MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)
#14, Ramohalli Cross, Kumbalagodu, Mysore Road, Bengaluru–560074

Robotics and Automation

Bachelor of Engineering (B.E)

Scheme and Syllabus of III & IV Semester

(2024 Scheme)

VISION

To empower young minds through technology, research and innovation, to produce technically competent and socially responsible professionals in higher education.

MISSION

1. To deliver excellence in education through innovative teaching, impactful research, and continuous skill development, preparing students to meet global challenges with technical expertise and ethical responsibility.
2. To foster a transformative learning environment that integrates technology, research and practical experience, empowering students to become skilled professionals and socially conscious leaders.
3. To cultivate a culture of lifelong learning and professional excellence by encouraging creativity, research, and community engagement, equipping students with the skills to thrive in a dynamic world.
4. To provide a holistic educational experience that combines advanced technology, hands-on research, and community-focused learning, shaping students into competent, ethical professionals who contribute positively to society.

QUALITY POLICY

Rajarajeswari College of Engineering is committed to imparting quality technical education that nurtures competent, ethical professionals with global relevance. We ensure academic excellence through a dynamic, outcome-based curriculum, experienced faculty, and cutting-edge infrastructure. Continuous improvement is driven by innovation, research and strong industry collaboration. We foster holistic development and a progressive environment that supports lifelong learning, teamwork, and professional growth.

CORE VALUES

Academic Excellence, Integrity, Innovation, Global Competence, Continuous Improvement.

Robotics and Automation

DEPARTMENT VISION

To develop technically skilled Robotics and Automation engineers with the systems & multidisciplinary approach in-line with the dynamic technologies for the competitive solution to the society.

DEPARTMENT MISSION

1. To provide a technical education through an effective teaching-learning process to meet the industry requirement.

2. To teach the process of designing, creating, and using robots to perform a certain task in problem-solving skills up-gradation of knowledge through a project-based approach in collaboration with industries.

PROGRAM OUTCOMES (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems /components / processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modeling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modeling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Develop skilled engineers with a solid foundation in Robotics and Automation, encompassing core competencies in diverse areas such as robotics programming, simulations, robot anatomy, and engineering principles.

PEO2: Thrive in their professional careers by delivering engineering solutions and showcasing technical expertise gained through continuous learning in the realm of robotics and automation.

PEO3: Create, design, and program robots for various engineering and societal applications using cutting-edge tools and technologies, while prioritizing solutions that are technologically advanced, economically viable, environmentally sustainable, and socially acceptable.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Develop Robotics and Automation systems that align with evolving industry demands, ensuring graduates are prepared to meet current and future industry requirements.

PSO2: Apply automation systems effectively in various domains such as manufacturing, healthcare, industrial engineering, and safety, addressing specific needs and enhancing efficiency and safety in these areas.

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Department of Robotics and Automation

Scheme of Teaching and Examinations – 2024

(Effective from the Academic Year 2025-26)

Semester: III

S.No	Course Category and Course Code		Course Title	TD / PSB	Teaching Hours / Week & Credits					Examination			
					Lecture	Tutorial	Practical	SDA	Credits	CIE Marks	SEE Duration Hrs	SEE Marks	Total Marks
					L	T	P	S					
1.	BSC	B24MZ301	Mathematics-III (Common to R&A, CV)	Maths	3	0	0	0	3	50	3	50	100
2.	PCC	B24RA302	Solid and Fluid Mechanics	R&A	3	0	0	0	3	50	3	50	100
3.	IPCC	B24EE303	Analog and Digital Electronics (Common to R&A, EEE)	EEE	3	0	2	0	4	50	3	50	100
4.	IPCC	B24RA304	Robotic Fabrication	R&A	3	0	2	0	4	50	3	50	100
5.	PCCL	B24RA305L	Modeling and Design Lab	R&A	0	0	2	0	1	50	3	50	100
6.	ESC	B24YY36X	ESC/ETC/PLC - III	R&A	3	0	0	0	3	50	3	50	100
7.	UHV	B24SCK307	Social Connect and Responsibility	Any Dept.	0	0	2	0	1	50	3	50	100
8.	AEC/ SEC	B24YY38X	Ability Enhancement Course / Skill Enhancement Course – III (Theory/Lab)	R&A	1 0	0 0	0 2	0	1	50	1 3	50	100
9.	NCMC	B24NCK39X	National Service Scheme / National Cadet Corps / Physical Education / Yoga / Music	HSMC	1	0	0		PP	50		-	50
								TOTAL	20	450		400	850

BSC: Basic Science Course, HSMC: Humanity, Social sciences including Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course L: Lecture, T: Tutorial, P: Practical S:SDA-Skill Development Activity, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation, PP/NP: Pass/Not Pass, YY: Programme Code (EC, CS, IS etc), X: 1/2/3/4**,** K: Indicates Common Course to all the streams of Engineering

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Rajarajeswari College of Engineering

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(Effective from the Academic Year 2025-26)

Engineering Science Course /Emerging Technology Course / Programming Language Course (ESC/ETC/PLC) - III			
B24RA361	Basic Communication Systems	B24RA362	Robot Mechanics and Control
B24RA363	Material Science	B24EC364	Object Oriented Programming (Common to ECE, RA)

Ability Enhancement Course / Skill Enhancement Course (AEC/SEC) – III			
B24EC381	C++ programming Lab (Common to ECE, RA)	B24RA382	Virtual Reality and App development
B24RA383	Materials Testing Lab	B24RA384	Applications of MATLAB

Non Credit Mandatory Courses (NCMC)			
B24NCK391	National Service Scheme (NSS)	B24NCK392	National Cadet Corps (NCC)
B24NCK393	Physical Education (PE)	B24NCK394	Yoga
B24NCK395	Music		

All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE), National Cadet Corps (NCC), Music and Yoga (YOG) with the concerned coordinator of the course during the first week of III/IV/V/VI semesters. Colleges are required to submit the Continuous Internal Evaluation (CIE) marks for the activities completed by students under selected course each semester. The students should be allowed to engage in different activities/courses each semester. For example, a student who participates in sports in the 3rd semester could choose to undertake NSS in the next semester and Yoga in another semester. This approach aligns with the student-centric focus of the National Education Policy (NEP) 2022 and helps distribute the workload related Physical Education/NSS/Yoga/NCC/Music of more evenly across different departments. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. **These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.**

HoD **Dean-Academics** **Principal**

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Department of Robotics and Automation

Scheme of Teaching and Examinations – 2024

(Effective from the Academic Year 2025-26)

Semester: IV

S. No	Course Category and Course Code		Course Title	TD / PSB	Teaching Hours / Week & Credits					Examination			
					Lecture	Tutorial	Practical	SDA	Credits	CIE Marks	SEE Duration Hrs	SEE Marks	Total Marks
					L	T	P	S					
1.	PCC	B24RA401	Theory of Applied Robotics	R&A	3	0	0	0	3	50	3	50	100
2.	PCC	B24RA402	Sensors and Transducers	R&A	3	0	0	0	3	50	3	50	100
3.	IPCC	B24RA403	Microcontrollers (Common to RA, EEE)	R&A	3	0	2	0	4	50	3	50	100
4.	IPCC	B24RA404	Measurement Systems	R&A	3	0	2	0	4	50	3	50	100
5.	PCCL	B24RA405L	Robot Programming and Simulation Lab	R&A	0	0	2	0	1	50	3	50	100
6.	ESC	B24 YY46X	ESC/ETC/PLC - IV	EC/R&A/ AI	3	0	0	0	3	50	3	50	100
7.	UHV	B24UHK407	Universal Human Values	Any Dept.	1	0	0	0	1	50	1	50	100
8.	AEC/ SEC	B24YY48X	Ability Enhancement Course / Skill Enhancement Course – III (Theory/Lab)	R&A	1 0	0 0	0 2	0	1	50	1 3	50	100
9.	NCMC	B24NCK49X	National Service Scheme / National Cadet Corps / Physical Education / Yoga / Music	HSMC	1	0	0		PP	50		-	50
								TOTAL	20	450		400	850

BSC: Basic Science Course, HSMC: Humanity, Social sciences including Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course L: Lecture, T: Tutorial, P: Practical S:SDA-Skill Development Activity, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation, PP/NP: Pass/Not Pass, YY: Programme Code (EC, CS, IS etc), X: 1/2/3/4, K: Indicates Common Course to all the streams of Engineering

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Engineering Science Course /Emerging Technology Course / Programming language Course (ESC/ETC/PLC) - IV			
B24RA461	Digital Communication	B24RA462	Smart Materials and Structures
B24RA463	Basic Control Systems	B24EC464	Java Programming (Common to ECE,EEE, R&A)

Ability Enhancement Course / Skill Enhancement Course (AEC/SEC) – IV			
B24EC481	Programmable Logic Controllers (Common to ECE, R&A)	B24RA482	Introduction to AI & ML
B24RA483	Principles of Robotics	B24EE484	Arduino & Raspberry Pi lab (Common to ECE,EEE, R&A)

Non Credit Mandatory Courses (NCMC)			
B24NCK491	National Service Scheme (NSS)	B24NCK492	National Cadet Corps (NCC)
B24NCK493	Physical Education (PE)	B24NCK494	Yoga
B24NCK495	Music		

All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE), National Cadet Corps (NCC), Music and Yoga (YOG) with the concerned coordinator of the course during the first week of III/IV/V/VI semesters. Colleges are required to submit the Continuous Internal Evaluation (CIE) marks for the activities completed by students under selected course each semester. The students should be allowed to engage in different activities/courses each semester. For example, a student who participates in sports in the 3rd semester could choose to undertake NSS in the next semester and Yoga in another semester. This approach aligns with the student-centric focus of the National Education Policy (NEP) 2022 and helps distribute the workload related Physical Education/NSS/Yoga/NCC/Music of more evenly across different departments. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. **These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.**

III - Semester Syllabus

SEMESTER-III MATHEMATICS-III Category: BSC (COMMON TO R&A, CV)					
Course Code	:	B24MZ301	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

	Course Objectives
1.	Explain the basic concepts of probability, random variables, probability distribution
2.	Calculate and interpret correlation coefficients to determine the strength and direction of linear relationships between variables.
3.	To develop mathematical model to integrate some non integrable functions using special theorems.
4.	To perform complex variables and to apply in signal transformation .
5.	Ability to formulate a variational problem for a given geometric setting.

Module-1: Probability distribution	No. of Hours
Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Exponential distribution.	9
Module-2: Curve fitting & Statistical Methods	**No. of Hours**
Curve Fitting: Curve fitting by the method of least squares-fitting the curves of the form: $y = ax + b, y = ax^2 + bx + c$ and $y = ax^b$. Statistical methods: Introduction to Moments, Skewness, Kurtosis and problems. Karl Pearson's coefficient of correlation and lines of regression.	9
Module-3: Complex Variable -I	**No. of Hours**
Review of a function of a complex variable, limits, continuity, and differentiability. Analytic function and connected theorem and properties, Cauchy-Riemann equations in Cartesian and polar forms. Transformations: Conformal transformations, discussion of transformations: $w = z^2$, $w = e^z$ and bilinear transformations-problems. **Application:** Analyzing alternating current (AC) circuits, signal processing.	9
Module-4: Complex Variable -II	**No. of Hours**
Complex line integral ,properties of Complex line integral, Cauchy's theorem ,consequences of cauchy's theorem, cauchy's integral formula, generalized cauchy's integral formula, Laurent's theorem-Laurent's series , singularity and Residue, formulae for the residue at the pole, Cauchy's Residue theorem (without proof) and problems. **Application:** Calculating electric and magnetic fields, Fluid Dynamics.	9
Module-5: Calculus of Variations:	**No. of Hours**
Introduction to variation of functionals, extremal of functional, Euler equation– special cases, problems. Geodesics, Hanging cable and Brachistochrone problems. Exploring geodesics graphically using MATLAB.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the basic concepts of probability, random variables, probability distribution
CO2	Make use of correlation and regression analysis to fit a suitable mathematical model for the statistical data.
CO3	Illustrate the fundamental concepts of multivariate statistics, complex analysis, partial differential equations and variational problems
CO4	Understand the concept of complex variables and their applications in signal transformation.
CO5	Demonstrate the ideas of complex differentiation and integration for solving related problems through theoretical approach.

Text Books	
1.	B.S.Grewal:"Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2.	E.Kreyszig:"Advanced Engineering Mathematics",John Wiley & Sons,8th Ed.(Reprint),2016

Reference Text Books	
1.	H. K. Dass, " Advanced Engineering Mathematics" S. Chand publication.
2.	C. Ray Wylie, Louis C. Barrett : "Advanced Engineering Mathematics", 6th Edition
3.	B.V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 208.

Web links and Video lectures (e-Resources)
1. https://nptel.ac.in/courses/12286025
2. VTU EDUSAT PROGRAMME – 20
3. http://www.class-central.com/subject/math(MOOCs)

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO8	PO11
CO1	3	3	3	2	-	-	-	-	1	-	2
CO2	3	3	3	2	-	-	-	-	1	-	2
CO3	3	3	3	2	-	-	-	-	-	-	2
CO4	3	3	3	2	-	-	-	-	-	-	2
CO5	3	3	3	2	-	-	-	-	-	-	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
SOLID & FLUID MECHANICS **Category: PCC**					
Course Code	:	B24RA302	CIE	:	50 Marks
Teaching Hours/Week (L:T:P)	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	Gain knowledge of linear elastic properties and stress train relations.
2.	Derive and solve problems on Principal stresses developed in structures.
3.	Compute the stress strain for bars, beams, shafts, and column and to apply the concept of Dynamic similarity and to apply it to experimental modeling.
4.	Gain knowledge of basic properties of fluids, fluid statics.
5.	To apply conservation of mass, momentum and energy equation and to determine the discharge of fluid flow.

Module-1: Simple Stress and Strain	**No. of Hours**
Introduction, Concept of Stress and Strain, Linear elasticity, Hooke's Law and Poisson's ratio. Extension / Shortening of a bar, bars with varying cross sections (circular and rectangular), Elongation due to self-weight, Principle of super position. Volumetric strain, expressions for volumetric strain for bars with uniform circular and rectangular cross sections. Simple shear stress and shear strain, Elastic Constants (No derivation for relationship between elastic constants)	9
Module-2: Compound Stresses	**No. of Hours**
Introduction, Concept of Plane stress, Stress tensor for plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.	9
Module-3: Torsion of Circular Shafts and Columns	**No. of Hours**
Torsion of Circular Shafts: Introduction, Torsion equation –assumptions and derivation, Torsional rigidity / Stiffness of shafts. Power transmitted by solid and hollow circular shafts, Simple numerical problems. Columns: Introduction, End conditions, Assumptions in deriving Euler's equations, Sign Conventions for bending moments, Euler's formulas (no derivation) for axially loaded elastic long columns, Limitations of Euler's theory, Rankine's formula.	9
Module–4: Properties of Fluids and Fluid Statics	**No. of Hours**
Properties of Fluids: Introduction, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitation. Fluid Statics: Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, Atmospheric and vacuum pressures, simple manometers and differential manometers .Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid.	9
Module–5: Fluid Kinematics and Fluid Dynamics	**No. of Hours**
Fluid Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Coordinates only), velocity and acceleration Fluid Dynamics: Introduction equation of motion, Euler's equation of motion, and Bernoulli's equation from first principle sandals of romEuler's equation, limitations of Bernoulli's equation.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Gain the knowledge of properties, and stress-strain relations in linear elastic solid members and fluids.
CO2	Determine the stress & strain for simple stresses, compound stresses.
CO3	Apply the knowledge of mechanics of materials on applications like shafts & columns.
CO4	Apply the concepts of fluid statics, kinematics and dynamics while addressing problems in engineering and to determine the fluid flow through open and closed channel.

Text Books	
1.	Strength of Materials by R K Rajput, S. Chandand Company Pvt, 2014.
2.	Strength of Materials",S.S.Rattan,TataMcGrawHill,2009
3.	A Text Book of Fluid Mechanics and Hydraulic Machines Dr. R. K Bansal Laxmi Publishers
4.	Mechanics of Materials by JBKD as & Dr. PL Srinivasa Murthy.

Reference Books	
1.	Mechanics of Materials by RC Hibbeler,Pearson,Latestedition
2.	Fundamentals of Strength of Materials by PN Chandramouli PHI LearningPvt.Ltd, 2013.
3.	"FluidMechanics(SIUnits)"YunusA.CengelJohnM.Cimbala,TataMcGrawHill 3rd Edition, 2014.

Web links and Video lectures (e-Resources)
https://sm-nitk.vlabs.ac.in/List%20of%20experiments.html https://archive.nptel.ac.in/courses/112/105/112105269/ https://archive.nptel.ac.in/courses/112/107/112107146/ https://nptel.ac.in/courses/112107146

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CIE FOR THE THEORY:

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4. Total marks scored (30+20 = 50 marks).
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4. **Part-B** contains total 10 questions.
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7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

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CO2	3	2	2	-	1	1	-	1	-	-	1
CO3	3	2	2	-	1	1	-	1	-	-	1
CO4	3	2	2	-	1	1	-	1	-	-	1

Level 1-High, Level 2-Moderate, Level3- Low

SEMESTER-III					
ANALOG AND DIGITAL ELECTRONIC CIRCUITS **Category: IPCC** **(Common to EEE & R&A)**					
Course Code	:	B24EE303	CIE	:	50 Marks
Teaching Hours/Week (L:T:P)	:	3:0:2	SEE	:	50 Marks
Total Hours	:	45(T)+15(P)	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand the basics and applications of diodes and transistors
2.	To understand FETs and MOSFETs with their characteristics and biasing, and to analyze and design various feedback and oscillator circuits for electronic applications.
3.	To Illustrate simplification of Algebraic equations using Karnaugh Maps and Quine-McClusky Techniques.
4.	To Design Decoders, Encoders, Digital Multiplexer, Adders, Subtractors and Binary Comparators.
5.	To Describe Latches and Flip-flops, Registers and Counters.

Module - 1	**No. of Hours**
Diode Applications - Clipping circuits, Clamping Circuits **Bipolar Junction Transistor (BJT):** Transistor characteristics, transistor as an amplifier, CB, CE, CC configurations, the operating point, BJT Biasing:Fixed bias ,Collector to base Bias , voltage divider bias, bias compensation, Stability, CE amplifier response, gain bandwidth product, Emitter follower, RC coupled amplifier, two cascaded CE and multistage CE amplifiers	9
Module - 2	**No. of Hours**
Junction Field Effect Transistor (FET): FET Construction, Principle of Operation, VI Characteristics, MOSFET- Depletion and Enhancement MOSTET, FET biasing. **Feedback and Oscillator Circuits:**Feedback concepts, Feedback connection types, Oscillator operation, RC Phase shift oscillator, Wein bridge oscillator, Tuned Oscillator circuit, Crystal oscillator.	9
Module - 3	**No. of Hours**
Principles of combinational logic: Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4,5 variables, Incompletely specific functions (Don't care terms) Simplifying Max term equations, Quine-McClusky techniques 4 variables.	9
Module– 4	**No. of Hours**
Analysis and design of combinational logic: Decoders, Encoders, Digital multiplexers, Adders and subtractors, Look ahead carry, Binary comparators	9
Module– 5	**No. of Hours**
Flip-Flops and its Applications: Basic Bitable elements, Latches, The master-slave flip flops (pulse-triggered flip-flops): SR flip-flops, JK flip-flops, Characteristic Equations, Shift Registers, Binary ripple counters and synchronous binary counters	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Analyse clippers, clampers, and different biasing of transistors
CO2	Understand and analyze FETs and MOSFETs, their biasing, and apply feedback principles to design and analyze various oscillator circuits
CO3	Simplify digital circuits using Karnaugh Map , and Quine-McClusky Method
CO4	Design the combinational logic circuits
CO5	Explain flip flops and make use in designing different registers and counters.

PRACTICAL COMPONENT OF IPCC

Sl. No	**Experiments** **(to be carried out using discrete components)**
1.	To construct and observe clipping and clamping circuits for different configurations

2.	To construct and find bandwidth of RC coupled amplifier
3.	To conduct an experiment on a given JFET and obtain 1)Drain Characteristics 2) Transfer Characteristics
4.	To construct and check oscillation frequency for RC phase shift oscillator.
5.	Design and implement (i) Half Adder & Full Adder using i) basic gates. ii) NAND gates (ii) Half Subtractor& Full Subtractor using i) basic gates ii) NAND gates.
6.	Design and implement 4-bitParallelAdder/Subtractor using IC 7483.
7.	Design and Implementation of 1-bit Comparator
8.	Realize4-variable function using IC74151 (8:1MUX)
9.	Realize the following flip-flops using NAND Gates. JK, D Flip-Flops
10.	Realize 4 bit Shift Registers: SISO, SIPO, PIPO, PISO
11.	Realize 3 bit synchronous counter using flip flops

Text Books	
1.	Robert L. Boylestad and Louis Nashelsky, "Electronics devices and Circuit theory", Pearson, 10th Edition, 2012, ISBN: 978-81-317-6459-6.
2.	John M Yarbrough,-Digital Logic Applications and Design, Thomson Learning, 2001.

Reference Books	
1.	Analog Electronic Circuits: A simplified approach by U.B. Mahadevaswamy, Pearson Education India, 2010
2.	Donald D. Givone, —Digital Principles and Design, McGraw Hill, 2002.
3.	David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

The CIE marks for the theory component of the Integrated Course (IC) shall be 30 marks and for the laboratory component 20 marks.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY COMPONENT OF IC:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes / Weekly test / project work for (20+20) marks, scaled down to **20 marks.**
4. Total marks scored **(30+20 = 50 marks)** scaled down to **25.**

CIE FOR THE PRACTICAL COMPONENT OF IC:

1. On completion of every experiment / program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.
2. Each experiment is evaluated for 10 marks and scaled down to **5 marks.**
3. Laboratory test at the end of the 15th week of the semester / after completion of all the experiments shall be conducted for **50 marks** and scaled down to **20 marks.**
4. Total marks scored for lab component: **05+20=25 marks**.
5. The minimum marks to be secured in CIE to appear for SEE shall be 10(40% of maximum marks 25) in the theory and 10(40% of Maximum marks 25) in the practical.

6. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

Theory				
IA Test	**Exam conducted for**	**Scaled down to**	**Average of best two tests**	**Total**
IA-1	**50**	**30**	**30**	**50/2=25**
IA-2	**50**	**30**		
IA-3	**50**	**30**		
Two Assignments	**2×10=20**	**10**	**10**	
Two Quizzes	**2×10=20**	**10**	**10**	

LAB			
Continuous performance and record writing	**Each experiments evaluated for 10 marks**	**Scaled down to 05 marks**	**5+20=25**
Internal Test + Viva voce	**Exam conducted for 50 marks**	**Scaled down to 20 marks**	

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	2	-	1	1	1	-	2
CO2	3	3	3	-	2	-	1	1	1	-	2
CO3	3	3	2	-	3	-	1	1	1	-	2
CO4	3	2	3	-	3	-	1	1	1	-	2
CO5	3	2	2	-	2	-	1	1	1	-	2

Level3- High, Level2- Moderate,Level1- Low

SEMESTER-III					
ROBOTIC FABRICATION **Category: IPCC**					
Course Code	:	B24RA304	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:2	SEE	:	50 Marks
Total Hours	:	45(T) +15(P)	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Objectives	
1.	Introduce students to different methods of fabrication used in the manufacturing of robotic components.
2.	Develop an understanding of the materials used in robotic component fabrication and their properties.
3.	Familiarize students with traditional manufacturing processes commonly employed in the robotics industry.
4.	Provide an overview of additive manufacturing techniques and their applications in robotics.
5.	Introduce students to CNC programming and machining for precise fabrication of robotic components.

Module – 1	**No.of Hours**
Methods of Fabrication: Introduction to Fabrication Methods, Definition of fabrication methods, Importance of fabrication in robotics and automation, Overview of different fabrication techniques. Welding and Joining Techniques, Types of welding processes (arc welding, spot welding) Principles and applications of welding in robotic, component fabrication, Joint design considerations, Machining Processes, Introduction to machining operations (turning, milling, drilling, etc.). **Machining tools and equipment:** used in robotic component fabrication, Cutting parameters and tool selection, Sheet Metal Fabrication, Basics of sheet metal fabrication, Techniques for bending, cutting, and Forming sheet metal, Applications of sheet metal in robotic component manufacturing.	9
Module – 2	**No.of Hours**
Materials for Robotic Components : Material Selection for Robotic Components, Introduction to materials used in robotics (metals, polymers and composites), Material properties and their significance in robotic component design, Factors influencing material selection for specific applications. **Metal Alloys and Composites:** Overview of commonly used metal alloys in robotics, Properties and advantages of composite materials, Application areas and considerations for using composites in robotic components, Polymers and Elastomers, Properties and characteristics of polymers and elastomers, Use of polymers and elastomers in robotic component fabrication, Selection criteria and limitations of polymer-based materials.	9
Module – 3	**No.of Hours**
Traditional Manufacturing: Casting and Molding, Principles and processes of casting and molding, Different types of casting techniques (sand casting, investment casting.) Molding techniques for robotic component production, Forming and Stamping, Introduction to forming and stamping processes, Presses and tools used in forming and stamping operations, Applications and advantages of forming and stamping in robotics. Machining and CNC Operations: Advanced machining techniques for robotic component fabrication, Introduction to Computer Numerical Control (CNC) machines, Programming basics for CNC machining.	9
Module – 4	**No.of Hours**
Additive Manufacturing: Introduction to Additive Manufacturing, Definition and principles of additive manufacturing, Various additive manufacturing technologies (3D printing, selective laser sintering, etc.), Benefits and limitations of additive manufacturing in robotics. Additive **Manufacturing Techniques:** Detailed study of different additive manufacturing processes, Materials used in additive manufacturing for robotic components, Design considerations and optimization for additive manufacturing, Applications of Additive Manufacturing in Robotics, Case studies showcasing the useof additive manufacturing in robotics, Rapid prototyping and customization possibilities with additive manufacturing, Future trends and advancements in additive manufacturing for robotics.	9
Module – 5	**No.of Hours**
CNC Programming and Machining: Introduction to CNC Programming, Fundamentals of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM), Basics of CNC programming language (G-code, M- code), Programming techniques and syntax for CNC machining operations, CNC Machining Operations, Detailed study of CNC machining processes (turning, milling, drilling, etc.). **Machining strategies and tool selection for specific operations:** Troubleshooting common issues in CNC machining, CNC Machining of Robotic Components, Programming and machining of simple	9

robotic parts using CNC machines, Precision requirements and dimensional tolerances in robotic component fabrication, Inspection and quality control techniques for CNC machined parts.	

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply various fabrication methods and their applications in the robotics field.
CO2	Adopt the material behavior and analyze its usages for different robotic components based on their properties.
CO3	Apply traditional manufacturing processes to fabricate robotic components accurately.
CO4	Adopt additive manufacturing techniques for rapid prototyping and production of robotic components.
CO5	Demonstrate proficiency in CNC programming and machining operations to create precise robotic components.

Sl. No	List of Experiments
1.	Conduct hands-on demonstrations of different fabrication methods, such as welding Lap joint But Joint
2.	Conduct hands-on demonstrations of different fabrication methods, such as Welding L Joint Corner Joint.
3.	Conduct hands-on demonstrations of different fabrication methods, such as Lathe Turning Facing Operation.
4.	Conduct hands-on demonstrations of different fabrication methods, such as Lathe Knurling And Thread Cutting Operation
5.	Conduct hands-on demonstrations of different fabrication methods, such as Drilling,
6.	hands-on experience in CNC programming and machining by allowing them to design and manufacture simple robotic components using CNC machine
7.	Conduct hands-on demonstrations of different fabrication methods, such as Milling Squar Rectangle
8.	Conduct hands-on demonstrations of different fabrication methods, such as face and end milling
9	Conduct hands-on demonstrations of different fabrication methods, such as Lathe Knurling and taper turning Operation using CNC machine.
10	Conduct hands-on demonstrations of different fabrication methods, such as Lathe Thread cutting Operation using CNC machine.

Text Books	
1.	Serope Kalpakjian Illinois Institute of Technology Steven R. Schmid The University of Notre Dame SI Conversion by Hamldon Musa Universiti Teknologi Malaysia Prentice Hall Singapore London." Manufacturing Engineering and Technology (2007).
2.	William D. Callister Jr. and David G. "Materials Science and Engineering: An Introduction" by Rethwisch. 10th edition, John Wiley & Sons, 2020.

Reference Text Books	
1.	John J. Craig, Introduction to Robotics: Mechanics and Control
2.	Renfrew, Alasdair. "Introduction to robotics: Mechanics and control." International Journal of Electrical Engineering & Education 41.4 (2004): 388.
3.	Groover, Mikell P., Mitchell Weiss, and Roger N. Nagel.Industrial Robotics: Technology, Programming, and Applications Industrial robotics: technology, programming and application. McGraw-Hill Higher Education, 1986.

Web links and Video lectures (e-Resources)

1. Robotics Online (https://www.robotics.org/) Description: This website provides comprehensive resources related to robotics, including articles, industry news, and information on fabrication methods.
2. Video Lecture Series: MIT Open Course Ware - Introduction to Robotics (https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/) Description: This video lecture series covers various topics in robotics, including fabrication methods, materials, and manufacturing processes.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

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The CIE marks for the theory component of the Integrated Course (IC) shall be 30 marks and for the laboratory component 20 marks.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY COMPONENT OF IC:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes / Weekly test / project work for (20+20) marks, scaled down to **20 marks.**
4. Total marks scored **(30+20 = 50 marks)** scaled down to **25.**

CIE FOR THE PRACTICAL COMPONENT OF IC:

1. On completion of every experiment / program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.
2. Each experiment is evaluated for 10 marks and scaled down to **5 marks.**
3. Laboratory test at the end of the 15th week of the semester / after completion of all the experiments shall be conducted for **50 marks** and scaled down to **20 marks.**
4. Total marks scored for lab component: **05+20=25 marks**.
5. The minimum marks to be secured in CIE to appear for SEE shall be 10(40% of maximum marks 25) in the theory and 10(40% of Maximum marks 25) in the practical.
6. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

Theory				
IA Test	**Exam conducted for**	**Scaled down to**	**Average of best two tests**	**Total**
IA-1	**50**	**30**	**30**	**50/2=25**
IA-2	**50**	**30**		
IA-3	**50**	**30**		
Two Assignments	**2×10=20**	**10**	**10**	
Two Quizzes	**2×10=20**	**10**	**10**	

LAB			
Continuous performance and record writing	**Each experiments evaluated for 10 marks**	**Scaled down to 05 marks**	**5+20=25**
Internal Test + Viva voce	**Exam conducted for 50 marks**	**Scaled down to 20 marks**	

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.

3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	1	2	1	-	-	1	-
CO2	2	2	1	1	1	1	1	-	-	2	-
CO3	1	1	1	1	1	1	1	-	-	2	-
CO4	1	1	1	1	1	1	1	-	-	1	-
CO5	1	1	1	1	1	1	1	-	-	1	-

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
MODELING AND DESIGN LAB **Category: PCCL**					
Course Code	:	B24RA305L	CIE	:	50 Marks
Teaching Hours L : T : P	:	0:0:2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To acquire the knowledge of limits, tolerance and fits and indicate them on machine drawings.
2.	To make drawings using orthographic projections and sectional views.
3.	To impart knowledge of thread forms, fasteners, keys, joints, couplings.
4.	To understand and interpret drawings of machine components leading to preparation of assembly drawings using CAD packages.

Module – 1: Geometrical Dimensioning and Tolerances (GD&T) (only for CIE)	**No.of Hours**
Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry.	2
Module – 2: Thread Forms and Fasteners	**No.of Hours**
Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External) square and Acme. Sellers thread, American Standard thread, Helicoil thread inserts. **Fasteners:** Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, countersunk head screw, grub screw, Allen screw.	4
Module – 3: Assembly of Joints, couplings (using 3D environment)	**No.of Hours**
(Part drawings shall be given) Joints: Like Cotter joint (socket and spigot), knuckle joint (pin joint). Couplings: Like flanged coupling (protected and unprotected type), universal coupling.	6
Module – 4: Assembly of Machine Components (using 3D environment)	**No.of Hours**
(Part drawings shall be given) Lifting devices (screw jack) Bearings (Plummer block) Machine tool components (machine vice) I.C. Engine components (piston) I.C. Engine components (connecting rod)	24

Course Outcomes: At the end of the course, the students will be able to	
CO1	Interpret the Machining and surface finish symbols on the component drawings.
CO2	Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies
CO3	Illustrate various machine components through drawings
CO4	Create assembly drawings as per the conventions.

Text Books	
1.	K L Narayana, P Kannaiah, K Venkata Reddy, "Machine Drawing", New Age International, 3rd Edition. ISBN 13: 978-81-224-2518-5, 2006
2.	N D Bhatt,"MachineDrawing", CharotarPublishingHousePvt. Ltd.,50th Edition, ISBN-13: 978-9385039232, 2014

Reference Text Books	
1.	Sadhu Singh, P. L. Sah, "Fundamentals of Machine Drawing", PHI Learning Pvt. Ltd, 2nd Edition, ISBN: 9788120346796, 2012
2.	Ajeet Singh, "MACHINE DRAWING", Tata McGraw-Hill Education, , ISBN: 9781259084607, 2012

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE marks for the practical course is 50 Marks.

- CIE shall be evaluated for max marks 100. Marks obtained shall be accounted for CIE final marks, reducing it by 50%.
- CIE component should comprise of Continuous evaluation of Drawing work of students as and when the Modules are covered.

Atleast one closed book Test covering all the modules on the basis of below detailed weightage. Weightage for Test and Continuous evaluation shall be suitably decided by respective course coordinators.

Module	**Max. Marks Weightage**	**Evaluation Weightage in marks**
		Submission of printouts
Module 1	10	10
Module 2	10	10
Module 3	30	30
Module 4	50	50
Total	100	100

SEMESTER END EXAMINATION (SEE)

Semester End Evaluation (SEE): SEE marks for the practical course is 50 Marks.

- The duration of SEE is 03 hours. Questions shall be set worth of 3 hours
- SEE shall be conducted jointly by the two examiners.
- SEE shall be conducted and evaluated for maximum marks 100. Marks obtained shall be accounted for SEE final marks, reducing it to 50 marks.
- Question paper shall be set jointly by both examiners and made available for each batch as per schedule.
- Questions are to be set preferably from Text Books.
- Evaluation shall be carried jointly by both the examiners.
- One full question shall be set from Modules 2,3 and 4 as per the below tabled weightage details.

Module	**Max. Marks Weightage**	**Evaluation Weightage in marks**
		Computer display & printout
Module 2	20	20
Module 3	30	30
Module 4	50	50
Total	100	100

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	1	-	-	1	-	1	-
CO2	2	2	1	1	1	-	-	1	-	2	-
CO3	1	1	1	1	1	-	-	1	-	2	-
CO4	1	1	1	1	1	-	-	1	-	1	-

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
BASIC COMMUNICATION SYSTEMS **Category: ESC/ETC/PLC-III**					
Course Code	:	B24RA361	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To prepare students with fundamental knowledge in the field of Communication systems.
2.	Use of different modulation and demodulation techniques used in the communication.
3.	Analyze transmitter and receiver circuits.
4.	To apply and analyze the source and error control coding techniques.
5.	To understand the concept of Global system for mobile communications (GSM) techniques and architecture.

Module – 1: Analog Communication	**No. of Hours**
Introduction to Communication Systems – Modulation – Types – Need for Modulation. Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems.	9
Module – 2 : Data and Pulse Communication	**No. of Hours**
Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse Code Modulation (PCM) – Comparison Of Various Pulse Communication System .Data Communication: History Of Data Communication – Standards, Organizations For Data Communication- Data Communication Circuits – Data Communication Codes – Data Communication Hardware – Serial And Parallel Interfaces.	9
Module – 3: Digital Modulation	**No. of Hours**
Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying(PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM– Bandwidth Efficiency– Comparison of various Digital Communication System.	9
Module – 4: Source And Error Control Coding	**No. of Hours**
Entropy, Source Encoding Theorem, Shannon Fano Coding, Huffman Coding, Mutual Information, Channel Capacity, Error Control Coding, Linear Block Codes, Cyclic Codes –ARQ Techniques	9
Module – 5: Multi-User Radio Communication	**No. of Hours**
Global system for mobile communications (GSM) – Code Division Multiple Access (CDMA) – Cellularconcept and Frequency Reuse – Channel Assignment and Handover Techniques – Overview of Multiple Access Schemes – Satellite Communication – Bluetooth.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Analyze digital and Analog communication circuits
CO2	Compare the various AM and FM modulation techniques and analyze the related degree of modulation factors bandwidth, etc., given the voltage/frequency amplitudes of the carrier signalsand the intelligence signals.
CO3	Apply pulse code modulation and various digital modulation techniques to given signal.
CO4	Apply and analyze the source and error control coding techniques.
CO5	Understand the concept of Global system for mobile communications (GSM) techniques and architecture.

Text Books	
1.	Wayne Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, Pearson Education, 2009.
2.	B.P.Lathi,“Modern Analog and Digital Communication Systems”, 3rd Edition,Oxford University Press,2007.

Reference Text Books	
1.	Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, 2004
2.	H.Taub, D L Schilling and G Saha, “Principles of Communication”, 3rd Edition, PearsonEducation, 2007.

Web links and Video lectures (e-Resources)
1. https://www.digimat.in/nptel/courses/video/117105143/L01.html
2. https://www.digimat.in/nptel/courses/video/117105144/L01.htm

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	3	-	1	-	-	-	-	1	2
CO2	2	2	2	-	2	-	-	-	-	2	2
CO3	1	1	1	-	2	-	-	-	-	2	1
CO4	1	1	1	-	1	-	-	-	-	1	1
CO5	2	1	1	-	1	-	-	-	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-III					
ROBOT MECHANICS AND CONTROL **Category: ESC/ETC/PLC-III**					
CourseCode	:	B24RA362	CIE	:	50Marks
Teaching Hours L:T :P	:	3:0:0	SEE	:	50Marks
TotalHours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Objectives	
1.	Understand and discuss the fundamental elementary concepts of Robotics.
2.	Provide insight into different types of robots.
3.	Explain intelligent module for robotic motion control.
4.	Educate on various path planning techniques.
5.	Illustrate the working of innovative robotic devices

Module–1: Introduction To Robotics	**No. of Hours**
Introduction to Robotics and Automation, laws of robot, brief history of robotics, basic components of robot, robot specifications, classification of robots, human system and robotics, safety measures in robotics, social impact, Robotics Market and the future prospects, advantages and disadvantages of robots.	9
Module–2: Robot Anatomy and Motion Analysis	**No. of Hours**
Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics.	9
Module–3: Robot Drives and End Effectors	**No. of Hours**
Robot drive systems: Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, 1DoF, 2DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to- point control, playback with continuous path control.	9
Module–4: Path Planning	**No. of Hours**
Definition Joint space technique, Use of P degree polynomial Cubic, polynomial Cartesian space technique, parametric descriptions, straight line and circular paths, position and orientation planning.	9
Module–5: Robotics Applications: Material Handling	**No. of Hours**
Pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel and underwater applications, Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Autonomous robots, and Swarm robots.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the significance, social impact and future prospects of robotics and automation in various engineering applications.
CO2	Identify and describe the components and anatomy of robotic system.
CO3	Know about various path planning techniques and analyze different motions of robotics system
CO4	Use the suitable drives and end- effectors for a given robotics application.
CO5	Apply robotics concept to automate the monotonous and hazardous tasks and categorize various types of robots based on the design and applications in real world scenarios.

Text Books	
1.	S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.
2.	Mikell P.Grooveret.al., "Industrial Robots Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).
3.	Ganesh S Hegde,"AtextbookonIndustrialRobotics",Universitysciencepress,3rd edition, 2017.

Reference Text Books	
1.	Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering–An Integrated Approach", Eastern Economy Edition, PrenticeHallofIndiaPvt.Ltd.,2006.
2.	Fu K S,Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987.https://www.robots.com/applications.

Web links and Video lectures(e-Resources)

1. https://roboticscasual.com/ros-tutorial-pick-and-place-task-with-the-moveit-c-interface/
2. https://roboticscasual.com/ros-tutorial-simulate-ur5-robot-in-gazebo-urdf-explained/
3. https://roboticscasual.com/the-best-degrees-to-work-in-robotics/
4. https://roboticscasual.com/robotics-tutorials/
5. https://www.ieee-ras.org/educational-resources-outreach/educational-material-in-robotics-andautomation.
6. https://www.isa.org/

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	1	2	-	-	3	2

CO2	3	1	-	-	-	3	1	-	-	2	2
CO3	3	2	-	-	-	1	2	-	-	2	1
CO4	1	1	-	-	-	1	2	-	-	2	1
CO5	1	1	-	-	-	1	2	-	-	1	1

Level3-High, Level2-Moderate, Level1-Low

SEMESTER-III					
MATERIAL SCIENCE **Category: ESC/ETC/PLC-III**					
Course Code	:	B24RA363	CIE	:	50Marks
Teaching Hours L:T:P	:	3:0:0	SEE	:	50Marks
Total Hours	:	45(T)	Total	:	100Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Objectives	
1.	Provide a comprehensive understanding of the structure, properties, and behavior of materials.
2.	Enable students to link material properties to their applications in robotics and automation.
3.	Introduce advanced materials and their role in robotics, automation systems, and smart manufacturing.
4.	Cultivate skills for selecting materials based on design and application requirements.

Module-1: Introduction to Materials Science	**No. of Hours**
Overview of materials and their applications in robotics and automation. **Classification of materials:** Metals, ceramics, polymers, composites, and smart materials. Atomic structure and bonding: Impact on material properties. **Crystallography:** Crystal structures, imperfections, and defects. Thermal, electrical, magnetic, and optical properties of materials.	9
Module-2: Mechanical Properties of Materials	**No. of Hours**
Stress-strain behavior, elasticity, plasticity, toughness, and hardness. Fatigue, creep, and fracture mechanics. **Testing methods:** Tensile, compression, impact, and hardness testing. Relevance of mechanical properties in robotic joints, arms, frames and end-effectors	9
Module-3: Materials Processing and Manufacturing	**No. of Hours**
Fundamentals of material processing techniques: Casting, forging, welding, and additive manufacturing. Heat treatment processes and their effects on material properties. Surface engineering techniques for wear and corrosion resistance in automation components.	9
Module-4: Advanced Materials for Robotics	**No. of Hours**
Composite materials: Types, fabrication, and applications in lightweight robotic arms. **Smart materials:** Shape-memory alloys, piezoelectric materials, magneto rheological fluids, and applications in actuators and sensors. **Nanomaterials:** Carbon nano tubes, graphene, and their use in robotics and automation. **Biomaterials:** Role in soft robotics and prosthetics.	9
Module-5: Material Selection and Processing	**No. of Hours**
Material selection criteria: Cost, performance, and environmental considerations. **Processing techniques:** Additive manufacturing, machining, casting, and welding. **Surface engineering:** Coatings and treatments for wear and corrosion resistance. **Case studies:** Material choices for robotic gears, actuators, and frames.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Classify and analyze materials based on their properties and structure.
CO2	Select suitable materials for robotic and automation components.
CO3	Apply concepts of material properties in designing efficient systems.
CO4	Design and utilize emerging materials for robotics applications.

Text Books	
1.	Callister, W. D., & Rethwisch, D. G., Materials Science and Engineering: An Introduction.
2.	Ashby, M. F., Materials Selection in Mechanical Design.

Reference Text Books	
1.	Askeland, D. R., & Wright, W. J., Essentials of Materials Science and Engineering.
2.	Shackleford, J. F., Introduction to Materials Science for Engineers.
3.	**Groover, M. P.**, *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*
4.	Recent journal articles and conference papers in robotics and materials science.

Web links and Video lectures(e-Resources)
Bhattacharya,B., Materials Selection and Design, NPTEL Course Material, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/ .
Prasad, R., Introduction to Materials Science and Engineering, NPTEL Course Material, Department of Material

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	2
CO2	3	2	-	2	-	-	-	-	-	-	1
CO3	3	2	2	1	-	-	-	-	-	-	1
CO4	3	2	2	-	-	-	-	-	-	-	1

Level3-Highly, Level2-Moderately, Level1-Low

SEMESTER-III					
OBJECT ORIENTED PROGRAMMING **Category: ESC/ETC/PLC-III** **(Common to ECE, RA)**					
Course Code	:	B24EC364	CIE	:	50 Marks
Teaching Hours/Week (L:T:P)	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand object-oriented programming using C++and Gain knowledge about the capability to store information together in an object
2.	To illustrate the capability of a class to rely upon another class and functions
3.	To Create and process data in files using file I/O functions
4.	To understand the process of templates and virtual attributes.
5.	To understand the generic programming features of C++ including Exception handling

Module – 1: An overview of C++	**No. of Hours**
What is object-Oriented Programming? Introducing C++ Classes, The General Form of a C++ Program. Classes and Objects: Classes, Friend Functions, Friend Classes, Inline Functions, Parameterized Constructors, Static Class Members, When Constructors and Destructors are Executed, The Scope Resolution Operator, Passing Objects to functions, Returning Objects, Object Assignment Ch 11, Ch 12	9
Module – 2: Arrays, Pointers, References, and the Dynamic Allocation Operators	**No. of Hours**
Arrays of Objects, Pointers to Objects, The this Pointer, Pointers to derived types, Pointers to class members. Functions Overloading, Copy Constructors: Functions Overloading, Overloading Constructor Functions. Copy Constructors, Default Function Arguments, Function Overloading and Ambiguity. Ch 13, Ch 14	9
Module – 3: Operator Overloading	**No. of Hours**
Creating a Member Operator Function, Operator Overloading Using a Friend Function, Overloading new and delete Inheritance: Base-Class Access Control, Inheritance and Protected Members, Inheriting Multiple Base Classes , Constructors, Destructors and Inheritance, Granting Access, Virtual Base Classes Ch 15, Ch 16	9
Module– 4: Virtual Functions and Polymorphism	**No. of Hours**
Virtual Functions, The Virtual Attribute is Inherited, Virtual Functions are Hierarchical, Pure Virtual Functions, Using Virtual Functions, Early v/s Late Binding. Templates: Generic Functions, Applying Generic Functions, Generic Classes. The type name and export Keywords. The Power of Templates Ch 17, Ch 18	9
Module– 5: Exception Handling	**No. of Hours**
Exception Handling Fundamentals, Handling Derived-Class Exceptions, Exception Handling Options, Applying Exception Handling. The C++ I/O System Basics: C++ Streams, The C++ Classes, Formatted I/O File I/O: and File Classes, Opening and Closing a File, Reading and Writing Text Files, Detecting EOF. Ch 19, Ch 20, Ch21	9

Course outcome: At the end of the course, the student will be able to	
CO1	Understand the basic concepts of object-oriented programming.
CO2	Design appropriate classes for the given real world scenario.
CO3	Apply the knowledge of compile-time / run-time polymorphism to solve the given problem
CO4	Use the knowledge of inheritance for developing optimized solutions
CO5	Apply the concepts of templates and exception handling for the given problem 6 Use the concepts of input output streams for file operations

Text Books	
1.	1. Herbert schildt, The Complete Reference C++, 4th edition, TMH, 2005

Reference Books	
1.	1. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd., Sixth Edition 2016.
2.	. Bhave , " Object Oriented Programming With C++", Pearson Education , 2004.

Web links and Video lectures (e-Resources)
1. Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA
2. Functions of C++ -https://www.youtube.com/watch?v=p8ehAjZWjPw

ASSESSMENT DETAILS BOTH (CIE AND SEE)

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CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	1	2	2	1	1	-	1	2	1
CO2	1	-	1	2	2	-	-	-	1	1	1
CO3	2	-	1	2	3	-	-	-	1	1	1
CO4	2	-	1	1	1	1	1	-	1	2	1
CO5	1	-	1	2	2	1	1	-	2	1	1

Level3 -High, Level2- Moderate, Level1- Low

SEMESTER-III					
C++ PROGRAMMING LAB **Category: AEC/SEC-III** **(Common to ECE, RA)**					
Course Code	:	B24EC381	CIE	:	50 Marks
Teaching Hours L : T : P	:	0 : 0 : 2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	Understand object-oriented programming concepts, and apply them in solving problems..
2.	To create, debug and run simple C++ programs..
3.	Introduce the concepts of functions, friend functions, inheritance, polymorphism and function overloading
4.	Introduce the concepts of exception handling and multithreading
5.	Understand the concept of Inheritance

Sl. No	**List of Experiments**
1.	Write a C++ program to find largest, smallest & second largest of three numbers using inline functions Max & Min.
2.	Write a C++ program to calculate the volume of different geometric shapes like cube, cylinder and sphere using function overloading concept.
3.	Define a STUDENT class with USN, Name & Marks in 3 tests of a subject. Declare an array of 10 STUDENT objects. Using appropriate functions, find the average of the two better marks for each student. Print the USN, Name & the average marks of all the students.
4.	Write a C++ program to create class called MATRIX using two-dimensional array of integers, by overloading the operator == which checks the compatibility of two matrices to be added and subtracted. Perform the addition and subtraction by overloading + and – operators respectively. Display the results by overloading the operator r <<. . If (m1 == m2)then m3 = m1 +m2 and m4= m1 – m2 else display error
5.	Demonstrate simple inheritance concept by creating a base class FATHER with data members: First Name, Surname, DOB & bank Balance and creating a derived class SON, which inherits: Surname & Bank Balance feature from base class but provides its own feature: First Name & DOB. Create & initialize F1 & S1 objects with appropriate constructors & display the FATHER & SON details.
6.	Write a C++ program to define class name FATHER & SON that holds the income respectively. Calculate & display total income of a family using Friend function.
7.	Write a C++ program to accept the student detail such as name & 3 different marks by get_data() method & display the name & average of marks using display() method. Define a friend function for calculating the average marks using the method mark_avg().
8.	Write a C++ program to explain virtual function (Polymorphism) by creating a base class polygon which has virtual function areas two classes rectangle & triangle derived from polygon & they have area to calculate & return the area of rectangle & triangle respectively
9.	Design, develop and execute a program in C++ based on the following requirements: An EMPLOYEE class containing data members &members functions: i) Data members: employee number (an integer), Employee_ Name (a string of characters), Basic_ Salary (in integer), All_ Allowances (an integer), Net_Salary (an integer). (ii) Member functions: To read the data of an employee, to calculate Net_Salary& to print the values

	of all the data members. (All_Allowances = 123% of Basic, Income Tax (IT) =30% of gross salary (=basic_ Salary_All_Allowances_IT).
10.	Write a C++ program with different class related through multiple inheritance & demonstrate the use of different access specified by means of members variables & members functions.
11.	Write a C++ program to create three objects for a class named count object with data members such as roll no. & Name. Create members function members data ( ) for setting the data values & display ( ) member functions to display which object has invoked it using,,this" pointer.
12.	Write a C++ program to implement exception handling with minimum 3 exceptions classes including two built in exceptions.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Able to understand and design the solution to a problem using object-oriented programming concepts.
CO2	Able to reuse the code with extensible Class types, User-defined operators and function overloading
CO3	Achieve code reusability and extensibility by means of Inheritance and Polymorphism
CO4	Implement the features of C++ including templates, exceptions and file handling for providing programmed solutions to complex problems

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

SEMESTER-III					
VIRTUAL REALITY AND APP DEVELOPMENT **Category: AEC/SEC-III**					
Course Code	:	B24RA382	CIE	:	50 Marks
Teaching Hours L : T : P	:	1:0:0	SEE	:	50 Marks
Total Hours	:	15(T)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	1Hrs

Course Objectives	
1.	Describe how VR systems work and list the applications of VR
2.	Understand the design and implementation of the hardware that enables VR systems to be built
3.	Understand the system of human vision and its implication on perception and rendering.
4.	Explain the concepts of motion and tracking in VR systems.
5.	Describe the importance of interaction and audio in VR systems

Module – 1: Introduction to Virtual Reality	**No. of Hours**
Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output-Visual, Aural & Haptic Displays, Applications of Virtual Reality.	5
Module – 2: Representing the Virtual World	**No. of Hours**
Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR	5
Module – 3: The Geometry of Virtual Worlds &The Physiology of Human Vision	**No. of Hours**
Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.	5
Module – 4: Visual Perception & Rendering	**No. of Hours**
Visual Perception - Perception of Depth, Perception of Motion, Perception of Colour, Combining Sources of Information. Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates	5
Module – 5: Motion & Tracking	**No. of Hours**
Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies	5

Course Outcomes: At the end of the course, the students will be able to	
CO1	Describe how VR systems work and list the applications of VR.
CO2	Analyse & design and implementation of the hardware that enables VR systems to be built
CO3	To describe the system of human vision and its implication on perception and rendering
CO4	Explain the concepts of motion and tracking in VR systems.
CO5	Describe the importance of interaction and audio in VR systems

Text Books	
1.	Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2.	Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan BCraig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, SanFrancisco, CA, 2002

Reference Text Books	
1.	Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2.	Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory andPractice", Addison Wesley, USA, 2005
3.	Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds",2005.

Web links and Video lectures (e-Resources)
1.http://lavalle.pl/vr/book.html 2. https://nptel.ac.in/courses/106/106/106106138/ 3. https://www.coursera.org/learn/introduction-virtual-reality

ASSESSMENT DETAILS (BOTH CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks (Multiple Choice Questions), after the completion of the syllabus 40%, 70% and 80% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	-	1	2	-	-	1	-	2	2
CO2	1	1	-	1	2	-	-	1	-	3	2
CO3	1	1	-	1	2	-	-	1	-	2	2
CO4	1	1	-	1	2	-	-	1	-	3	2
CO5	1	1	-	1	2	-	-	1	-	2	2

Level-3 -High, Level-2- Moderate, Level-1 - Low

SEMESTER-III					
MATERIALS TESTING LAB **Category: AEC/SEC-III**					
Course Code	:	B24RA383	CIE	:	50 Marks
Teaching Hours /Week (L:T:P)	:	0:0:2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To learn the concept of the preparation of samples to perform characterization such as microstructure, volume fraction of phases and grain size.
2.	To understand mechanical behavior of various engineering materials by conducting standard tests
3.	To learn material failure modes and the different loads causing failure

Sl. No	**Experiment Name**
1.	Preparation of specimen for Metallographic examination of different engineering materials. To report microstructures of plain carbon steel, tool steel, grey C.I, SG iron, Brass, Bronze & composites.
2.	Tensile, test of steel, aluminium and cast-iron specimens using Universal Testing Machine.
3.	Shear test of steel, aluminium and cast-iron specimens using Universal Testing Machine.
4.	Compression test of steel, aluminium and cast-iron specimens using Universal Testing Machine.
5.	Flexural test of wooden specimen/aluminum /steel specimens using Universal Testing Machine.
6.	Torsion Test on steel bar using torsion testing machine.
7.	Izod and Charpy Tests on Mild steel and C.I Specimen.
8.	To determine the hardness values of MildSteel / Aluminium by Rockwell hardness Testing machine.
9.	To determine the hardness values of Copper/Brass by Brinell's Hardness testing machine
10.	To determine the hardness values of HSS material by Vickers Hardness testing machine.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Acquire experimentation skills in the field of material testing
CO2	Develop theoretical understanding of the mechanical properties of materials by performing experiments with UTM machine.
CO3	Apply the knowledge of testing methods in related areas.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	1	-	-	1
CO2	3	2	1	-	-	-	-	1	-	-	1
CO3	3	2	1	-	-	-	-	1	-	-	1

Level 1-High, Level 2-Moderate, Level-low

SEMESTER-III					
APPLICATIONS OF MATLAB **Category: AEC/SEC-III**					
Course Code	:	B24RA384	CIE	:	50 Marks
Teaching Hours L : T : P	:	0 : 0 : 2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists
2.	To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3.	To impart the knowledge of Laplace transform, an important transform technique for Engineers this requires knowledge of integration

Sl. No	**List of Experiments**
1.	Introduction to MATLAB through matrices, and general Syntax
2.	Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations usingMATLAB
3.	Evaluating Extremum of a single variable function
4.	Understanding integration as Area under the curve
5.	Evaluation of Volume by Integrals (Solids of Revolution)
6.	Evaluating maxima and minima of functions of several variables
7.	Applying Lagrange multiplier optimization method
8.	Evaluating Volume under surfaces.
9.	Evaluating triple integrals.
10.	Evaluating gradient, curl and divergence.
11.	Evaluating line integrals in vectors.
12.	Applying Green's theorem to real world problems

Course Outcomes: At the end of the course, the students will be able to	
CO1	Having an ability to apply mathematics and science in engineering applications.
CO2	Having a clear understanding of the subject related concepts and of contemporary issues.
CO3	Having problem solving ability- solving social issues and engineering problems.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

IV - Semester Syllabus

SEMESTER-IV					
THEORY OF APPLIED ROBOTICS **Category: PCC**					
CourseCode	:	B24RA401	CIE	:	50 Marks
TeachingHours/Week (L:T:P)	:	3:0:0	SEE	:	50 Marks
TotalHours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To identify and enumerate different link-based mechanisms with basic understanding of motion
2.	To interpret and analyze various velocity and acceleration diagrams for various mechanisms
3.	To understand and illustrate various power transmission mechanisms using suitable method
4.	To design and evaluate the performance of different cams and followers
5.	To compute the natural and damped frequencies offer e1-DOFmechanical systems

Module-1	No. of Hours
Links and Mechanisms: Introduction: Definitions: Link, kinematic pairs, kinematic chain, mechanism, structure, degrees of freedom, Classification links, Classification of pairs based on type of relative motion, mobility of mechanism. **Mechanisms:** Quick return motion mechanisms. Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms and Peaucellier's mechanism. **Intermittent Motion mechanisms:** Geneva wheel mechanism, Ratchet and Pawl mechanism, toggle mechanism, Ackerman steering gear mechanism	9
Module-2	**No. of Hours**
Belt Drives: Definitions: Flat belt drives, ratio of belt tensions, centrifugal tension, and power transmitted, (Simple Numerical Problems). **Gear Drives:** Gear Trains: Simple gear trains, compound gear trains. : Gear terminology, law of gearing, path of contact, arc of contact, contact ratio of spur gear.	9
Module-3	**No. of Hours**
Balancing of Rotating Masses: Static and dynamic balancing, balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. Simple numerical problem both numerical and graphical **Industrial Robots – Kinematics**: Introduction to Industrial Robots and their Applications, Robot Coordinates and Transformations, Forward Kinematics, Inverse Kinematics, Differential kinematics, Trajectory Planning	9
Module–4	**No. of Hours**
Cams: Types of cams, types of followers. Displacement, velocity and acceleration curves for uniform velocity, Simple Harmonic Motion, Uniform Acceleration and Retardation **Campro files:** disccam with reciprocating/oscillating follower having knife-edge, roller and follower inline and offset (Without derivations).	9
Module–5	**No. of Hours**
Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronisms, effort and power (no Numerical problem). **Gyroscope:** Gyroscopic couple. Effect of gyroscopic couple on plane disc, Aeroplane, Ship, stability of two wheelers and four wheelers (Without numerical problems)	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	To identify and enumerate different link-based mechanisms with basic understanding of motion.
CO2	To understand and illustrate various power transmission mechanisms
CO3	To understand and illustrate various Governing mechanisms using suitable methods
CO4	To design and evaluate the performance of different cams and followers
CO5	Analyze the different types of governors and gyroscope effects.

Text Books	
1.	Theory of Machines Rattan S.S, TataMcGraw-Hill Publishing Company Ltd., NewDelhi, Edition,2009
2.	TheoryofMachinesSadhuSingh,PearsonEducation(Singapore)Pvt. Ltd, Indian Branch New Delhi,2nd Edition 2006
3.	Mechanism and Machine Theory G. Ambekar PHI 2009
4.	Saha S K, Introduction to Robotics, McGraw Hill publishing, 2014

Reference Books	
1.	Theoryof Machines. ThomasBevan. CBS Publication 1984
2.	DesignofMachineryRobert L.Norton,McGraw Hill 2001
3.	Mechanisms and Machines-Kinematics, Dynamics and Synthesis Michael M Stanisicengage Learning2016

Web links and Video lectures(e-Resources)
1.https://nptel.ac.in/courses/112106270

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	1	1	-	1	-	-	1
CO2	3	2	2	-	1	1	-	1	-	-	1
CO3	3	2	2	-	1	1	-	1	-	-	1
CO4	3	2	2	-	1	1	-	1	-	-	1
CO5	3	2	2	-	1	1	-	1	-	-	1

Level 1-High, Level 2-Moderately, Level 3-Low

SEMESTER-IV					
SENSORS & TRANSDUCERS **Category: PCC**					
Course Code	:	B24RA402	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand the construction and characteristics of sensors
2.	To introduce students the criteria for selecting a sensor for a particular measurement.
3.	To study functional elements and static characteristics of instruments.
4.	To familiarize students with the basic techniques of designing the required signal conditioning for a particular sensor.
5.	To know about the standards for smart sensors infrastructure.

Module - 1	**No. of Hours**
Introduction to sensors and transducers, Principle of sensing and transduction, Difference betweentransducer and sensor, Classification of sensors. Principle of working and applications of light sensors, Potentiometers, force and pressure sensors, temperature sensors, proximity switches and Hall Effect sensors.	9
Module - 2	**No. of Hours**
Transducer and classification: Primary & Secondary, active & passive transducers, analog & digital modes of operation, null & deflection methods. I/O configuration of measuring instruments & instrument system– methods of correction for interfering & modifying inputs. Static characteristics: Meaning of static calibration, accuracy, precision & bias. Combination of component errors in overall systemaccuracy calculation. Static sensitivity, linearity, threshold, resolution, hysteresis and dead space.	9
Module - 3	**No. of Hours**
Capacitive transducer – various arrangements, Inductive transducer, LVDT, RTD temperature characteristics, thermistor characteristics, Active type: Thermocouple – characteristics. Optical and Radiation Pyrometers: Fundamentals, Radiation detectors, Strain gauges-types, Gauge factor, configuration. Electrical actuation system: Electrical systems, Mechanical switches, solenoids, Relays, DC/AC motors, Stepper motors & Servo Motors.	9
Module - 4	**No. of Hours**
Signal Conditioning: Introduction - Hardware - Digital 1/0, Analog to digital conversions, resolution, Filtering Noise using passive components - Registers, capacitors, amplifying signals using OP amps. Digital Signal Processing - Digital to Analog conversion, Low pass, high pass, notch filtering.Data acquisition systems (DAQS), data loggers, Supervisory control and data acquisition (SCADA),Communication methods.	9
Module - 5	**No. of Hours**
Smart sensors: Introduction, Primary Sensors, Excitation, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. Sensors Applications: On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Comprehend, classify and analyse the behaviour of different types of sensors.
CO2	Analyse the characteristics and performance measures of sensors and select suitable sensor for the givenindustrial applications.
CO3	Gain the knowledge about electrical actuation systems.
CO4	Learn fundamentals of signal conditioning, data acquisition and communication systems.
CO5	Apply the various smart sensors in the Automotive and home appliance applications.

Text Books	
1.	D. Patranabis, “Sensors and Transducers”, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, India, 2013.
2.	Jon S. Wilson, “Sensor Technology Hand Book”, Newnes Publishing Company, Boston, USA, 2005.

Reference Text Books	
1.	A.K. Sawhney, Puneet Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", DhanpatRai and Co. Pvt. Ltd., New Delhi, India, 2014.
2.	Ramon Pallas-Areny, John G. Webster, "Sensors and Signal Conditioning", 2nd Edition, Wiley India Pvt. Ltd., India, 2012.

Web links and Video lectures (e-Resources)
1. https://onlinecourses.nptel.ac.in/noc19_ee41/preview

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	1	1	-	-	2	-	2	1
CO2	1	2	1	1	1	-	-	-	-	2	-
CO3	2	-	-	1	1	-	-	-	-	2	-
CO4	2	2	-	1	1	-	-	-	-	2	-
CO5	1	-	-	1	1	-	-	-	-	2	1

Level 1-High, Level 2-Moderately, Level 3-Low

SEMESTER-IV					
MICROCONTROLLERS **Category: IPCC**					
Course Code	:	B24RA403	CIE	:	50 Marks
Teaching Hours/Week (L:T:P: S)	:	3:0:2	SEE	:	50 Marks
Total Hours	:	45(T) + 15(P)	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand the difference between Microprocessor and Microcontroller and embedded microcontrollers.
2.	Analyze the basic architecture of 8051microcontroller.
3.	Program 8051 microcontroller using Assembly Language and C
4.	Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051
5.	Understand the interrupt structure of 8051 and Interfacing I/O devices using I/O ports of 8051.

Module – 1: Microcontroller	**No. of Hours**
Microcontroller: Microprocessor Vs Microcontroller, Micro controller & Embedded Processors, Processor Architectures-Harvard Vs Princeton & RISC Vs CISC , 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing. (Text book 1-1.1,Text book 2-1.0,1.1,3.0,3.1,3.2,3.3)	9
Module – 2: Instruction Set	**No. of Hours**
Instruction Set: Assembler Directives, 8051 Addressing Modes, Data Transfer Instructions, Arithmetic instructions, Logical Instructions, Jump & Call Instructions Stack & Subroutine Instructions of 8051 (with examples in assembly Language). (Text book 1-2.5,Text book 2- Chapter 5,6,7,8)	9
Module – 3: Timers/Counters & Serial port programming	**No. of Hours**
Timers/Counters & Serial port programming: Basics of Timers & Counters, Data types & Time delay in the 8051 using C, Programming 8051 Timers, Mode 1 &Mode 2 Programming (Text book 2- 3.4, Text book 1- 7.1, 9.1) Basics of Serial Communication, 8051 Connection to RS232, Programming the 8051 to transfer data serially & to receive data serially using C.(Text book 2- 3.5, Text book 1- 10.1,10.2,10.3,10.5)	9
Module– 4: Interrupt Programming	**No. of Hours**
Interrupt Programming: Basics of Interrupts, 8051 Interrupts, Programming Timer Interrupts, Programming Serial Communication Interrupts, Interrupt Priority in 8051(Assembly Language only) (Text book 2- 3.6, Text book 1- 11.1,11.2,11.4,11.5)	9
Module– 5: I/O Port Interfacing & Programming	**No. of Hours**
I/O Port Interfacing & Programming: LCD interfacing, DAC 0808 Interfacing, ADC 0804 interfacing, Stepper motor interfacing, DC motor control & Pulse Width Modulation (PWM) using C only. (Text book 1- 12.1, 13.1, 13.2, 17.2, 17.3)	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Describe the difference between Microprocessor and Microcontroller, Types of Processor Architectures and Architecture of 8051Microcontroller.
CO2	Discuss the types of 8051 Microcontroller Addressing modes & Instructions with Assembly Language Programs.
CO3	Explain the programming operation of Timers/Counters and Serial port of 8051 Microcontroller.
CO4	Illustrate the Interrupt Structure of 8051 Microcontroller & its programming.
CO5	Develop C programs to interface I/O devices with 8051 Microcontroller.

Text Books	
1.	The “8051 Microcontroller and Embedded Systems – Using Assembly and C”, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollind. Mckinlay; Phi, 2006 / Pearson, 2006.
2.	“The 8051 Microcontroller”, Kenneth j. Ayala, 3rd edition, Thomson/Cengage Learning.

Reference Books	
1.	“The 8051 Microcontroller Based Embedded Systems”, Manish K Patel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.

2.	"Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005.

Web links and Video lectures (e-Resources)
https://youtu.be/8MLV5GP7FMY?si=R5PW1AqINV4pO-JK
https://youtu.be/yYjPAhJ_YHM?si=C50l8qGBDlV5dSAu
https://youtu.be/2-geyR_aM28?si=QO3IvO3_i92DcgX8

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

The CIE marks for the theory component of the Integrated Course (IC) shall be 30 marks and for the laboratory component 20 marks.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY COMPONENT OF IC:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes / Weekly test / project work for (20+20) marks, scaled down to **20 marks.**
4. Total marks scored **(30+20 = 50 marks)** scaled down to **25.**

CIE FOR THE PRACTICAL COMPONENT OF IC:

1. On completion of every experiment / program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.
2. Each experiment is evaluated for 10 marks and scaled down to **5 marks.**
3. Laboratory test at the end of the 15th week of the semester / after completion of all the experiments shall be conducted for **50 marks** and scaled down to **20 marks.**
4. Total marks scored for lab component: **05+20=25 marks**.
5. The minimum marks to be secured in CIE to appear for SEE shall be 10(40% of maximum marks 25) in the theory and 10(40% of Maximum marks 25) in the practical.
6. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

Theory				
IA Test	**Exam conducted for**	**Scaled down to**	**Average of best two tests**	**Total**
IA-1	**50**	**30**	**30**	**50/2=25**
IA-2	**50**	**30**		
IA-3	**50**	**30**		
Two Assignments	**2×10=20**	**10**	**10**	
Two Quizzes	**2×10=20**	**10**	**10**	

LAB			
Continuous performance and record writing	**Each experiments evaluated for 10 marks**	**Scaled down to 05 marks**	**5+20=25**
Internal Test + Viva voce	**Exam conducted for 50 marks**	**Scaled down to 20 marks**	

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.

LABORATORY

Practical Component of IPCC (12 Experiments)

Experiments using Keil software.

Sl. No	List of Experiments
	PROGRAMMING
1.	Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array.
2.	Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube(Bit manipulations).
3.	Counters.
4.	Boolean & Logical Instructions (Bit manipulations).
5.	Conditional CALL & RETURN.
6.	Code conversion
7.	Programs to generate delay. Programs using serial port and on-Chip timer /Counter.
	INTERFACING Write ALP/C programs to interface 8051 chip to Interfacing modules to develop single chip solutions.
8.	Stepper and DC motor control interface to 8051.
9.	Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface to 8051; change the frequency and amplitude.
10.	External ADC and Temperature control interface to 8051.
11.	Alphanumeric LCD panel and Hex keypad input interface to 8051.
12.	Write a C program to (i) transmit and (ii) to receive a set of characters serially by interfacing 8051 to a terminal

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	3	2	3	-	-	-	-	1	1
CO2	3	-	3	2	3	-	-	-	-	1	1
CO3	3	-	3	2	3	-	-	-	-	1	1
CO4	3	-	3	2	3	-	-	-	-	1	1
CO5	3	-	3	2	3	-	-	-	-	1	1

Level 1-High, Level 2-Moderate, Level 3-Low

SEMESTER IV					
MEASUREMENT SYSTEMS **Category: IPCC**					
Course Code	:	B24RA404	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:2	SEE	:	50 Marks
Total Hours	:	45(T) + 15(P)	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Objectives	
1.	To provide basic knowledge of metrology and dimensional measurement techniques, focusing on limits, fits, tolerances, and gauging in precision engineering.
2.	To introduce the principles of measurement systems, transducers, and signal conditioning in engineering instrumentation.
3.	To explain the principles, materials, and applications of sensors, actuators, and smart micro-systems in modern engineering.
4.	To introduce with foundational knowledge of instrument classifications and the working principles of various electromechanical measuring instrument.
5.	To introduce the fundamentals of nanotechnology, nanostructures, and advanced microscopy for precise nanoscale measurement and characterization.

Module – 1:Fundamentals of Engineering Metrology and Dimensional Measurement Systems	**No.of Hours**
Introduction to Metrology: Definition, Objectives of metrology, Material Standards, Wavelength Standards, Classification of standards, Line and End standards, Calibration of End bars. **System of Limits, Fits, Tolerance and Gauging:** Definitions, Tolerance, Tolerance analysis (addition & subtraction of tolerances) Inter changeability & Selective assembly. Class & grade of tolerance, Fits, Types of fits. Hole base system and Shaft base system. Taylor's principle, Types of limit gauges.	8
Module – 2:Measurement Systems and Instrumentation Fundamentals	**No.of Hours**
Measurement system and basic concepts of measurement methods: Definition, Significance of measurement, generalized measurement system, Static characteristics- Accuracy, Precision, Calibration, Threshold, Sensitivity, Hysteresis, Repeatability, Linearity, Loading effect, Dynamic characteristics- System response, Time delay. Classification of errors. **Transducers:** Transfer efficiency, Primary and Secondary transducers, Electrical transducers, Mechanical, Electronic transducers, Relative comparison of each type of transducers. working principles of strain, pressure, temperature, and LVDT measurement devices. **Intermediate, Modifying and Terminating Devices:** Mechanical systems- Bourdon Tube pressure gauge, Electrical and Electronics intermediate, modifying and terminating devices- Electronic amplifiers. Terminating devices, Cathode ray oscilloscope and Electronic Gripper, Vaccum gripper in Robotics.	10
Module – 3: Micro and Smart Sensor-Actuator Systems in Measurement Technology	**No.of Hours**
Micro And Smart Devices And Systems: Principles and Materials: Definitions and salient features of sensors, actuators, and systems. **Sensors:** Silicon capacitive accelerometer, Piezo-resistive pressure sensor, Blood analyzer, Conductometric gas sensor, Fiber-optic gyroscope. **Actuators:** Silicon micro-mirror arrays, Piezo-electric based inkjet print- head, Electrostatic comb-drive, Magnetic micro relay, Shape- memory-alloy based actuator, Electro-thermal actuator. **Systems:** Micro gas turbine, Portable clinical analyzer.	9
Module 4: Electromechanical Insturments	**No.of Hours**
Measuring instrument classifications-Instrument types, absolute and secondary instruments, Comparision instruments. **Construction and Operations of Electromechanical Instruments**- Permanent magnet moving coil instrument, Electrodynamic instrument, Moving-Iron instrument, Electrostatic instrument, Thermal-type instrument and Galvanometer.	9
Module 5: Nano-Metrology and Advanced Microscopy Techniques	**No.of Hours**
Nano-metrology: Nanotechnology definition, importance of Nano-dimension, classification of Nanostructures, applications. Introduction to microscopy, Transmission Electron Microscope(TEM), applications of TEM, Scanning Electron Microscope(SEM), applications of SEM, Scanning Tunnelling	9

Microscope (STM), applications of STM, Atomic Force Microscope, applications of AFM, Force Measurement using AFM, X-Ray Diffraction System: Principles, Bragg Law, Two-dimensional XRD System, Applications of XRD System.	

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand and apply metrology principles, measurement standards, and design gauges for engineering components.
CO2	Explain measurement system characteristics, classify transducers, and analyze intermediate and terminating devices in signal processing.
CO3	Identify, describe, and analyze the principles and applications of micro and smart sensors, actuators, and integrated systems.
CO4	Able to classify instruments and explain the construction and operation of key electromechanical measuring devices
CO5	Understand and apply nano-metrology techniques like TEM, SEM, STM, AFM, and XRD for analyzing nanomaterials and structures.

Text Books	
1.	N.V. Raghavendra & L. Krishnamurthy, "Engineering Metrology and Measurements",Oxford University Press,2013 ISBN: 9780198085492.
2.	Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Microsensors, MEMS, and Smart Devices", Wiley, 1st Edition, 2001, ISBN: 9780471861096.

Reference Text Books	
1.	Vikram K. Varadan, Jyhwen Wang, and Osama O. Awadelkarim, "Smart Material Systems and MEMS: Design and Development Methodologies", John Wiley & Sons,2006, ISBN: 9780471678190.
2.	Donald A. Neamen, "Microelectronics Circuit Analysis and Design", McGraw-Hill Education, 4th Edition, ISBN: 9780073380701.
3.	Dr. Thalappil Pradeep, Dr. S. Ramakrishna, Dr. S. S. R. Anjaneyulu,"Textbook on Nanoscience and Nanotechnology (2012)", McGraw-Hill Education, 2012, ISBN: 9780070702355.
4.	David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press, 3rd Edition, ISBN:0-19-569614-X.

Web links and Video lectures (e-Resources)
1. https://archive.nptel.ac.in/courses/112/104/112104250
2. https://archive.nptel.ac.in/courses/112/103/112103261
3. https://archive.nptel.ac.in/courses/108/105/108105153
4. https://archive.nptel.ac.in/courses/108/105/108105064
5. https://nptel.ac.in/courses/118102003

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

The CIE marks for the theory component of the Integrated Course (IC) shall be 30 marks and for the laboratory component 20 marks.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY COMPONENT OF IC:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes / Weekly test / project work for (20+20) marks, scaled down to **20 marks.**
4. Total marks scored **(30+20 = 50 marks)** scaled down to **25.**

CIE FOR THE PRACTICAL COMPONENT OF IC:

1. On completion of every experiment / program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day.
2. Each experiment is evaluated for 10 marks and scaled down to **5 marks.**
3. Laboratory test at the end of the 15th week of the semester / after completion of all the experiments shall be conducted for **50 marks** and scaled down to **20 marks.**
4. Total marks scored for lab component: **05+20=25 marks**.
5. The minimum marks to be secured in CIE to appear for SEE shall be 10(40% of maximum marks 25) in the theory and 10(40% of Maximum marks 25) in the practical.
6. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

Theory				
IA Test	**Exam conducted for**	**Scaled down to**	**Average of best two tests**	**Total**
IA-1	**50**	**30**	**30**	**50/2=25**
IA-2	**50**	**30**		
IA-3	**50**	**30**		
Two Assignments	**2×10=20**	**10**	**10**	
Two Quizzes	**2×10=20**	**10**	**10**	

LAB			
Continuous performance and record writing	**Each experiments evaluated for 10 marks**	**Scaled down to 05 marks**	**5+20=25**
Internal Test + Viva voce	**Exam conducted for 50 marks**	**Scaled down to 20 marks**	

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.

LABORATORY

Practical Component of IPCC (12 Experiments)

Sl. No	Name of the experimewnt
1.	Liner measurement and angular measurements: Slip gauges- Measurement of angle-sine bar, Sine centre, Angle gauges, and Optical instruments for angular measurements.
2.	Calibration of Strain measurement instrument.
3.	Calibration of Pressure measurement instrument.

4.	Calibration of measuring temperature using different Sensors & study the characteristics of Thermocouple, RTD and Thermistor.
5.	Calibration of LVDT for displacement Measurement.
6.	Calibration of Speed Measurement (Magnetic Pickup & Photo reflective)
7.	Study of MCLEOD Gauge.
8.	Study of Rotameter.
9.	Study of Vibration Measurement instrument.
10.	Study of Angular type Capacitance Measurement Trainer

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3						1
CO2	3	3	2	2	3						1
CO3	3	2	2	2	3	1	1			1	2
CO4	3	2	2	2	3						2
CO5	1	1	-	-	-	1	2	-	-	1	-

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
ROBOT PROGRAMMING & SIMULATION LAB **Category: PCCL**					
Course Code	:	B24RA405L	CIE	:	50 Marks
Teaching Hours L:T:P	:	0:0:2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3Hrs

Course Objectives	
1.	To introduce different types of robotics and demonstrate them to identify different parts and components
2.	To write Robot programming for simple operations.

Sl. No	**List of Experiments**
1.	Determination of maximum and minimum position of links.
2.	Verification of transformation (Position and orientation) with respect to gripper and world Coordinate system.
3.	Estimation of accuracy, repeatability and resolution.
4.	Robot programming and simulation for pick and place.
5.	Robot programming and simulation for Color identification.
6.	Robot programming and simulation for Shape identification.
7.	Robot programming and simulation for machining (cutting, welding).
8.	Robot programming and simulation for any industrial process (Packaging, Assembly).
Demonstration Experiments (For CIE)	
9.	Robot programming and simulation for writing practice.
10.	Robot programming and simulation for multi process
11.	Robot programming and simulation for 3D printing

CourseOutcomes: Attheendofthecourse,thestudentswillbeableto	
CO1	Use of robotic simulation software to model the different types of robots.
CO2	Use of robot simulation Software to calculate the Work volume for different robots.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	3	1	-	-	1	2
CO2	3	1	-	-	-	3	1	-	-	1	2

Level3-High, Level2-Moderate, Level1-Low

SEMESTER-IV					
DIGITAL COMMUNICATION **Category: ESC/ETC/PLC-IV**					
Course Code	:	B24RA461	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To prepare the students with fundamental knowledge in the field of digital communication systems.
2.	To use of different modulation techniques used in communication.
3.	To analyze signaling over AWGN and Band limited channels.
4.	To understand and analyze the concepts of spread spectrum modulation.
5.	To design and apply the concepts of information theory and coding.

Module – 1: Digital Modulation Techniques:	**No.of Hours**
Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM. Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability. Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams treatment of Transmitter and Receiver, Probability of error (without derivation of probability of error equation).	9
Module – 2: Signalling over AWGN Channels	**No.of Hours**
Introduction, Geometric representation of signals, Gram- Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel (without statistical characterization), Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver.	9
Module – 3: Signal design for Band limited Channels	**No.of Hours**
Design of band limited signals for zero lSI-The Nyquist Criterion (statement only), Design of band limited signals with controlled lSI-Partial Response signals, Probability of error for detection of Digital PAM: Symbol-by-Symbol detection of data with controlled lSI.	9
Module – 4: Spread Spectrum Modulation	**No.of Hours**
Principles of Spread Spectrum: Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Effect of De-spreading on a narrowband Interference, Probability of error (statement only), Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum, CDMA based on IS95.	9
Module – 5: Information Theory and Coding	**No.of Hours**
Introduction to Information Theory:Measure of information, Average information content of symbols in long independent sequences. Source Coding:Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Huffman coding. Error Control Coding:Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications.
CO2	Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels.
CO3	Differentiate various spread spectrum schemes and compute the performance parameters of communication system.
CO4	Apply the fundamentals of information theory and Perform source coding for given message.

Text Books	
1.	Simon Haykin, "Digital Communication Systems", John Wiley & sons, 1st Edition, 2014, ISBN 978-0- 471-64735-5.
2.	John G Proakis and Masoud Salehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.

Reference Books
1. Bernard Sklar, "Digital Communications – Fundamentals and Applications", 2nd Edition, Pearson Education, 2016, ISBN: 9780134724058.
2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**2**	-	-	1	1	-	1	-	-	1	1
CO2	2	-	-	1	1	-	1	-	-	1	1
CO3	2	-	-	1	1	-	1	-	-	1	1
CO4	2	-	-	1	1	-	1	-	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
SMART MATERIALS AND STRUCTURES **Category: ESC/ETC/PLC-IV**					
Course Code	:	B24RA462	CIE	:	50Marks
Teaching Hours L:T:P	:	3:0:0	SEE	:	50Marks
Total Hours	:	45(T)	Total	:	100Marks
Credits	:	3	SEE Duration	:	3hrs

Course Objectives	
1.	To acquire a comprehensive understanding of smart materials.
2.	To gain knowledge about smart sensors and their functionalities.
3.	To develop an understanding of smart actuators and their applications.
4.	To explore the concept of smart composites and their unique properties.
5.	To acquire knowledge about smart structures and materials and their practical applications.

Module–1: Overview of Smart Materials	**No. of Hours**
Introduction to Smart Materials, Principles of Piezoelectricity, Perovskite, Piezoceramic Materials,SingleCrystalsvsPolycrystallineSystems,PiezoelectricPolymers,Principles of Magnetostriction, Rare earth Magneto strictive materials, Giant Magnetostriction and Magneto-resistance Effect, Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers.	9
Module–2: High-Band Width, Low Strain Smart Sensors	**No. of Hours**
Piezoelectric Strain Sensors, In-plane and Out-of Plane Sensing, Shear Sensing, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Magneto strictive Sensing, Villari Effect, Matteuci Effect and Nagoka-Honda Effect, Magnetic Delay Line Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM), System Identification using Smart Sensors.	9
Module–3: Smart Actuators	**No. of Hours**
Modelling Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magneto volume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control	9
Module–4: Smart Composites	**No. of Hours**
Review of Composite Materials, Micro and Macro-mechanics, Modelling Laminated Composites based on Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, Governing Equation of Motion, Finite Element Modelling of Smart Composite Beams	9
Module–5: ER & MR Fluids and MEMS	**No. of Hours**
ER and MR Fluids: Mechanisms and properties, Fluid Composition and behavior. **MEMS** – Mechanical Properties of MEMS Materials, Scaling of Mechanical Systems, Fundamentals of Theory, The Intrinsic Characteristics of MEMS, Miniaturization, Microelectronics Integration.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Communicate and connect to the surrounding
CO2	Fostera responsible connection with society by actively involving oneself in the community Where they work.
CO3	Notice the needs and problems of the community and involve the main problem–solving
CO4	Develop among themselves a sense of social & civic responsibility & utilize their Knowledge in finding practical solutions to individual and community problems.
CO5	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Text Books	
1.	BrianCulshaw,SmartStructuresandMaterials,ArtechHouse,2000
2.	Gauenzi,P.,SmartStructures,Wiley,2009.

Reference Text Books	
1.	Cady,W.G.,Piezoelectricity,DoverPublications.
2.	"SmartMaterialsandStructures",M.V.GandhiandB.S.ThompsonChapmen&Hall, London,1992(ISBN:0412370107)
3.	"SmartStructuresAnalysisandDesign",A.V.Srinivasan,CambridgeUniversityPress,NewYork,2001,(ISBN:0521650267).

Web links and Video lectures (e-Resources)
1. https://apm.iitm.ac.in/smart_materials.html
2. https://home.iitm.ac.in/aarajan/smc%20lab.html
3. https://youtu.be/ZIC5JFIHni4

ASSESSMENT DETAILS BOTH (CIE AND SEE)

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CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	3	-	-	-	2	1
CO2	2	2	-	-	-	2	-	-	-	2	1
CO3	2	3	-	-	-	2	-	-	-	2	1
CO4	3	2	-	-	-	3	-	-	-	2	1
CO5	3	2	-	-	-	3	-	-	-	2	1

Level3-High, Level2-Moderate, Level1-Low

SEMESTER-IV					
BASIC CONTROL SYSTEMS **Category: ESC/ETC/PLC-IV**					
Course Code	:	B24RA463	CIE	:	50 Marks
Teaching Hours L : T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	Understand basics of control systems and design mathematical models using block diagram reduction, SFG, etc.
2.	Understand Time domain and Frequency domain analysis.
3.	Analyze the stability of a system from the transfer function
4.	Familiarize with the State Space Model of the system.

Module – 1: Introduction to Control Systems	**No.of Hours**
Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems - Mechanical Systems, Electrical Systems, Analogous Systems. Text 1: 1.1, 2.2	9
Module – 2 : Block diagrams and signal flow graphs	**No.of Hours**
Transfer functions, Block diagram algebra and Signal Flow graphs. Text1: 2.4, 2.5, 2.6	9
Module – 3: Time Response of feedback control systems	**No.of Hours**
Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design). Text1: 5.3, 5.4, 5.5	9
Module – 4: Stability analysis and Root Locus Techniques	**No.of Hours**
Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis: more on the Routh stability criterion. The root locus concepts, Construction of root loci. Text1: 6.1, 6.2, 6.4, 6.5, 7.1, 7.2, 7.3	9
Module – 5: Frequency domain analysis and stability	**No.of Hours**
Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function. Mathematical preliminaries, Nyquist Stability criterion, (Stability criteria related to polar plots are excluded) **State Variable Analysis:** Introduction to state variable analysis: Concepts of state, state variable and state models. State model for Linear continuous –Time systems, solution of state equations. Text1: 8.1, 8.2, 8.4, 9.2, 9.3, 12.2, 12.3, 12.6	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Deduce transfer function of a given physical system, from differential equation representation or Block Diagram representation and SFG representation.
CO2	Calculate time response specifications and analyse the stability of the system.
CO3	Draw and analyse the effect of gain on system behaviour using root loci.
CO4	Perform frequency response Analysis and find the stability of the system.

Text Books	
1.	Control Systems Engineering, I J Nagrath, M. Gopal, New age international Publishers, 5th edition.

Web links and Video lectures (e-Resources)
• https://nptel.ac.in/courses/108106098

ASSESSMENT DETAILS BOTH (CIE AND SEE)

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CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	-	1	1	-	-	-	-	1	1
CO2	1	1	1	1	1	-	-	-	-	1	1
CO3	1	1	-	1	1	-	-	-	-	1	1
CO4	1	1	1	1	1	-	-	-	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
JAVA PROGRAMMING **Category: ESC/ETC/PLC-IV** **(Common to ECE, EEE, RA)**					
Course Code	:	B24EC464	CIE	:	50 Marks
Teaching Hours L:T : P	:	3:0:0	SEE	:	50 Marks
Total Hours	:	45(T)	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Objectives	
1.	To learn primitive constructs JAVA programming language.
2.	To understand Object Oriented Programming Features of JAVA.
3.	To gain knowledge on packages, multithreaded programming and exceptions.

Module–1: An Overview of Java	**No. of Hours**
Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords). **Data Types, Variables, and Arrays:** The Primitive Types (Integers, Floating-Point Types, Characters, Booleans), Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, Introducing Type Inference with Local Variables. **Operators:** Arithmetic Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The Operator, Operator Precedence, Using Parentheses. **ControlStatements:**Java'sSelectionStatements(if,TheTraditionalswitch),Iteration Statements (while, do-while, for, The For-Each Version of the for Loop, Local Variable Type Inference in a for Loop, Nested Loops), Jump Statements (Using break, Using continue, return).	9
Module–2: Introducing Classes	**No. of Hours**
Class Fundamentals**,** Declaring Objects**,** Assigning Object Reference Variables**,** Introducing Methods, Constructors**,** The this Keyword**,** Garbage Collection. **Methods and Classes:** Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes.	9
Module–3: Inheritance and Interfaces	**No. of Hours**
Inheritance: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class. **Interfaces:** Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods.	9
Module–4: Packages and Exceptions	**No. of Hours**
Packages: Packages, Packages and Member Access, Importing Packages. **Exceptions:**Exception-HandlingFundamentals**,**ExceptionTypes**,**UncaughtExceptions**,**Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built- in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions.	9
Module–5: Multithreaded Programming	**No. of Hours**
Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using is Alive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State. **Enumerations, Type Wrappers and Autoboxing:** Enumerations (Enumeration Fundamentals**,** The values() and value Of() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers),Autoboxing(AutoboxingandMethods,Autoboxing/UnboxingOccursinExpressions, Autoboxing /Unboxing Boolean and Character Values).	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Demonstrate proficiency in writing simple programs involving branching and looping structures.

CO2	Design a class involving data members and methods for the given scenario.
CO3	Apply the concepts of inheritance and inter faces in solving real world problems.
CO4	Use the concept of packages and exception handling in solving complex problem.
CO5	Apply concepts of multi threading, autoboxing and enumerations in program development

Text Books	
1.	HerbertSchildt, Java The Complete Reference, 7th Edition, Tata Mc Graw Hill, 2007.

Reference Text Books	
1.	MaheshBhaveandSunilPatekar,"ProgrammingwithJava",FirstEdition,PearsonEducation,2008, ISBN:9788131720806
2.	RajkumarBuyya,SThamarasiselvi,xingchenchu,ObjectorientedProgrammingwithjava,TataMcGraw Hill education private limited
3.	EBalagurusamy,ProgrammingwithJavaAprimer,TataMcGrawHill companies
4.	AnitaSethandBLJuneja,JAVAOnestepAhead,OxfordUniversityPress,2017

Web links and Video lectures (e-Resources)	
1.	JavaTutorial:https://www.geeksforgeeks.org/java/
2.	Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu):https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
3.	JavaTutorial:https://www.w3schools.com/java/
4.	JavaTutorial:https://www.javatpoint.com/java-tutorial

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks, after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	1	2	2	1	1	-	1	2	1
CO2	1	-	1	2	2	-	-	-	1	1	1
CO3	2	-	1	2	3	-	-	-	1	1	1
CO4	2	-	1	1	1	1	1	-	1	2	1
CO5	1	-	1	2	2	1	1	-	2	1	1

Level3 -High, Level2- Moderate, Level1- Low

SEMESTER-IV					
PROGRAMMABLE LOGIC CONTROLLER **Category: AEC/SEC-IV** **(Common to ECE, RA)**					
Course Code	:	B24EC481	CIE	:	50 Marks
Teaching Hours L : T : P	:	1:0:0	SEE	:	50 Marks
Total Hours	:	15(T)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	1 Hr

Course Objectives	
1.	To understand the need for automation in the industry with basic controller mechanisms involved.
2.	To study programming concepts to achieve the desired goal or to define the various steps involved in the automation.
3.	To understand programming involved with basic subroutine functions.
4.	To make use of the internal hardware circuits of automation circuit to control the devices during various states by monitoring the timers and counters.
5.	To handle the data of the I/O devices to interface the data with the controller and auxiliary devices.

Module – 1: Introduction	**No. of Hours**
Programmable logic controller (PLC), role in automation (SCADA), advantages and disadvantages, hardware, internal architecture, sourcing and sinking (Textbook 1: 1.1 to 1.4) 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: 2.1 to 2.3 and 4.1 to 4.7).	3
Module – 2 : Programming	**No. of Hours**
Ladder programming- ladder diagrams, logic functions, latching, multiple outputs, entering programs, functional blocks, program examples like location of stop and emergency switches. (TextBook1: 5.1 to 5.7).	3
Module – 3: Programming Methods	**No. of Hours**
Instruction Lists- Ladder programs and Instruction lists, Branch codes, Programming Examples- Signal lamp-valve operation task. Sequential Function Charts- Branching and convergence. (TextBook1: 6.1 to 6.3).	3
Module – 4: Internal Relays	**No. of Hours**
ladder programs, battery-backed relays, one-shot operation, set and reset, master control relay (TextBook1: 7.1 to 7.6). Timers and counters: Types of timers, ON and OFF- delay timers, pulse timers, forms of counter, programming, up and down counters. (TexBook1: 9.1 to 9.6).	3
Module – 5: Shift register and data handling	**No. of Hours**
shift registers, ladder programs, registers and bits, data handling, arithmetic functions. (TextBook1: 11.1 to 11.2 and 12.1 to 12.3)	3

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the PLC and how to construct PLC ladder diagrams.
CO2	Demonstrate an application with programming.
CO3	Analyze the characteristics of registers and conversion examples.
CO4	Apply PLC functions to timing and counting applications.
CO5	Analyse the analog operation of PLC and demonstrate the robot applications with PLC.

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.

Reference Text Books	
1.	Programmable Logic Controllers"- E. A Paar, 3rd Edition, An Engineers Guide. Newness, 2003.
2.	"Introduction to Programmable Logic Controller"- Garry Dunning, 3rd Edition, Thomson Asia Pte Ltd. Publication, 2006

Web links and Video lectures (e-Resources)
1.https://nptel.ac.in/courses/122106025
2. https://nptel.ac.in/courses/108105132
3. https://nptel.ac.in/courses/117104072

ASSESSMENT DETAILS (BOTH CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks (Multiple Choice Questions), after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	3	1	-	-	1	2
CO2	2	2	-	-	-	2	1	-	-	2	2
CO3	1	1	-	-	-	1	2	-	-	2	1
CO4	1	1	-	-	-	1	2	-	-	1	1
CO5	1	1	-	-	-	1	2	-	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-IV					
INTRODUCTION TO AI&ML **Category: AEC/SEC-IV**					
Course Code	:	B24RA482	CIE	:	50Marks
Teaching Hours L:T:P	:	1:0:0	SEE	:	50Marks
Total Hours	:	15(T)	Total	:	100Marks
Credits	:	1	SEE Duration	:	1hrs

Course Objectives	
1.	To impart artificial intelligence principles, techniques and history.
2.	To assess the applicability, strengths, and weakness of the basic knowledge representation, problem-solving and learning methods in solving engineering problems.
3.	To develop intelligent systems by assembling solutions to concrete computational problems.

Module–1: Artificial Intelligence and its Issues	**No. of Hours**
Definitions-Importance of AI, Evolution of AI-Applications of AI, Classification of AI systems concerning the environment, Knowledge Inferring systems and planning, Uncertainty and towards Learning Systems.	3
Module–2: Overview to Problem Solving	**No. of Hours**
Problem-solving by Search, Problem space-State space, Blind Search-Types, and Performance measurement.	3
Module–3: Heuristic Search, Knowledge Representation, and Reasoning	**No. of Hours**
Types, Game play in Gemini-max algorithm, Alpha-Beta Pruning. Logical Systems Knowledge-Based Systems, Proposition a l Logic Constraints, Predicate Logic First Order Logic, Inference in First-Order Logic, On to logical Representations and Applications.	3
Module–4: Uncertainty and knowledge Reasoning	**No. of Hours**
Overview Definition of uncertainty, Bayes Rule Inference, Belief Network, Utility-Based System, Decision Network.	3
Module–5: Learning Systems	**No. of Hours**
Forms of Learning Types-Supervised, Unsupervised, Reinforcement Learning, Learning decision trees	3

Course Outcomes: At the end of the course, the students will be able to	
CO1	Evaluate Artificial Intelligence (AI) methods and describe their foundations.
CO2	Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation, and learning.
CO3	Demonstrate knowledge of reasoning and knowledge representation for solving real- world problems.
CO4	Analyze and illustrate how search algorithms play vitalrole in problem solving
CO5	Illustrate the construction of learning and expert system

Text Books	
1.	Russell, S and Norvig, P. 2015. Artificial Intelligence-A Modern Approach, 3rd edition, Prentice-Hall.
2.	Poole, D and Mackworth, A. 2010. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press.

Reference Text Books	
1.	Ric, E., Knight, Kand Shankar, B.2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.
2.	Luger, G.F. 2008. Artificial Intelligence Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.

Web links and Video lectures (e-Resources)

1. https://www.youtube.com/watch?v=wnqkfpCpK1g
2. https://pll.harvard.edu/course/cs50s-introduction-artificial-intelligence-python
3. https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/artificial-intelligencevs-machine-learning
4. https://youtu.be/t4K6lney7Zw
5. https://www.youtube.com/watch?v=QDX-1M5Nj7s

ASSESSMENT DETAILS (BOTH CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks (Multiple Choice Questions), after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	3	-	-	-	2	1
CO2	2	2	-	-	-	2	-	-	-	2	1
CO3	2	3	-	-	-	2	-	-	-	2	1
CO4	3	2	-	-	-	3	-	-	-	2	1
CO5	3	2	-	-	-	3	-	-	-	2	1

Level3-High, Level2-Moderate, Level1-Low

SEMESTER-IV					
PRINCIPLES OF ROBOTICS **Category: AEC/SEC-IV**					
CourseCode	:	B24RA483	CIE	:	50Marks
TeachingHoursL:T:P	:	1:0:0	SEE	:	50Marks
TotalHours	:	15(T)	Total	:	100Marks
Credits	:	1	SEEDuration	:	01hrs

Course Objectives	
1.	To introduce the functional elements of Robotics.
2.	To introduce the mechanics and control of manipulators.
3.	To introduce dynamics and control of manipulators.
4.	To impart knowledge on the direct and inverse kinematics.
5.	To introduce the manipulator differential motion and control.

Module–1: Basic Concepts	**No. of Hours**
Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and controlissues- Various manipulators – Sensors - work cell - Programming languages.	3
Module–2: The Mechanics and Control of Mechanical Manipulators	**No. of Hours**
Description of position and orientation, Inverse kinematics of manipulators, Velocities, static forces, singularities.	3
Module–3: Dynamics	**No. of Hours**
Trajectory generation, Manipulator design and sensors, Linear position control, Nonlinear position control, Force control, Programming robots robot programming languages, Off-line programming and simulation.	3
Module–4: Direct and Inverse Kinematics	**No. of Hours**
Mathematical representation of Robots - Position and orientation – Homogeneous transformation- Various joints- Representation using the DenavitHattenberg parameters -Degrees of freedom-Direct kinematics-Inverse kinematics.	3
Module–5: Manipulator differential motion and statics	**No. of Hours**
Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and armsingularity - Static analysis - Force and moment Balance.	3

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand basic concept of robotics.
CO2	Know about the mechanics and control in robotics.
CO3	Know about the dynamics and control in robotics.
CO4	Know about the direct and inverse kinematics involved in Robotics.
CO5	Know about the differential motion add statics in robotics.

Text Books	
1.	JohnJ. Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
2.	T.C Manjunath, Fundamental of robotics, Fourth edition, Nandu printers and publishers Private LTD, 2006.

Reference Text Books	
1.	R.K. Mittal and I.J. Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
2.	M.P. Groover, M. Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

ASSESSMENT DETAILS (BOTH CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE FOR THE THEORY:

1. Three tests each of 50 marks (Multiple Choice Questions), after the completion of the syllabus 40%, 70% and 100% respectively.
2. Average of best two internal assessment tests each of 50 marks, scale down to 30 marks.
3. Any two assessment methods as per regulations i.e. Two assignments / Two Quizzes/ Weekly test / project work for 40 marks, scaled down to 20 marks.
4. Total marks scored (30+20 = 50 marks).
5. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50).

SEMESTER END EXAMINATION (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	3	-	-	-	2	1
CO2	2	2	-	-	-	2	-	-	-	2	1
CO3	2	3	-	-	-	2	-	-	-	2	1
CO4	3	2	-	-	-	3	-	-	-	2	1
CO5	3	2	-	-	-	3	-	-	-	2	1

Level3-High, Level2-Moderate, Level1-Low

SEMESTER-IV					
ARDUINO AND RASPBERRY Pi LAB **Category: AEC/SEC-IV** **(Common to ECE, EEE, RA)**					
Course Code	:	B24EE484	CIE	:	50 Marks
Teaching Hours L : T : P	:	0 : 0 : 2	SEE	:	50 Marks
Total Hours	:	15(P)	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Objectives	
1.	To understand interfacing of basic I/O devices (LEDs, buzzers, buttons) with Arduino/Raspberry Pi
2.	To understand sensor interfacing (temperature, humidity, current, distance, analog sensors) and data acquisition
3.	To understand actuator control using relays, motors, and real-time clock integration
4.	To apply the cocept of wireless communication and IoT connectivity using Bluetooth and cloud platforms
5.	To comprehend skills for measuring, monitoring, and transmitting energy-related parameters for smart applications

Sl. No	**List of Experiments**
1.	i) To interface LED/Buzzer with Arduino and write a program to ‘turn ON’ LED for 1 sec after every 2 seconds. ii) ii) To interface Push button/Digital sensor (IR/LDR) with Arduino and write a program to ‘turn ON’ LED when push button is pressed or at sensor detection.
2.	i) To interface DHT11 sensor with Arduino and write a program to print temperature and humidity readings. ii) ii) To interface OLED with Arduino and write a program to print temperature and humidity readings on it.
3.	To interface motor using relay with Arduino and write a program to ‘turn ON’ motor when push button is pressed.
4.	To interface Bluetooth with Arduino and write a program to send sensor data to Smartphone using Bluetooth.
5.	To interface Bluetooth with Arduino and write a program to turn LED ON/OFF when '1'/'0' is received from Smartphone using Bluetooth.
6.	Write a program to interface an analog sensor (e.g., potentiometer or temperature sensor) with Arduino and display the analog values on the Serial Monitor.
7.	To interface a Real-Time Clock (DS3231/DS1307) module with Arduino and write a program to display the current date and time on the Serial Monitor.
8.	Write a program to measure an analog voltage (0–5V) using Arduino and display the measured voltage on the Serial Monitor.
9.	Interface a current sensor (e.g., ACS712) with Arduino and write a program to measure and display the current flowing through a load on the Serial Monitor.
10.	To interface a DC motor through a relay module with Arduino/ Raspberry Pi and write a Python program to turn ON the motor when a push button is pressed.
11.	Interface an ultrasonic sensor (HC-SR04) with Arduino/ Raspberry Pi and write a program to measure and display the distance in centimeters on the Serial Monitor.

12.	Write a python program on Raspberry Pi to upload temperature and humidity data to thing speak cloud.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the interfacing and control of digital devices such as LEDs and buzzers using Arduino.
CO2	Understand sensor interface to acquire and display data from temperature, humidity, distance, voltage, and current sensors.
CO3	Design motor and relay-based actuation systems using sensor input for automation and control.
CO4	Analyze communication techniques for exchanging data with smartphones and cloud servers using Bluetooth and IoT.
CO4	Understand and evaluate methods for measuring and transmitting sensor parameters using Raspberry Pi.
CO5	Understand the interfacing and control of digital devices such as LEDs and buzzers using Arduino.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

Component	Scale down to	Total Marks
Conduction of experiments and Record Writing (Each Experiment evaluated for 10 marks)	20	20
Internal Lab Test 1(After 6 experiments) Exam conduction for 50 marks	15	15
Internal Lab Test 2 (After 6 experiments) Exam conduction for 50 marks	15	15
	CIE	**50**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Students can pick one question (experiment) from the questions lot prepared by the examiners.
4. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
5. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
6. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	2	-	-	-	-	-	2
CO2	3	2	-	2	3	-	-	-	-	-	2
CO3	3	3	3	2	3	-	-	-	1	1	2
CO4	3	3	2	2	3	1	-	-	2	2	2
CO5	3	3	2	2	3	2	2	1	2	2	3

Level 3 - High, Level 2 - Moderate, Level 1 - Low