MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous institution Affiliated to VTU, Belgaum)

Autonomous Programmes

Bachelor of Engineering

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

SYLLABUS

III & IV Semester
(2023-24 Admitted Batch)

Academic Year 2024-25

Scheme & Syllabus for BE (E&C) III and IV semesters
2024-25 Academic Year

VISION OF THE DEPARTMENT

To produce industry ready, research oriented and socially responsible Electronics & Communication Engineers.

MISSION OF THE DEPARTMENT

- To create an ambience for learning.
- To conduct research, beneficial to the society.
- To promote industry-academic interaction at all-levels.
- To be continuously agile to the needs of the stake holders.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The graduates will:
PEO1: Design and test Electronics & Communication systems and be successful professional in the field of ECE and allied areas.
PEO2: Be a good leader, team worker with strong communication skills.
PEO3: Possess capability to pursue higher education and be involved in research in the core and allied areas of E&C engineering and be a lifelong learner.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: An ability to understand the basic concepts in Electronics and Communication Engineering and to apply them to various areas, like Signal and image processing, VLSI, Embedded systems, photonics, networks, MEMS, antennas etc., in the design and implementation of complex systems.

PSO2: Possess the skills to analyze and solve problems, using the latest software tools and hardware available in E & C Engineering along with analytical skills for real-time applications.

PROGRAM OUTCOMES

The program is targeted at developing the following competencies, skills and abilities amongst students of E & C Engineering:

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**, reviewer search 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. **Conducting 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 in formed 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 multi disciplinary 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 multi disciplinary 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.

Scheme of Evaluation (Theory Courses)

Assessment	Marks
THREE CIE's conducted for a total of 30 marks	30
Activities as decided by course faculty	20
SEE	50
Total	100

Scheme of Evaluation (Laboratory Courses)

Assessment	Marks
Continuous Evaluation in every lab session by the Course coordinator	10
Record Writing	20
Laboratory CIE conducted by the Course coordinator	20
SEE	50
Total	100

Scheme of Evaluation (Integrated Laboratory Courses)

Assessment	Marks
Continuous Evaluation in every lab session by the Course coordinator	05
Record Writing	05
Laboratory CIE conducted by the Course coordinator	10
Total	20

Examination	Maximum Marks	Minimum Marks to Qualify
CIE	50	20
SEE	50	20

THIRD SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
BSC	23MAEC301	Mathematics for Electronics and Communication Engineering	4-1-0	4	5
PCC	23EC302	Analog Electronic Circuits	3-0-0	3	3
PCC	23EC303	Digital Electronics	3-0-0	3	3
IPCC	23EC304	Network Analysis	3-0-2	4	5
ESC	23ESC30X	Engineering Science Course (ESC/ETC/PLC) -III	3-0-0	3	3
PCCL	23EC306	Digital Electronics Laboratory	0-0-2	1	2
UHV	23SCR	Social Connect and Responsibility	0-0-2	1	2
AEC	23AEC3XX	Ability Enhancement Course – III	0-0-2	1	2
MC	23NYP1	NSS, Yoga, PE	0-0-2	A	2
			Total	20	27

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

Engineering Science Course (ESC/ETC/PLC) -III			
23ESC305	Electronic Instrumentation	23ESC306	Robotics and Automation
23ESC307	Linear ICs and Applications	23ESC308	Microcontroller
Ability Enhancement Course – III			
23AEC307	Analog Electronic and Linear Integrated Circuits Laboratory	23AEC308	C++ Basic Programming
23AEC309	Scilab Programming Laboratory	23AEC310	IoT Applications Laboratory

FOURTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PCC	23EC401	Analog Communication and Switching Systems	3-0-0	3	3
PCC	23EC402	Electromagnetic Field Theory and Transmission lines	3-1-0	3	4
IPCC	23EC403	Signals and systems	3-0-2	4	5
PCC	23EC404	ARM Embedded Systems	3-0-0	3	3
ESC	23ESC40X	Engineering Science Course (ESC/ETC/PLC)-IV	3-0-0	3	3
PCCL	23EC406	Communication Laboratory	0-0-2	1	2
AEC	23AEC4XX	Ability Enhancement Course – IV	0-1-2	1	3
BSC	23BEEC408	Biology For Engineers	0-0-2	1	2
UHV	23UHV	Universal human values	0-0-2	1	2
MC	23NYP2	NSS, Yoga, PE	0-0-2	A	2
Total				**20**	**29**

Engineering Science Course (ESC/ETC/PLC)-IV			
23ESC405	Linear Algebra and Integral Transforms	23ESC406	Microwave Communication
23ESC407	PCB Design	23ESC408	Switching and Finite Automata Theory
Ability Enhancement Course - IV			
23AEC407	ARM Embedded Systems Laboratory	23AEC408	Programmable Logic Controllers
23AEC409	Statistics with R Lab for machine learning	23AEC410	Lab VIEW Programming

Mathematics for Electronics and Communication Engineering

Course Code :23MAEC301	**LTPC: 4-1-0-4**
Exam Hours : 3	Hours / Week: 5
SEE :**50 Marks**	Total hours: 52

Course Objective: Students will be able to use appropriate data structures for solving problems.

Course Outcomes:

At the end of the course students will be able to:

COs	Outcomes	POs	PSOs
CO1	Correlate the experimental data using correlation coefficient. Predict the output corresponding to input using regression, fit a curve to the data, solve simple problems on probability and joint probability.	1	-
CO2	Validate an assumption through "hypothesis testing" (that is the assumption is not simply because of chance).	1,2	-
CO3	Analyze the problems connected with probability distribution, random processes and also, predict the probability in the long run for Markov chain based problems.	1,2	-
CO4	Model real life problems/engineering application problems and solve the same.	1,2	-

Course Contents:

MODULE-1	**Teaching Hours**
Statistics: Correlation, Karl Pearson coefficient of correlation and Spearman's rank correlation coefficient. Physical interpretation of numerical value of the rank correlation coefficient. Linear Regression analysis (when the experimental output depends on one input). Illustrative examples from engineering field, multiple linear regression analysis (When the experimental output depends on two inputs). Curve fitting-exponential. **Continuous Random Variables:** Definition of PDF and CDF, Expectation and Variance, illustrative examples. **Self-study/Applications:** Curve fitting-linear, quadratic.	13 Hours
MODULE-2	
Continuous Probability distribution: Exponential pdf, Normal/Gaussian pdf. Discussion on the choice of PDF. Illustrative examples from engineering field. **Sampling theory:** Population & sampling, sampling with & without replacement, sampling distribution of means, sampling distribution of Proportions, sampling distribution of differences & sums. **Applications:** Current measurement problems and Digital transmission channel connected with pdf. **Self-study:** Uniform pdf, Detection of signal connected with pdf.	13 Hours
Module–3	
Confidence intervals & Hypothesis Testing: Brief introduction to confidence intervals, Testing a hypothesis, central limit theorem-statement, Level of significance, Simple sampling of attributes, Test of significance for large samples, Comparison of large samples, Student's t-distribution, Chi-square distribution. **Applications:** Propellant burning rate, process-capacity problem, drying time problem, Two catalyst effect on chemical reaction **Self-study:** F-test, Analysis of variance.	13 Hours
Module–4	
Joint Probability Distribution & Stochastic Processes: Concept of joint probability, Joint distributions of discrete random variables, Independent random variables-problems. Joint expectation, co-variance, and correlation. **Random Process:** Introduction, Deterministic and non-deterministic processes, distribution and density function, stationarity and statistical independence, statistical independence,	13 Hours

stationary random process, wide-sense stationarity, time average and ergodicity. **Markov Chains**: Introduction, stochastic matrices, fixed probability vectors and regular stochastic matrices. **Applications:** Application of Markov chain to determine the voting tendencies. **Self-study:** Estimating the population distribution of a city due to migration.	
Module–5	
Tutorial: 1. A report on the need of studying Correlation & Linear Regression. 2. Examples on Correlation & Linear Regression. 3. A report on the need of studying Multiple Regression. 4. Examples on Multiple Regressions. 5. Examples on Continuous Random Variable. 6. Examples on Normal probability distribution & exponential probability distribution. 7. Discussion on the applications connected with Normal probability distribution. 8. Discussion on the applications connected with Exponential probability distribution. 9. Examples on Hypothesis testing such as student-t test, Chi-square. 10. Examples on Joint probability distribution. 11. Application of Joint probability distribution in engineering. 12. Examples on Markov chain. Application of Markov chain in engineering.	
Activity: 1. Negative binomial distribution: Failure of server's problems, 2. Poisson distribution: Contamination problem, flaws in wires. 3. Exponential distribution: lack of memory property. 4. Continuous random variable: Shaft conforms. 5. Continuous random variable: detection of signal, Digital transmission channel. 6. Hypothesis analysis Depression treatment. 7. Hypothesis analysis defect in printed circuit board. 8. Confidence levels: Doping the cement with lead effect on percentage of calcium. 9. Current measurement problems, Propellant burning rate, process-capacity problem, drying time problem, two catalyst effect on chemical reaction. Application of Markov chain in estimating the population distribution of a city due to migration.	

Note – 1. Theorems and properties without proof. Applicable to all the Modules.
2. Self study part is not included for Semester End Examination.

Text Books:

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd 9th edition, 2014.
3. B V Ramana Higher Engineering Mathematics, Tata McGraw Hill Publications, 2nd edition, 2007.

Reference Books:

1. Scott L.Miller, Donald G. Childers: "Probability and Random Process with application to Signal Processing", Elsevier Academic Press, 2nd Edition, 2013.

2. Statistics for engineers and Scientists, William Navide, Mc-Graw hill education, India pvt. Ltd., 3rd edition 2014.
3. T.Veerarajan: “Probability, Statistics and Random Process“, 3rd Edition, Tata McGraw Hill Co., 2008.
4. Theory and problems of probability, Seymour Lipschutz and marclarslipson, Schaum out line series, 2nd edition.

Web links

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)

CO-PO Mapping:

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	3	2												
CO3	3	2												
CO4	3	2												

ANALOG ELECTRONIC CIRCUITS

Course Code :23EC302	**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, The Early Effect, An alternative form of Common Emitter 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:

2. **BehzadRazavi**"Fundamentals of Microelectronics", 2nd Edition, Wiley India Pvt. Ltd., 2014.

3. **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 LT-spice 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 monostable multivibrator without any triggering circuit, to produce a ±11V,1ms output pulse.
2. Design a non-inverting 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 non-inverting 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	3	2												
CO2	2	2	2		2									
CO3	3	2			2									
CO4	2													

DIGITAL ELECTRONICS

Course Code :23EC303	**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. **[Self Learning:** NAND and NOR implementation]	**10 Hours**
MODULE-2	
Simplification of Boolean Functions, Combinational Circuits Design and Analysis: Single Variable Entered Karnaugh map [excluding don't care expression],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	2	3											2	1
CO2	2	3							1				2	
CO3	2	3	3		2				1				2	2
CO4	2	3	3		2				1				2	2

NETWORK ANALYSIS

Course Code :23EC304	**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/noc23_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	2	3			2								2	1
CO2	2	3			2								2	1
CO3	2	3			2								2	1
CO4	2	3			2				1				-	2

DIGITAL ELECTRONICS LABORATORY

Course Code :23EC306	**LTPC: 0-0-2-1**
Exam Hours : 3	Hours / Week : 2
SEE: **50 Marks**	Total hours: 26

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. **Record Writing (Max. Marks:20):**
   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)**
	Experimental	Several important experimental details are missing. Narrative is incorrect, illogical, or copied directly from the	Narrative includes the most important experimental details but is missing one or more relevant pieces of	Contains details on how the experiment was performed and the procedures followed.

		lab manual. Written in the incorrect tense.	information.	
	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 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. Continuous Evaluation (Max. Marks:10):

a. Rubrics of Evaluation

Sl. No.	Criteria	Scale of Assessment		
		Satisfactory (0-4 marks)	**Good (4-8 marks)**	**Excellent (8-10 marks)**
1.	Components selection	Incapable of selecting components relevant to the experiment.	Needed guidance in selecting components relevant to the experiment.	Capable of selecting correct components relevant to the experiment.
2.	Circuit connection	Student was unable to make correct component connections as per the circuit diagram.	Student needed guidance to make correct component connections as per the circuit diagram.	Student was able to make correct component connections as per the circuit diagram.
3.	Troubleshooting	Unable to detect the error.	Able to detect the error but unable to correct it.	Student has ability to detect and correct the errors.
4.	Punctuality	Always arriving late to the lab.	The student was on time to the lab but not involved in conduction of experiments.	On-time and actively conducting the experiments.
5.	Workplace Clearance	Irresponsibility using the components and didn't clear the workplace on completion of lab work.	Showed responsibility towards the components but didn't clear the workplace on completion of lab work.	Showed responsibility towards the components but cleared the workplace on completion of lab work.

NOTE: An average of 5 components will be taken.

3. 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.

b. Rubrics of Evaluation

Sl. No.	Criteria	Scale of Assessment		
		Satisfactory (0-6 marks)	**Good (7-14 marks)**	**Excellent (17-20 marks)**
1.	Write up	Incomplete justification to the objectives proposed; Steps are mentioned but unclear; without justification to objectives.	A good justification for the objectives; Methodology to be followed is specified but detailing is not done.	All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified.
2.	Circuit connection	Student was unable to make correct component connections as per the circuit diagram.	Student needed guidance to make correct component connections as per the circuit diagram.	Student was able to make correct component connections as per the circuit diagram.
3.	Troubleshooting	Unable to detect the error.	Able to detect the error but unable to correct it.	Student has ability to detect and correct the errors.
4.	Results	No results were achieved or the achieved results were meaning less.	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.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	1	1	1		1									
CO2	1	2	3		1				2					
CO3	1	2	3		1				2					

Engineering Science Course (ESC/ETC/PLC)

ELECTRONIC INSTRUMENTATION

Course Code : 23ESC305	**LTPC: 3-0-0-3**
Exam Hours : 3	Hours / Week : 3
SEE: **50 Marks**	Total hours: 40

Course Objective: The student will have the knowledge of generalized measurement system, its construction, working and errors associated with them and also understand different electronic operation.

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 instrument characteristics, errors and generalized measurement system.	PO1,PO2
2.	Analyze Instrument calibration and working of CRO/special oscilloscopes and spectrum analyzer for measurement.	PO1,PO2,
3.	Analyze and interpret different signal generator circuits for the generation of various waveforms and need of different transducers.	PO1,PO2,
4.	Understand and use different display devices and data acquisition system.	PO1,PO2,

Course Contents:

MODULE-1	**Teaching Hours**
Measurement systems, units and standards, and Measurement Errors: Introduction Gross errors and systematic errors, Absolute and relative errors, basic concepts of accuracy, Precision, Resolution and Significant figures, Measurement error combinations. (relevant problems). **Digital Instruments & calibrations:** Introduction, Ramp type, Dual slope integrating type (V–T), integrating type (V–F) and successive approximation principles, Resolution and sensitivity, General specifications, Digital Multimeters, Digital Frequency meters, Digital measurement of time, Automation and Digital Instruments, Instrument Calibration: comparison methods, Digital multimeters as standard instruments.	**10 Hours**
MODULE-2	
Display devices: Introduction, CRT features, Dual Trace Oscilloscopes, digital storage oscilloscopes and its applications, Oscilloscope controls, Oscilloscope probes, Classification of Displays: LCD, LED, backlight LEDs, PLASMA, OLED and QLED Transducers: Introduction, Electrical transducer, selecting a transducer, capacitive transducer, Inductive transducer, piezo electrical transducer.	**10 Hours**
MODULE-3	
Signal generators: Introduction, Low frequency signal generators, function generator, pulse generators, RF signal generator, sweep frequency generators. **Biomedical application instruments:** Blood gas analyzer, Blood glucose meter, Electronic cardiac meter, digital/IR thermometer.	**10 Hours**
MODULE-4	
Data Acquisition and conversion: Objective of DAS, signal conditioning for the inputs, single data acquisition system, multi- channel DAS. **Miscellaneous Instruments:** Distortion meter, Spectrum analyzers, Network Analyzer, Digital Power/Energy Meter.	**10 Hours**

Text Books:

1. **David A Bell,"** Electronic Instrumentation and Measurements", oxford University Press, 3rd Edition, 2013.
2. **H S Kalsi**, "Electronic Instrumentation", Tata McGraw-Hill Education, 3rd Edition, 2012

Reference Books:

1. **John P Bentely**, "Principles of measurement systems",3rd Edition, Pearson Education, 2000.
2. **Rangan, Sharma & Mani**," Instrumentation Devices and systems", TMH 2nd edition, 2005.
3. **D. Helfrick and W.D. Cooper**, "Modern Electronic Instrumentation and Measuring Techniques", Pearson, 1st Edition, 2015.
4. **Albert D.Helfrick.** Electrical Spectrum and Network Analyzers: A practical Approach, Pearson, 2015.

Activity Number	Activity Name	Description	Marks	POs
1	Report	Prepare a report on how Electronic instruments used for various applications.	10	1,2
2	Presentation	Presentation on different Biomedical application instruments and Miscellaneous Instruments	10	1,2

Course Outcomes	Program Outcomes [POs]												Program Specific Outcomes	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												

Robotics and Automation

Course Code : 23ESC306	LTPC: 3-0-0-3
Exam Hours : 3	Hours / Week : 3
SEE : **50 Marks**	Total hours : 40

Course Objective: An understanding about robotics with emphasis on basics of manipulators, coordinate transformation, kinematics, trajectory planning and control techniques.

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.	Outline the Robotic basics and their classification.	1
2.	Analyze the end effectors of Robotics.	1,5
3.	Interpret the Kinematics and path planning for Robotic system.	1,5
4.	Design sensors and robotics for industrial applications.	1, 3,5

Course Contents:

MODULE – 1	Hours
BASIC CONCEPTS OF ROBOTICS: Introduction, Evolution of robots and robotics, Laws of Robot, Robot definition, Generations of Robots, Robot anatomy, Coordinate frames, mapping and transforms. (Text 1: 1.1 to 1.6, 2.1 to 2.5) **END EFFECTORS:** Introduction, Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Consideration. (Text 2: 5.1 to 5.4)	**10**
MODULE – 2	
KINEMATICS: Introduction, Direct kinematic model: Mechanical structure and notations, Description of joints and links. Kinematic modeling of the manipulator.Denavit –Hartenberg Notation. ROBO Software implementation of kinematic models. (Text1: 3.1 to 3.4)	**10**
MODULE – 3	
PATH PLANNING: Introduction, Definitions of Trajectory planning, Trajectory planning problem, terminology, steps in trajectory planning, classification of trajectory planning, types of trajectory function tasks, joint space techniques, Cartesian space technique. (Text 1: 7.1 to 7.8)	**10**
MODULE – 4	
ROBOTIC SENSORS AND VISION: Introduction, Sensors and Robotics, Kinds of sensors used in Robotics. Robotic Vision, Industrial applications of vision –controlled robotic vision systems. (Text 1: 9.1 to 9.5)	**10**

Activities

1. Mini project for 15 marks
2. Quiz for 05 marks

Text Book:

1. **R K Mittal And I J Nagarth,** "Robotics And Control", Mc Graw – Hill, 2003.
2. **M.P.Groover,** "Industrial Robotics – Technology, Programming and Applications", McGraw-Hill, 2001.

Reference Books:

1. **Fu.K.S. Gonzalz.R.C., and Lee C.S.G.,** "Robotics Control, Sensing, Vision and Intelligence", Mc Graw – Hill, 1987.
2. **Richard D. Klafter, Thomas A. Chmielewski and Michael Negin,,**"Robotic engineering- An Integrated Approach", Prentice Hall Inc, 1989.

3. **Janakiraman.P.A,** "Robotics and Image Processing", Tata McGraw-Hill, 1995.

Mapping of Course Outcomes [COs] and Program Outcomes [POs]:

Course Outcomes	Program Outcomes [POs]												Program Specific Outcomes	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	1				2									
CO2	1				2									
CO3	1				2									
CO4	1		3		2									

LINEAR ICs and APPLICATIONS

CourseCode:23ESC307	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, Voltage follower, non-inverting and inverting amplifiers: Op-Amp parameters – Ideal and practical operational amplifiers, Input output and supply voltages, offset voltages and currents, Input and output impedances, Slew rate and frequency limitations. Direct-coupled, Voltage Follower, Direct-coupled Non-inverting Amplifiers, 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 Schmitt trigger circuit, Astable-multivibrator,Monostable-multivibrator,Triangularwavegenerator,555TimerMonostable. Filtertypesandcharacteristics,First-Orderactivefilters,Second-Orderfilters,Band-Passfilters,Notchfilters.	**10Hours**
MODULE-4	
Voltage Regulators, DAC & PLL: Voltage regulator basics, IC linear voltage regulators-723IC Regulator, Analog/Digital Conversion Basics, Digital-to-Analog Conversion, Basic Phase-Locked Loop System, PLL Components.	**10Hours**

Text Book:

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

Reference Books:

1. **Ramakant A Gayakwad**,"Op Amps and Linear Integrated Circuits", 4th Edition,PearsonEducation,2015.
2. **D.RoyChoudhuryandShailB.Jain,**"LinearIntegratedCircuits",4th edition,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	3	2	1											
CO2	3	3	3											
CO3	3	2	3											
CO4	3	3	2		3				3	3				

MICROCONTROLLERS

Course Code :23ESC308	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 become familiar with the architecture and the instruction set. Impart knowledge about assembly language programs and 8051 C. Provide strong foundation for designing real world application using microcontrollers.

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.	Understand the architecture and instruction set of microcontrollers.	1
2.	Apply the knowledge of programming concepts and skills to develop codes in assembly and C language.	1,2
3.	Investigate the programming of I/O ports to interface the controller to external devices.	1,2
4.	Design, test and implement Microcontroller based systems	1,2,3

Course Contents:

MODULE-1	Teaching Hours
Microprocessors and Micro controllers The 8051 Architecture: Introduction, 8051 Microcontroller Hardware. Addressing modes, External data Moves, PUSH and POP Opcodes, Data exchanges, Example Programs; Byte level logical Operations, Bit level Logical Operations, Rotate and Swap Operations, Example Programs. Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Example Programs.	**10 Hours**
MODULE-2	
Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Example Programs. The JUMP and CALL Program range, Jumps, calls and Subroutines, Data types and time delays in 8051C, I/O programming, logic operations.	**10 Hours**
MODULE-3	
Programming 8051 Timers, Counter Programming, programming timers 0 and 1 in 8051C. Basics of Serial Communication, 8051 Serial communication Programming, Programming the second serial port, Serial port programming in C.	**10 Hours**
MODULE-4	
Arduino: Microcontroller, Organization of a Microcontroller, Microcontroller Peripherals, Open Source Hardware (OSHW), Arduino Brief History, Arduino Uno Board, Arduino IDE, Basic Interfacing examples	**10 Hours**

TEXT BOOKS:

1. **Kenneth J. Ayala,** "The 8051 Microcontroller Architecture, Programming &Applications", Cengage Learning, 3rd Edition, 2004.
2. **Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay**,"The 8051 Microcontroller and Embedded Systems – using assembly and C ", Pearson Education India, 2nd Edition, 2007.
3. "Microcontroller Programming with Arduino and Python", Sudhakar Kumar, Manas
4. Ranjan Das Rajesh Kushalkar, Nirmala Venkat, Chandrashekhar Gourshete Kannan M. Moudgalya ,
5. FOSSEE Project Indian Institute of Technology Bombay June 2021

REFERENCE BOOKS:

1. **Dr. Ramani Kalpathi, Ganesh Raja**," Microcontrollers and Applications" 1 st edition, Sanguine publications, 2007.
2. **J Raj Kamal**, "Microcontrollers Architecture, Programming Interfacing and System Design", 1st edition Pearson Education, 2005.
3. **Udayashankar M. Mallikarjunaswamy**, "8051 Microcontroller Hardware software &applications.TMH 2000.

ACTIVITY

1. 8051 Microcontroller based application for activity:
2. RFID and Keypad Based Security System using 8051 Microcontroller
3. PIR Sensor and GSM Based Security System
4. Bluetooth Controlled Home Automation System using 8051
5. Digital Code Lock using 8051 Microcontroller
6. Interfacing ADC0808 with 8051 Microcontroller
7. Digital Clock using 8051 Microcontroller
8. Displaying an Image on Graphical LCD using 8051 Microcontroller
9. Digital Thermometer using LM35 and 8051 Microcontroller
10. RFID Interfacing with 8051 Microcontroller
11. Android Controlled Robot using 8051 Microcontroller
12. Controlling Light using Touch Sensor and 8051 Microcontroller

I. Plan of action: Group is created having 4 students, for each group above mentioned application is given to design and implement.

II. Rubrics for activity:

Sl. No	Criteria	Marks	Evaluation	
1	Writing Code	05	Minor mistakes and required guidance - (1-3 marks)	Correct code and does not taken guidance- (4-5marks)
2	Hardware Implementation	10	Require guidance- (5-7marks)	No guidance- (8-10 marks)
3	Report and Presentation	05	Report require correction and average presentation- (1-3 marks)	Good report and presentation- (4-5 marks)

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	3												3	3
CO2	3	3											3	3
CO3	3	3											3	3
CO4	3	3	3	3	3				3	3			3	3

Ability Enhancement Course – III

ANALOG ELECTRONIC AND LINEAR INTEGRATED CIRCUITS LABORATORY

Course Code :23AEC307	**LTPC: 0-0-2-1**
Exam Hours : 3	Hours / Week : 2
SEE: **50 Marks**	Total hours: 26

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**
	Design of a RC-Coupled single stage BJT amplifier and determination of gain versus frequency response.
	Design and testing of BJT-RC Phase shift oscillator for given audio frequency.
	Design and testing of FET – Colpitt's oscillator for Radio frequencies.
	Design and testing of a Crystal oscillator.
	OP-Amp applications: Inverting and non inverting amplifier, Summer and Subtractor.
	MOSFET characteristics, Design and testing of MOSFET amplifier circuit.
	Triangular wave generator and Astable multivibrator using OPAMP.
II	**Using P-Spice software**
	OP-Amp applications: Inverting and non inverting amplifier
	OP-Amp applications: Summer and Subtractor.
	Rectifier Circuits: Half-wave and Full-wave Rectifier.
	Design of a RC-Coupled single stage BJT amplifier.
	Design Zener voltage regulator circuit.

REFERENCE BOOK:

1. S. PoornachandraRao. 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		3		2								2		
CO2		3		2								2		
CO3		2		2	3							2		

C++ Basic Programming

Course Code :23AEC308	LTPC: 0-0-2-1
Exam Hours : 3	Hours / Week : 2
SEE: **50 Marks**	

Course Objective: The student will have hands on experience on C++ programming concepts.

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.	To understand the basic concepts of C++ program	1,2
2.	Implementing array operation using C++ program	1,3,5,9
3.	An ability to create strings and functions	1,3,5,9
4.	An ability to develop programs using recursion method	1,3,5,9

Course Contents:

Sl.No	Experiments
1	Write a C++ program to sort the elements in ascending and descending order.
2	Write a C++ program to find the sum of all the natural numbers from 1 to n.
3	Write a C++ Program to Check Whether Number is Even or Odd.
4	Write a C++ Program to Find Largest Among Three Numbers.
5	Write a C++ Program to Make a Simple Calculator.
6	Write a C++ GCD of Two Numbers.
7	Write a C++ Program To Find LCM of Two Numbers.
8	Write a C++ Program to Check Whether a Number is Palindrome or Not.
9	Write a C++ Program to check Prime Number.
10	Write a C++ Program For Fibonacci Numbers.

TEXT BOOK:

1. Bhushan Trivedi, "Programming with ANSI C++", Oxford Press, Second Edition, 2012.
2. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill _Education Pvt.Ltd , Fourth Edition 2010.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	1	2											1	3
CO2	2		3		2				1				1	3
CO3	2		3		2				1				1	3
CO4	2		3		2				1				1	3

Sci-lab Programming Laboratory

Course Code :23AEC309	LTPC: 0-0-2-1
Exam Hours : 3	Hours / Week : 2
SEE: **50 Marks**	Total hours: 26

Course Objective: To equip students with the skills to utilize Scilab for solving, modeling, and visualizing complex electronics engineering problems

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	Able to use Scilab to solve complex electronics problems and perform simulations.	1,2,3,5,9
2	Apply mathematical concepts within Scilab for circuit analysis and system modeling.	1,2,3,5,9
3	Develop and visualize electronic systems using Scilab's plotting and graphical tools.	1,2,3,5,9

Course Contents:

1. Write a Scilab program to calculate the current flowing through a resistor given the voltage across it and its resistance using Ohm's Law (I = V/R).
2. Write a Scilab program to compute the output voltage of a voltage divider circuit given the input voltage and the values of the two resistors.
3. Write a Scilab program to convert a resistor's color code to its resistance value.
4. Write a Scilab program to calculate the equivalent resistance of resistors connected in series and parallel.
5. Write a Scilab program to model and plot the charging and discharging curves of a capacitor in an RC circuit.
6. Write a Scilab program to calculate the time constant of an RL circuit given the values of the resistor and the inductor.
7. Write a Scilab program to compute the resonant frequency of an RLC circuit given the values of the resistor, inductor, and capacitor
8. Write a Scilab program to calculate the required series resistor for an LED given the supply voltage, the LED forward voltage, and the desired current.
9. Write a Scilab program to calculate the base, collector, and emitter currents of a Bipolar Junction Transistor (BJT) given the supply voltage, base resistor, and collector resistor.
10. Write a Scilab program to calculate the gain of an operational amplifier in both inverting and non-inverting configuratio
11. Write a Scilab program to design a simple RC low-pass and high-pass filter, and plot their frequency response.
12. Write a Scilab program to calculate the impedance of a circuit containing resistors, inductors, and capacitors in series and parallel at a given frequency.
13. Write a Scilab program to model and plot the output of a full-wave rectifier circuit.
14. Write a Scilab program to calculate the real, reactive, and apparent power in an AC circuit given the voltage, current, and power factor.
15. Write a Scilab program to simulate the basic logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) and their truth tables.

Textbooks:

1. Perrine Mathieu, Philippe Roux, **Scilab, from theory to practice,** ISBN: 978-2-8227-0293-5, 2016.
2. Dr. M. Affouf, **Scilab by example**, ISBN: 978-147920344, 2012.

MOOC Course:

1. **https://www.udemy.com/course/scilab-an-open-source-alternative-of-matlab/**
2. **https://onlinecourses.swayam2.ac.in/aic20_sp38/preview**

Software Download Link:

1. **https://www.scilab.org/**

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	1	2	3		3				2				1	2
CO2	1	2	3		3				2				1	2
CO3	1	2	3		3				2				1	2
CO4	1	2	3		3				2				1	2

IOT APPLICATIONS LABORATORY

Course Code :23AEC310	**LTPC:0-0-2-1**
Exam Hours : 3	Hours / Week : 2
SEE :50 Marks	Total hours: 26

Course Objective: Working with IoT boards for interfacing various sensors to develop IoT 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	Interface most commonly used sensors and IoT boards.	1, 5
2	Select the right sensors, actuators and communication protocols to use in application specific IoT system.	5
3	Explore the solutions to social problems and potential business opportunities that **IoT** can uncover.	3, 5, 7

Course Contents:

Exp No.	**Experiment Title**
1.	Introduction to Microcontroller based IoT boards(Arduino, Rasberry Pi, TI-MSP-430).
2.	Working with Arduino using push Button switch, potentiometer, thermistor and other sensors.
3.	Using DHT-11 temperature and humidity sensor.
4.	Connecting 16x2 LCD display to Arduino.
5.	Using IR sensor with Arduino and its applications
6.	Ultrasonic distance measurement and servomotor control using Arduino.
7.	Joystick based controlling using Arduino.
8.	Android based Bluetooth Integration to Arduino.

TEXT BOOK:

1. ArshdeepBahga and Vijay Madisetti, "Internet of Things - A Hands on Approach",Universities Press, 2015

REFERENCE BOOK:

2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition, Wiley ISBN: 978-1-119-99435-0, 370 pages, January 2012

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2				2									
CO2	3													
CO3	3				2									

Course Title	Social Connect & Responsibility		
Course Code	23SCR	L-T-P	(0-0-2)1
Exam	3 Hrs.	Hours/Week	2
CIE	100 Marks	Total Hours	20 hours

Course Objective: Provide a formal platform for students to communicate and connect with their surroundings and create a responsible connection with society.

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's
1	Describe societal challenges and build solutions to alleviate these complex social problems through immersion, design & technology.	3,5,6
2	Communicate and connect with their surroundings.	7,12

MODULE – 1

Plantation and adoption of a tree: Plantation of a tree that will be adopted by a group of students. They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.

MODULE – 2

Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms.

MODULE -3

Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.

MODULE -4

Water Conservation: knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices. **Food Walk** City's culinary practices, food lore, and indigenous materials of the region used in cooking.

Course Conduction

A total of 15-20 hours engagement per semester is required for the course. Students will be divided into teams and each team will be handled by two **faculty mentors**. Faculty mentors will design the activities for evaluation.

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE)

After completion of, the social connect, the student shall prepare, with daily **diary** as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor. The report shall be evaluatedon the basis of the following criteria and/or other relevant criteria pertainingto the activity completed.

- Dairy recording the details of activity conducted
- Planning and scheduling the social connect
- Information/Data collected during the social connect
- Analysis of the information/data and report writing

Considering all above points allotting the marks as mentioned below

Excellent	80 to 100
Good	60 to 79
Satisfactory	40 to 59
Unsatisfactory and fail	<=39

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	2	3	-	-	-	-	-	-		
CO2	-	-	-	-	-	-	3	-	-	-	-	3		

IV Semester

ANALOG COMMUNICATION AND SWITCHING SYSTEMS

Course Code :23EC401	**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 sideband 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, availability 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, John Wiley, 2009.
2. **JE Flood**, "Telecommunications Switching Traffic&Networks",Pearsoneducation,2002.

REFERENCEBOOKS:

1. **John C. Bellamy** "Digitaltelephony", WileyIndia 3rd Edition,2000.
2. **ThygarajanandViswanathan**"Principleoftelecommunicationandswitching",PHI2 b004.

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
2	10	Assignment on Switching systems/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	3	2			1							1		
CO2	2	3			1							1		
CO3	3	2												
CO4	2	3												

ELECTROMAGNETIC FIELD THEORY AND TRANSMISSION LINES

Course Code :23EC402	**LTPC:3-1-0-3**
Exam Hours : 3	Hours/Week :4
SEE:**50Marks**	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, 2,12
2	Apply the theory of electric and magnetic fields and solve problems using Maxwell's equations.	1, 2,12
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, 5,9

Course Contents:

MODULE-1	Teaching Hours
Electrostatic fields: Introduction, 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, divergence theorem, Gauss's law, Poisson's and Laplace equations.	**13 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.	**13 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.	**13 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.	**13 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	3	2										1	1	1
CO2	2	3										1	1	
CO3	3	2											1	
CO4	3	2	2										1	

SIGNALS AND SYSTEMS

Course Code :23EC403	**LTPC: 3-0-2-4**
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. **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)**
	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.
	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	3	3			2								2	1
CO2	3	3			2								2	1
CO3	3	3			2								2	1
CO4	3	3			2				2					2

ARM EMBEDDED SYSTEMS

Course Code :23EC404	**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
1.	Depict the organization, architecture, bus technology, memory and operation of the ARM Processors.	1, 2
2.	Employ the knowledge of the Instruction set of ARM processors to develop basic Assembly Language Programs.	1, 2
3.	Describe the techniques involved in writing C code for ARM processors and Exception & Interrupt handling in ARM Processors.	1, 2
4.	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, 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, 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 Boot loader **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:

1. **Furber S,** "ARM System on chip Architecture", 2nd edition, Addison Wiley, 2008.
2. **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	3	3	3		3				3	3			3	2
CO2	3	3	3		3				3	3			3	2
CO3	3	3	3		3				3	3			3	2
CO4	3	3	3		3				3	3			3	2

COMMUNICATION LABORATORY

Course Code :23EC406	**LTPC:0-0-2-1**
Exam Hours : 3	Hours / Week : 2
SEE :**50 Marks**	Total hours: 26

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**
	Demonstrate various modulation techniques used in communication systems.	1, 2
	Design and develop Butterworth active filter circuits.	1, 2
	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	3	2											3	
CO2	3	2											3	
CO3					3				3	3				3

Engineering Science Course (ESC/ETC/PLC)

Course Title	Linear Algebra and Integral Transforms		
Course Code	23ESEC405	L-T-P	(3-1-0) 3
Exam	3 Hrs.	Hours/Week	4
SEE	50 Marks	Total Hours	40L+13T

Course Objective: Students will be able to use appropriate data structures for solving problems.

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Utilise the concept of consistency of system of equations to solve the engineering application problems and compute the number of linearly independent vectors.	1	-
2.	Examine for the existence of diagonalization of matrix, find the suitable matrix of transformations so as to get the required image and analyse the system of equations to compute the number of linearly independent Eigenvectors.	1,2	-
3.	Compute Laplace transform on simple functions , Fourier series of periodic functions, the orthogonal basis, QR factors of Matrices, and solve homogeneous differential equations using matrices	1	-
4.	Examine for adopting different techniques of integration so as to compute Fourier series, Laplace transform of a given function.	1,2	-
5.	Model the real-life problems/engineering application problems and solve the same.	1,2	-

MODULE – 1	10 Hrs.

Laplace Transforms: Introduction, Definition, Importance of Laplace transform in engineering applications, properties, Laplace transform of standard functions, Laplace transform of derivatives, Laplace transform of periodic functions, unit-step functions.

Inverse Laplace Transforms: Definition and general properties, Convolution theorem – illustrative examples, Initial value problems. To solve Applications of initial value problems in engineering using Laplace transform

Self-Study--Unit impulse functions (Dirac – delta function). Application of Fourier series to Laplace equation.

MODULE – 2	10Hrs.

Fourier Series: Periodic functions and their graphical representation, to find the function for standard graphs, to find Fourier series by change of interval method, to represent the experimental data as a Fourier series using the method - Practical harmonic analysis. application of Fourier series in engineering-To represent the signal (wave form) in terms of Fourier series, Fourier series representation for the excitation described by the wave form, graphs of Fourier series approximating the given function.

Self-Study-- Half range series method. Applications of Fourier transforms/ fast Fourier transforms in computer science engineering.

MODULE -3	10Hrs.

Linear Algebra: Importance of Matrices in engineering. Rank of a matrix. Consistency of nonhomogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors.

Special matrices-matrix of rotation, reflection, translation. To find the matrix of transformation when the image of some points is given**. Applications** of solution of system of equations to balance the chemical equations.

Self-Study-- Traffic flow problem, to find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician.

MODULE -4	**10Hrs.**

Linear Algebra: Eigen values and Eigenvectors, properties, Illustrative examples,

Applications-Stretching of an elastic membrane, to determine the growth of a population model. Role of Eigen values, eigenvectors in determining natural frequency

Rayleigh power method to find the highest Eigen value.

Diagonalization and powers of 3X3 matrices when Eigen values are already given.

Gram Schmidt process, QR-factorization, symmetric matrices and quadratic forms, Matrix method to solve homogeneous differential equations of order 2, degree 1.

Self-Study--Stability analysis of differential equations which governs the dynamical systems using the concept of Eigen value, eigenvectors. Applications of system of equations, Eigen value, eigenvectors, linear transformation in computer science. Application of Eigen value Eigen vectors in data compression, Signature testing, Face recognition. Google page ranking**.**

TUTORIAL:

1. Need to study in rank of a matrix.
2. Examples on rank of a matrix and consistency.
3. Importance of solution of system of equation in application problems traffic flow.
4. Examples on Eigen values and Eigen vectors and dioganalization.
5. A report on role of Eigen values and Eigen vector in engineering.
6. To fit a Fourier series to the experimental data.
7. Examples on Fourier series(change of interval method)
8. Examples on Laplace transform of periodic functions.
9. Examples on Laplace transform of unit step- function
10. Examples on Laplace transform of initial value problem.
11. A report the application of Fourier series in engineering.
12. A report the application of Laplace transform in engineering.

ACTIVITIES:

1. To represent saw tooth periodic motion of a follower operated by a Cam this rotates uniformly, in the form of Fourier series.
2. Application of Fourier series to Laplace equation, heat conduction.
3. Fourier series representation for the excitation described by the wave form,
4. Role of Eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system).
5. Lenovo input output method – application to balance the economy of a Country.
6. Applications of factorization of matrices-Google recommendation.
7. Jordan canonical form when minimal polynomial and characteristic polynomial is given and its application in Engineering.
8. Diagonalize a matrix and determining the principal stresses.
9. Application of Laplace transformation.
10. Application of Eigen value and Eigen vectors in data compression, Signature testing, Face recognition. Google page ranking.
11. Least square solution of system of equations- a matrix approach
12. Unit impulse functions (Dirac – delta function)- application.

Note – 1. Theorems and properties without proof. Applicable to all the Modules.

2. Self study part is not included for Semester End Examination.

Text Books:

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016.

2. Linear algebra by David c lay, 3rd edition, Pearson education, 2002.

Reference Books:

1. R K Jain and S R K Iyengar, Advanced engineering mathematics by Narosa publishers, 2nd edition, 2005.
2. Calculus by Thomas Finney, 9th edition, Pearson education, 2002.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd. 8th Edition (Wiley student edition) 2004.

Web links

- http://nptel.ac.in/courses.phd?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicerath.org/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-												
CO2	3	2												
CO3	3	-												
CO4	3	2												
CO5	3	2												

Microwave Communication

CourseCode:23ESC406	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
2.	Analyze the working of solid state devices and microwave passive devices.	1, 2
3.	Gain knowledge on effects of Microwave on human and application of Microwave.	1, 2
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	**10Hours**
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	**10Hours**
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	**10Hours**
MODULE-4	
Microwave Measurements: Tunable Detector, Slotted-Line Carriage, Spectrum Analyzer, Network Analyzer, VSWR Measurements. Microwave Antenna Measurements. **Microwave Radar Systems, Microwave Communication Systems.**	**10Hours**

Text Book:

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

Reference Books:

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	3	2											3	
CO2	3	2											3	
CO3	2	3											2	3
CO4	2	3	3		3				3	3			2	3

PCB Design

Course Code: 22ECS407	LTPC: 3-0-0-3
ExamHours:**3**	Hours/Week:**3**
SEE: **50Marks**	Total hours:**40**

Course objectives:

- Study about layout planning, art work and design of PCB
- To understand the PCB production process
- Discuss the role of Modern trends and automatic design of PCB

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

COs	Statement	PO's
1.	Define the detailed circuit diagram and prerequisite before the actual PCB layout.	1,2
2.	Understand the process of PCB production and Material selection	1,2
3.	Understand the PCB fabrication by transferring the conductor pattern on base material	1,2,12
4.	Know about the Plating techniques, Etching process and multilayer PCB board construction	1,2,12

Module-1	
Design of Printed Circuit Boards: Layout Planning: Introduction, General Consideration, PCB Sizes, Layout Approaches, Documentation, **Layout, General Rules and Parameters**: Introduction, Resistance, Capacitance, Inductance of PCB conductors, Conductor Spacing, Component Placing and Mounting, Cooling Requirements and Package Density, Layout Check, Artwork.	10 Hours
Module-2	
Technology of PCB: Film Master Production: Introduction, Emulsion Parameters, Film Emulsions, Dimensional Stability of Film Masters, Reprographic Cameras, Darkroom, Film Processing, Film Registration, **Properties of Copper Clad Laminates:** Introduction, Manufacture of Copper Clad Laminates, Properties and Types of Laminates, Specifications and Test Methods, **Board cleaning before Pattern Transfer:** Manual and Machine Cleaning Processes.	10 Hours
Module-3	
Photo printing: Basic Processes for Double Sided PCBs, Photo resists, Wet Film Resists, Coating Processes, Exposure and further Processing of Wet Film Resists, Dry Film Resists. **Screen Printing:** Screen Fabrics, Screen and Frame Preparation, Pattern Transfer onto the screen, Reclamation of the Screen Fabrics, Printing, Trouble shooting	10 Hours
Module-4	
Plating: Introduction, Immersion Plating, Electroless Plating, Electroplating, Plating Quality Control Etching, Etching Machines, Etchant Systems, Minimizing Pollution, Mechanical Machining operations. **Multilayer Boards:** Introduction, Design and Test Considerations, Multilayer Construction, Equipment, Laminating Process and further processing.	10 Hours

Suggested Learning Resources:

Books

1. Printed Circuit Boards-Design & Technology by Walter C Bosshart, TataMcGraw-Hill Pvt. Ltd, 2010
2. Printed Circuit Boards-Design, Fabrication, Assembly and Testing by Dr.R.S. Khandapur,Mc Graw-Hill Education, 2017

Activity:

Activity Number	Activity Name	Description	Marks	POs
1	**Conduction of experiment**	PCB making for simple electronic circuits and testing	**10**	**2,5,9,**
2	**Quizzes or seminar**	Quizzes or Seminar can be conducted on different topics.	**10**	**1, 2, 12**

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	2	3											1	
CO2	3	2											1	
CO3	3	2										2	1	
CO4	3	2										2	1	

Switching and Finite Automata Theory

CourseCode:23ESC408	LTPC:3-0-0-3
ExamHours:**3**	Hours/Week:**3**
SEE:**50Marks**	Totalhours:**40**

Course Objective: This course will enable students to:

- Understand the basics of threshold logic, effect of hazards on digital circuits and techniques of fault detection
- Explain finite state model and minimization techniques
- Know structure of sequential machines, and state identification
- Understand the concept of fault detection experiments

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	Explain the concept of threshold logic	1,2
2	Understand the effect of hazards on digital circuits and fault detection and analysis	2,12
3	Define the concepts of finite state model	1,3,4
4	Analyze the structure of sequential machine	2,3

Course Contents:

Module-1	
Threshold Logic: Introductory Concepts: Threshold element, capabilities and limitations of threshold logic, Elementary Properties, Synthesis of Threshold networks: Unatefunctions, Identification and realization of threshold functions, Themapasatoolinsynthesizingthresholdnetworks.(Sections7.1,7.2ofText) L1,L2,L3	10 Hrs.
Module-2	
Reliable Design and Fault Diagnosis: Hazards, static hazards, Design of Hazard-freeSwitchingCircuits,Faultdetectionincombinationalcircuits,Faultdetectionincombinationalcircuits:Thefaults,TheFaultTable,Coveringthefaulttable,Faultlocation experiments: Preset experiments, Adaptive experiments, Boolean differences,Faultdetectionbypathsensitizing.(Sections8.1,8.2,8.3,8.4,8.5ofText) L1,L2,L3	10 Hrs.
Module-3	
Sequential Machines: Capabilities, Minimization and Transformation The Finite state model and definitions, capabilities and limitations of finite statemachines,Stateequivalenceandmachineminimization:k-equivalence,The minimization Procedure, Machine equivalence, Simplification of incompletely specified machines Mac (Section10.1,10.2,10.3,10.4ofText)L1,L2,L3	10 Hrs.
Module-4	
Structure of Sequential Machines: Introductory example, State assignment using partitions: closed partitions, The attice of closed partitions, Reduction of output dependency, Input dependence and autonomous clocks, Covers and generation of closed partitions by state splitting: Covers, The implication graph, An application of state splitting to parallel decomposition. (Section 12.1, 12.2, 12.3, 12.4, 12.5, 12.6 of Text) L1, L2, L3	10Hrs.

Text Book:

1. **Switching and Finite Automata Theory**–Zvi Kohavi,Mc GrawHill,2nd edition,2010ISBN:0070993874.

Reference Books:

1. **Fault Tolerant And Fault Testable Hardware Design**- Parag K Lala, Prentice HallInc.1985.
2. **Digital Circuits and Logic Design**.- Charles RothJr, Larry L. Kinney,Cengage
3. Learning, 2014, ISBN: 978-1-133-62847-7.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	2	2											2	1
CO2		2										1	2	1
CO3	2		3	1									2	1
CO4		2	3										2	

Activity Number	Activity Name	Description	Marks	POs
1	Conduction of Experiment	Designing simple systems for Fault detections.	10	2,5,9
2	Presentation	Presentation on different topics of Finite Automata	10	1,6,9, 10

Ability Enhancement Course / Skill Enhancement Course - IV

ARM EMBEDDED SYSTEMS LABORATORY

Course Code: 23AEC407	**LTPC: 0-1-2-1**
Exam Hours: 3	Hours / Week :**3**
SEE: **50 Marks**	Total hours: 26

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**
1.	Analyse ARM processor fundamentals to develop programming skills of ARM processor	2, 5
2.	Design and implementation of ARM interfacing modules.	2, 5
3.	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		3			3								3	2
CO2		3			3								3	2
CO3					3				3	3			3	2

Programmable Logic Controllers

Course Code :23AEC408	LTPC: 0-1-2-1
Exam Hours : 3	Hours / Week: 3
SEE :**50 Marks**	Total hours: 26

Course Objective: This course will enable student to:

- Tounderstandtheneedforautomationintheindustrywithbasiccontrollermechanismsinvolved.
- To study programming concepts to achieve the desired goal or to define the various steps involved in the automation.
- To understand programming involved with basic subroutine functions.
- To make use of the internal hardware circuits of automation circuit to control the devices during various states by monitoring the timers and counters.
- TohandlethedataoftheI/Odevicestointerfacethedatawiththecontrollerandauxiliarydevices.

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.	Describe the PLC and how to construct PLC ladder diagrams.	PO1, PO2
2.	Illustrate an application with programming.	PO1, PO2,PO5
3.	Apply PLC functions to timing and counting applications.	PO1,PO2
4.	Analyze the analog operation of PLC and demonstrate the robot applications with PLC.	PO1,PO2

Module-1
Introduction:Programmablelogiccontroller(PLC),roleinautomation(SCADA),advantagesand disadvantages, hardware, internal architecture, sourcing and sinking **(Textbook1:1.1to1.4)** **I/O devices and Processing :**list of input and output devices, examples of applications. I/O processing, input/output units, signal conditioning, remote connections, networks, processing inputs I/O addresses. **(TextBook1:2.1to2.3and4.1to4.7).**
Module-2
Programming: Ladder programming- ladder diagrams, logic functions, latching, multiple outputs, entering programs, functional blocks, program examples like location of stop and emergency switches. (**TextBook1:5.1to5.7).**
Module-3
Programming Methods: Instruction Lists- Ladder programs and Instruction lists, Branch codes, Programming Examples- Signal lamp-valve operation task. Sequential Function Charts- Branching and convergence. **(TextBook1:6.1to6.3).**
Module-4
Internal Relays: ladderprograms,battery-backedrelays,one-shotoperation,setandreset,mastercontrol relay (**TextBook1:7.1to7.6).** **Timersandcounters:**Typesoftimers,ONandOFF-delaytimers,pulsetimers,formsofcounter, programming, up and down counters. **(TexBook1:9.1to9.6).**

Virtual Lab link: https://plc-coep.vlabs.ac.in/

Text books:

1. Programmable Logic controllers-W Bolton, 5th edition/6th edition, Elsevier- newness, 2009/2015.
2. Programmable logic controllers - principles and applications"-John W. Webb, Ronald A Reiss, Pearson education, 5th edition, 2007.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS 01**	**PS O2**
CO1	2	2												
CO2	2	3			3									
CO3	2	2												
CO4	2	2												

Activity Number	Activity Name	Description	Marks	POs
1	**Conduction of Experiment**	Implementation of logic gates, DOL Starter, On- Delay and Off-Delay timer.	**10**	**2,5,9**
2	**Conduction of Experiment**	Implementation of Up-Down Counter, PLC Arithmetic Instructions, PID Controller	**10**	**2,5,9**

Course Title	Statistics with R Lab for machine learning		
Course Code	23AEC409	L-T-P	(0-1-2) 1
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	26

Course Objective: Students will be able to use appropriate data structures for solving problems.

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Write the programme for the mathematical procedure connected with probability, hypothesis testing, co-relation and regression.	1,2,5	-
2	Execute the programme and provide perfect output.	1,2,5	-

Practical Component:

Lab 1- To predict the conditional probabilities using Bayes theorem.

Lab 2- To predict the probability of discrete random variable- Binomial.

Lab 3- To predict the probability of discrete random variable- Poisson.

Lab 4- To predict the probability of discrete random variable- Hyper geometric.

Lab 5- To predict the probability of continuous random variable in an interval (Uniform random variable, exponential variable).

Lab 6- To predict the probability of continuous random variable in an interval (Normal random variable).

Lab 7- To predict the probability of application connected with Markov process in long run.

Lab 8- To compute the confidence interval for mean and standard deviation.

Lab 9- Hypothesis testing on application problem connected with mean, variance, proportions when sample size is large.

Lab10- Hypothesis testing on application problem connected with mean, variance, proportions when sample size is less (student's T distribution, chi square distribution)

Lab 11- Examining the correlation of the experimental data.

Lab 12- Carryout linear regression and multiple regression analysis for the experimental data.

(any 10 programmes)

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1	PSO	PSO
CO1	3	2			1									
CO2	3	2			1									

LAB VIEW PROGRAMMING

Course Code :23AEC410	LTPC: 0-1-2-1
Exam Hours : 3	Hours / Week: 3
SEE :**50 Marks**	Total hours:26

Course Objective:

- Aware of various front panel controls and indicators.
- Connect and manipulate nodes and wires in the block diagram.
- Locate various tool bars and pull-down menus for the purpose of implementing specific functions.
- Locate and utilize the context help window.
- Familiar with Lab VIEW and different applications using it.

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 LabVIEW to create data acquisition, analysis and display operations	1, 2, 5
2.	Create user interfaces with charts, graph and buttons	1, 2,5
3.	Use the programming structures and data types that exist in LabVIEW	1, 2,5
4.	Use various editing and debugging techniques.	1, 2,5

Course Contents:

1. Basic arithmetic operations : addition, subtraction, multiplication and division.
2. Boolean operations: AND, OR, XOR, NOT and NAND
3. Sum of ‘n’ numbers using ‘for’ loop
4. Factorial of a given number using ‘for’ loop
5. Determine square of a given number
6. Factorial of a given number using ‘while’ loop
7. Sorting even numbers using ‘while’ loop in an array
8. Finding the array maximum and array minimum

Demonstration Experiments (For CIE)

1. Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
2. Build a Virtual Instrument that simulates a Basic Calculator(using formula node).
3. Demonstrate how to create a basic VI which calculates the area and perimeter of a circle.

TEXT BOOKS:

1. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition,2011.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	2	2			2									
CO2	2	3			2									
CO3	2	2			3									
CO4	2	2			3									

Course Title	UNIVERSAL HUMAN VALUES		
Course Code	23UHV	L-T-P	(0-0-2)1
CIE	50 marks	Hours/Week	2 Hrs
SEE	50 marks	Total Hours	28 Hrs

Course Objective: The course aims at the development of the value education by the rightunderstanding through the process of self-exploration (about themselves), family, society and nature/existence. Strengthening of self-reflection by development of commitment and courage toact are presented as the prime focus throughout the course towards qualitative transformation inthe life of the student.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mappingto POs
1.	Start exploring themselves, get comfortable with each other and with the teacher and they start appreciating the need and relevance for the course. Also they are able to note that the natural acceptance (intention) is always for living in harmony.	6, 7, 8, 9, 12
2.	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them and need to take appropriate steps to ensure right participation (in terms of nurturing, protection and right utilization) in the nature.	6, 7, 8, 9, 12
3.	Present sustainable solutions to the problems in society and nature. Theyare also able to see that these solutions are practicable and draw roadmaps to achieve them.	6, 7, 8, 9, 12

Course Contents

Module - 1	8 Hrs

Introduction to Value Education : Understanding Value Education, Self-exploration as the Processfor Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations.

MODULE – 2	6 Hrs

Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrumentof the Self Lecture, Understanding Harmony in the Self Tutorial, Harmony of the Self with the Body to ensure self-regulation and Health.

MODULE-3	8 Hrs

Harmony in the Family, Nature and Existence: Harmony in the Family – the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order.
Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

MODULE-4	6 Hrs

Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic

Technologies, Production Systems and Management Models, Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

Self-Learning Activities-

Sharing about One self and Exploring Natural Acceptance
Exploring Harmony of Self with the Body
Exploring the Feeling of Respect
Exploring the Four Orders of Nature Lecture and Exploring Co-existence in Existence
Exploring Humanistic Models in Education, Exploring Steps of Transition towards Universal Human Order

Text Book and Teachers Manual-

The Textbook: A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
The Teacher's for a Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books-

Jeevan Vidya:EkParichaya, ANagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
HumanValues, A.N.Tripathi, New Age Intl. Publishers, New Delhi, 2004.
The Story of Stuff (Book).
The Story of My Experiments with Truth-by Mohandas Karamchand Gandhi
Small is Beautiful-E.F Schumacher.
Slow is Beautiful-Cecile Andrews
Economy of Permanence-J C Kumarappa
Bharat Mein Angreji Raj–Pandit Sunderlal.
Redis covering India-by Dharampal
Hind Swarajor Indian Home Rule-by Mohandas K. Gandhi.
India Wins Freedom-Maulana Abdul Kalam Azad
Vivekananda-Romain Rolland(English)
Gandhi-Romain Rolland(English)

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	1	3	2			1		
CO2						2	1	3	2			1		
CO3						2	1	3	2			1		

Evaluation :
Continuous Internal Evaluation (CIE)

Two CIEs will be conducted for 20 marks each.
For the activity component students should form a team of 3 to 4 members each. A group activity should be assigned to each team based on the modules covered in the course. Students should showthe progress in this activity as a preliminary phase for SEE.
Semester End Examination

SEE will be conducted for 50 marks in practical mode based on the assigned activity which may be a presentation/ prototype development/any other activity.