of penetration, reflection and refraction of EM waves at normal incidence, Poynting vector and flow of power, Poynting theorem.	**10 Hours**
MODULE-4	
Transmission lines: Primary constants, transmission line equation, lossless and distortion less lines, Input impedance of open circuited, short circuited and matched lines, VSWR, Impedance matching principle: quarter wave transformers, single stub tuner, Smith chart and its applications.	**10 Hours**

TEXT BOOK:

1. Mathew N.O.Sadiku, ―Elements of Electromagnetics, 6th Edition, Oxford University Press,2015.

REFERENCE BOOKS:

1. William H.Hayt Jr. and John A. Buck, ―Engineering Electromagnetics, 7th Edition, Tata McGraw-Hill, 2006.
2. Network Lines and Fields, John D Ryder, PHI, New Delhi.

ACTIVITY

Activity Number	Activity Name	Description	Marks	POs
1	Simulate EM waves generation	Demonstrate the generation of EM waves using Scilab/Matlab	**10**	**5**
2	Simulation of Numerical examples	Solve numerical examples and simulate different scenarios of the given example using Scilab/Matlab	**10**	**5**

Activity 2: Numerical examples will be given for the following concepts:

1. Force between 2 charges.
2. Electric field intensity due to point charge.
3. Electric field intensity due to line charge.
4. Electric field intensity due to sheet charge.
5. Magnetic field intensity due to point charge.
6. Magnetic field intensity due to line charge.
7. Magnetic field intensity due to sheet charge.
8. Plane waves in different media.

Students will simulate different scenario of EM waves and study the characteristics of EM waves.

Articulation Matrix

Course Outcomes	Program Outcomes												Program Specific Outcomes	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√												
CO2	√	√												
CO3	√	√												
CO4	√	√	√											

SIGNALS AND SYSTEMS (Integrated)

Course Code :22EC403 **LTPC: 3-0-1-4**
Exam Hours : 3 Hours / Week : 5
SEE: **50 Marks** Total hours: 65

Course Objective: Express a signal and a system in both time and frequency domains and develop a mathematical process to migrate between two representations of the same entity.
Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Illustrate the classification of signals, interconnection of elements in a system and basic operations on signals and systems.	1, 2, 5
2.	Apply the convolution operator to determine the output of continuous-time/discrete-time systems and acquire knowledge about the time domain analysis of higher order systems.	1, 2, 5
3.	Apply the knowledge of Fourier transforms and Z-transform in signal representation and analysis of linear time-invariant systems.	1, 2, 5
4.	Reinforce theory and techniques taught in the classroom through experiments using suitable simulation software in the laboratory.	1, 2, 5, 9

Course Contents:

MODULE-1	Teaching Hours
Introduction: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as interconnections of operations, properties of systems.	**10 Hours**
MODULE-2	
Time-domain representations for LTI systems: Impulse response representation: Concept of Convolution, Convolution Sum and Convolution Integral. Properties of impulse response representation. **System representation:** Differential and difference equation Representations, System response by solving differential and difference equation. **Block diagram representations:** direct-I, direct-II forms.	**10 Hours**
MODULE-3	
Fourier Representation of Signals: Introduction, Fourier representation for Four classes of signals, Fourier transform representation for continuous-time non- periodic signals and their properties. The Fourier transform representation of discrete-time non-periodic signals and their properties.	**10 Hours**
MODULE-4	
Z-Transforms: Introduction, Z – transform and their properties, properties of ROC, inverse Z – transforms. Transform analysis of LTI Systems, Unilateral Z-Transform and its application to solve difference equations.	**10 Hours**

TEXT BOOKS:

1. **Simon Haykin and Barry Van Veen**, "Signals and Systems", John Wiley & Sons, 2nd edition, 2018.
2. **A. Anand Kumar,** "Signals and Systems", PHI Learning Pvt. Ltd., 3rd edition, 2015.

REFERENCE BOOKS:

1. **Roberts,** "Signals and systems", TMH, 2004.
2. **Alan V.Oppenheim**, **Alan S. Willsky and S. Hamid Nawab**, "Signals and systems", PHI Learning, 2nd edition, 2015.
3. **Stephan J Chapman,** "MATLABORATORY Programming for engineers", Wadsworth publications, 2006.

PRACTICAL COMPONENT OF SIGNALS AND SYSTEMS

Conduct the following experiments using suitable simulation software (MATLAB/SciLab).

Sl. No.	Experiments
1.	Generation of elementary signals in continuous time and discrete time.
2.	To perform operations on signals such as addition, multiplication, scaling, shifting, folding, computation of energy and average power.
3.	Compute convolution between two discrete time signals.
4.	To find the Fourier Transform of a given signal and plotting its magnitude and phase spectrum
5.	To verify the properties of the Fourier Transform of a given signal.
6.	To locate the zeros and poles and plot the pole zero maps in Z-plane for the given transfer function

ACTIVITIES

1. **Record Writing (Max. Marks:10):**
   a. **Objective:** To record and document the results of experiments conducted.
   b. **Plan of Action:**
      - Each student must maintain observation and record for documenting the results.
      - Each experiment documented in the record must contain aim of the experiments, components required, circuit, theory related to the experiment, theoretical calculation and results obtained.
      - Each experiment will be evaluated and will be averaged to 10 marks.
   c. **Rubrics of Evaluation**

Sl. No.	Criteria	Scale of Assessment		
		Satisfactory (0-4 marks)	**Good (4-8 marks)**	**Excellent (8-10 marks)**
1.	Experimental	Several important experimental details are missing. Narrative is incorrect, illogical, or copied directly from the lab manual. Written in the incorrect tense.	Narrative includes the most important experimental details but is missing one or more relevant pieces of information.	Contains details on how the experiment was performed and the procedures followed.
2.	Results (Presentation of results, figures and tables)	Figures, graphs, and tables are poorly constructed; have missing titles, captions or numbers. Certain data reported are not mentioned in the text. Important data missing	All figures, graphs, and tables are correctly drawn, but some have minor problems that could be still be improved. All data and associated figures, etc. are mentioned in the text. Most relevant data present	All figures, graphs, and tables are numbered with appropriate captions. All tables, figures, etc. are explicitly mentioned in the text. Relevant experimental data are presented which are used in the discussion.

2. **Integrated Lab CIE (Max. Marks:10)**

   a. **Objective:** To conduct the experiments on the theoretical problems in the lab using MATLAB/Scilab.

   b. **Plan of Action:**
      - Each student will be given an experiment to conduct.
      - Students must perform theoretical calculations followed by practical conduction of the experiment after getting approval from the concerned course faculty.
      - Document the results obtained and compare the theoretical and practical results.

   c. **Rubrics of Evaluation**

Sl. No.	Criteria	Scale of Assessment		
		Satisfactory (0-4 marks)	**Good (4-8 marks)**	**Excellent (8-10 marks)**
1.	Theoretical calculation	No calculations were found.	Calculation done with minor mistakes.	The calculations are correct.
2.	Program Writing	Student was unable to write the program for the given problem.	Student needed guidance to make correction in the program for the problem given.	Student was able to write the program correctly for the given problem.
3.	Troubleshooting	Unable to detect the error.	Able to detect the error but unable to correct it.	Student has ability to detect and correct errors.
4.	Results	No results were achieved or the achieved results were meaningless.	The results achieved are not accurate but are within the tolerance range.	Accurate results have been achieved.
5.	Queries	Lacks sufficient knowledge and awareness.	Fair knowledge and awareness related to the topic.	Extensive knowledge and awareness related to the topic.

NOTE: An average of 5 components will be taken.

Articulation Matrix

Course Outcomes	Program Outcomes												Program Specific Outcomes	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√			√									
CO2	√	√			√									
CO3	√	√			√									
CO4	√	√			√				√					

Microwave Communication

CourseCode:22EC404 **LTPC:3-0-0-3**

ExamHours:**3** Hours/Week:**3**

SEE:**50Marks** Totalhours:**40**

Course Objective: The Students will understand the working of microwave solid state devices, working concepts of satellite communication and analyze the effect of microwaves on human body, impact of the professional engineering solutions on environment and society.

Course Outcomes**(COs)** {with mapping shown against the Program Outcomes (POs)} Upon completion of the course, students shall be able to:

COs	Statement	Pos
1.	Acquire knowledge about working principles of specific microwave vacuum tube devices, passive devices and solid state devices	1,2,3
2.	Gain knowledge on effect of microwaves on human body, impact of the professional engineering solutions on environment and society	1, 2, 3
3.	Illustrate the fundamentals of satellite communication and orbital mechanics	1, 2,3
4.	Design and implementation of microwave components/devices using open source tools	1,2,3,5, 9,10

Course Contents:

MODULE-1	Teaching Hours
Introduction to Microwave Devices/circuit and Microwave Vacuum tube devices-Klystrons, Reflex Klystron oscillator, Helix Travelling-Wave Tubes (TWT), Magnetron (Qualitative analysis). Microwave network theory, Symmetrical Z and Y Matrices for reciprocal network. S-Matrix representation of multiport network. Properties of S-Matrix	**10 Hours**
MODULE-2	
Introduction to Microwave solid state devices-Crystal diode, Schottky diode, PIN diode and its application, GUNN diode, Varactor diode. Microwave passive devices: Waveguide Tees-H plane Tee junction, E-plane Tee junction, Magic Tees, Isolators, Circulators, Directional couplers	**10 Hours**
MODULE-3	
Modern Trends in Microwaves Engineering, Effect of Microwaves on human body. Medical and Civil applications of microwaves, MMIC Materials, MMIC growth, Thin film formation	**10 Hours**
MODULE-4	
Introduction to satellite communication: Overview of satellite communication orbital mechanics: Developing the equation of the orbit, Kepler's laws of planetary motion. Describing orbit of a satellite, locating the satellite in the orbit, locating satellite with respect to earth, orbital elements. Launches &satellites: Launches & launch vehicles.	**10 Hours**

TextBook:

1. **Annapurna Das, Sisir K Das**, "Microwave engineering", TMH Publication 3rd edition, 2008.
2. **Sammuel Y. Liao** "Microwave Devices and Circuits engineering", PHI 3rd edition, 2008.
3. **Timothy Pratt**, "Satellite communications", Wiley Student Edition, 2nd Edition,2005

ReferenceBooks:

1. **Kennedy. Davis**, "Electronic Communication Systems", TMH, 4th Edition,2005.

Links:

https://nptel.ac.in/courses/117105130
https://onlinecourses.nptel.ac.in/noc20_ee35/preview
https://nptel.ac.in/courses/117101119

Activity Number	Activity Name / Description	Marks	POs
1	Demonstration of microwave communication using different microwave sources	10	1,2,3,5,9,10
2	Simulation of microwave components/devices using open source tools	10	1,2,3,5,9,10

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√	√											
CO2	√	√	√											
CO3	√	√	√											
CO4	√	√	√		√				√	√				

ARM EMBEDDED SYSTEMS

Course Code :22ECS405 **LTPC: 3-0-0-3**
Exam Hours : 3 Hours / Week: 3
SEE : **50 Marks** Total hours: 40

Course Objective: To enable the students to understand the importance and applications of ARM Design, know the architecture of ARM processors, use instruction sets of ARM processor and analyse the adaptation of C code, firmware, OS, Interrupts, caches, etc. in ARM embedded systems.

Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
5.	Depict the organization, architecture, bus technology, memory and operation of the ARM Processors.	1, 2
6.	Employ the knowledge of the Instruction set of ARM processors to develop basic Assembly Language Programs.	1, 2
7.	Describe the techniques involved in writing C code for ARM processors and Exception & Interrupt handling in ARM Processors.	1, 2
8.	Describe the importance and use of Firmware, OS and cache in ARM Embedded systems.	1, 2

Course Contents:

MODULE-1	Teaching Hours
ARM Embedded Systems Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. **ARM Processor Fundamentals:** ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions.	**10 Hours**
MODULE-2	
Introduction to the ARM Instruction set Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, Conditional Execution. ALP programming. **Introduction to the THUMB instruction set** Introduction, THUMB register usage, ARM – THUMB interworking, Other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions. ALP programming	**10 Hours**
MODULE-3	
Efficient C Programming: Overview of C Compilers and optimization, Basic C data types, Local Variable Types, Portability issues **Exception and Interrupt Handling:** Exception Handling-ARM Processor Exceptions and Modes, Vector Table, Exception Priorities, Link Register Offset, Interrupts- Interrupt Latency, Basic Interrupt Stack design and implementation, Interrupt Handling Schemes (**General description only** of the schemes)	**10 Hours**
MODULE-4	
Firmware: Firmware and Bootloader **Embedded Operating Systems:** Fundamental Components **Caches:** The memory Hierarchy and caches memory-caches and memory management units, Cache architecture basic architecture of caches memory, basic operation of cache controller, the relationship between cache and main memory.	**10 Hours**

Students have to conduct the following experiments as a part of CIE marks along with other Activities:

TEXT BOOKS:

1. Andrew N Sloss, Dominic System and Chris Wright**, "ARM System Developers Guide", Elsevier, Morgan Kaufmann publisher, 1st Edition, 2008.**

REFERENCE BOOKS:

3. **Furber S,** "ARM System on chip Architecture", 2nd edition, Addison Wiley, 2008.
4. **Rajkamal**, "Embedded System", Tata McGraw-Hill Publishers, 2nd Edition, 2008.

Activity Number	Activity Name / Description	Marks	POs
1	Mini-Project using ARM Processor: 1. A group of four members 2. A brief report has to be submitted along with demonstration to all the faculty members.	20	1,2,3,5, 9,10

Articulation Matrix

Course Outcomes	Program Outcomes												Program Specific Outcomes	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	√	√			√			√	√				√	√
CO2	√	√			√			√	√				√	√
CO3	√	√			√			√	√				√	√
CO4	√	√			√			√	√				√	√

COMMUNICATION LABORATORY

Course Code :22EC406 **LTPC:0-0-2-1**
Exam Hours : 3 Hours / Week : 2
SEE :**50 Marks** Total hours : 12

Course Objective: To provide hands on experience to the students on fundamental concepts of communication systems.
Course Outcomes (COs){with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
1.	Demonstrate various modulation techniques used in communication systems.	1, 2
2.	Design and develop Butterworth active filter circuits.	1, 2
3.	Evaluate the results of experiments conducted and communicate effectively	5, 9,10

Course Contents:

Exp No.	Experiment Title
1.	Active Filters : Low pass and High pass Filters (First Order and Second Order), Active Band pass and Notch/Band Elimination Filters (Second Order)
2.	Class C Tuned RF amplifier.
3.	Amplitude Modulation and Demodulation.
4.	Balanced Modulator and SSB generation.
5.	Frequency Modulation and Demodulation.
6.	Pre-emphasis and De-emphasis circuits
7.	Pulse Code Modulation
8.	Super heterodyne transmitter receiver: determination of sensitivity, selectivity, Fidelity

TEXT BOOKS:

1. **Simon Haykin**, "An introduction to Analog and Digital communications", 2nd edition, John Wiley, 2009
2. **Ramakant A. Gayakwad**, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	√	√											√	
CO2	√	√											√	
CO3					√				√	√				√

EMBEDDED SYSTEMS LABORATORY

Course Code: 22EC407 **LTPC: 0-0-2-1**
Exam Hours: 3 Hours / Week :**2**
SEE: **50 Marks**

Course Objective: The student will gain the knowledge of writing assembly language programs using ARM processor and to interface ARM processor with various modules.
Course Outcomes (COs) {with mapping shown against the Program Outcomes (POs)}
Upon completion of the course, students shall be able to:

COs	Statement	POs
2.	Analyse ARM processor fundamentals to develop programming skills of ARM processor	2, 5
3.	Design and implementation of ARM interfacing modules.	2, 5
4.	Develop communications skills through group work and report preparation.	5, 9, 10

Course Contents:

PART-A: Conduct the following experiments by writing Assembly Language Program (ALP) using ARM-7 using an evaluation board/simulator and the required software tool.

1. Write an ALP to multiply two 16 bit binary numbers.
2. Write an ALP to find the sum of first 10 integer numbers.
3. Write an ALP to find factorial of a number.
4. Write an ALP to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5. Write an ALP to add two 64 bit numbers.
6. Write an ALP to find the square of a number(1 to 10) using look-up table.
7. Write an ALP to find the largest/smallest number in an array of 32 numbers.
8. Write an ALP to arrange a series of 32 bit numbers in ascending/descending order.
9. Write an ALP to count the number of ones and zeros in two consecutive memory locations.
10. Write an ALP to Scan a series of 32 bit numbers to find how many are negative.

PART-B: Conduct the following experiments on an ARM 7 using evaluation version of Embedded 'C' & Keil Uvision-4 tool/compiler.

1. Display “Hello World” message using Internal UART.
2. Interface and Control a DC Motor.
3. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
4. Determine Digital output for a given Analog input using Internal ADC of ARM controller.
5. Interface a 4x4 keyboard and display the key code on an LCD.
6. Demonstrate the use of an external interrupt to toggle an LED On/Off.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1		√			√									
CO2		√			√									
CO3					√				√	√				