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

III & IV Semester Scheme and Syllabus

(2025 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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MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

DEPARTMENT OF ROBOTICS AND AUTOMATION

Scheme of Teaching and Examinations – 2025 Scheme

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

III Semester **Academic Year: 2026-27**

S.No	Course Category and Course Code		Course Title	TD	Teaching Hours / Semester				Examination				Credits
					Lecture	Tutorial	Practical	TW + SL	CIE Marks	SEE Marks	Total marks	SEE Duration in hours	
					L	T	P	S					
1.	ASC	B25MCR301	Probability, Statistics and Complex variables	Maths	**42**	**28**	**0**	**50**	**50**	**50**	**100**	**3**	**4**
2.	PCC	B25RA302	Solid and Fluid Mechanics	RA	**42**	**0**	**0**	**48**	**50**	**50**	**100**	**3**	**3**
3.	IPCC	B25RA303	Analog and Digital Electronics	RA	**42**	**0**	**28**	**50**	**50**	**50**	**100**	**3**	**4**
4.	PCC	B25RA304	Robotic Materials and Fabrication	RA	**42**	**0**	**0**	**48**	**50**	**50**	**100**	**3**	**3**
5.	PCC	B25RA305	Robot Mechanics and Control	RA	**42**	**0**	**0**	**48**	**50**	**50**	**100**	**3**	**3**
6.	PCCL	B25RAL306	Modeling and Design Lab	RA	**0**	**0**	**28**	**2**	**50**	**50**	**100**	**3**	**1**
7.	AEC	B25RAL307	Applications of MATLAB	RA	**0**	**0**	**28**	**2**	**50**	**50**	**100**	**3**	**1**
8.	SDC	B25RAP309	Community/Societal Project	RA	**0**	**0**	**0**	**30**	**100**	**-**	**100**	**3**	**1**
9.	NCMC	B25MAD308	Additional Mathematics – I	Maths	**40**	**0**	**0**	**0**	**50**	**50**	**100**		**pp**
10.	NCMC	B25NSK310A/ B/C/D/E	National Service Scheme /National Cadet Corps / Physical Education Yoga /Music	HSS	**0**	**0**	**0**	**28**	**100**	**-**	**100**		**PP**
11	SEC	B25SKL311	Skill Laboratory	Concerned Dept.	**0**	**0**	**30**	**0**	**100**	**-**	**100**	**-**	**1**
								TOTAL	**700**	**400**	**1100**		**21**

ASC: Applied Science Courses, BSC: Basic Science Course, HSMC: Humanities Studies and Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, SDC: Skill Development Course, L: Lecture, T: Tutorial, P: Practical, S: Self-Learning, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation, PP/NP: Pass/Not Pass, XX: Programme Code (EC, CS, IS etc.,), Y: A/B/C/D, K: Indicates Common Course to all the streams of Engineering

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DEPARTMENT OF ROBOTICS AND AUTOMATION

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NSS / NCC / PE / Yoga / Music: All students are required to register for any one of the following courses; National Service Scheme/National Cadet Corps/Physical Education /Yoga/ Music - with the respective course coordinator during the first week of the third semester.

Colleges shall submit Continuous Internal Evaluation (CIE) marks for each semester based on the activities completed by students under the selected course. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga. Activities shall be conducted over two semesters (III&IV), and successful completion of the registered course/or courses along with the required CIE score is mandatory for the award of the degree. Institutions must ensure that events are appropriately scheduled and reflected in the semester-wise calendar for NSS, PE, Music, and Yoga activities.

These courses shall not be considered for the calculation of SGPA or CGPA and for vertical progression. However, completion of course(s) is compulsory for degree eligibility.

The courseB25XX307Y – Ability Enhancement Course Laboratory can be offered either as a single compulsory course. Alternatively, the course B25XX307Y - Ability Enhancement Course Laboratory shall be offered as multiple elective options under the course codesB25XX307Y (where Y =A/B/C/D)

HOD **Dean-Academics** **Principal**

MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Scheme of Teaching and Examinations – 2025 Scheme

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

IV Semester **Academic Year: 2026-27**

S. No	Course Category and Course Code		Course Title	TD	Teaching Hours / Semester				Examination				Credits
					Lecture	Tutorial	Practical	TW + SL	CIE Marks	SEE Marks	Total marks	SEE Duration in hours	
					L	T	P	S					
1.	PCC	B25RA401	Theory of Applied Robotics	RA	**42**	**28**	**0**	**50**	**50**	**50**	**100**	**3**	**4**
2.	PCC	B25RA402	Sensors and Transducers	RA	**42**	**28**	**0**	**50**	**50**	**50**	**100**	**3**	**4**
3.	IPCC	B25EE403	Microcontrollers(Common to EEE & RA)	RA	**42**	**0**	**28**	**50**	**50**	**50**	**100**	**3**	**4**
4.	PCC	B25RA404	Artificial Intelligence for Automation	AIML	**42**	**28**	**0**	**48**	**50**	**50**	**100**	**3**	**3**
5.	BSC	B25BEK405	Biology for Engineers	RA	**28**	**0**	**0**	**2**	**50**	**50**	**100**	**2**	**2**
6.	PCCL	B25RAL406	Robot Programming and Simulation lab	RA	**0**	**0**	**28**	**2**	**50**	**50**	**100**	**3**	**1**
7.	AEC	B25EEL407	Arduino and Raspberry Pi Lab	RA	**0**	**0**	**28**	**2**	**50**	**50**	**100**	**3**	**1**
8.	SDC	B25RAP409	Environmental Project	RA	**0**	**0**	**0**	**30**	**50**	**50**	**100**	**3**	**1**
9.	NCMC	B25MAD408	Additional Mathematics – II	Maths	**42**	**0**	**0**	**0**	**50**	**50**	**100**		**PP**
10.	NCMC	B25NSK410A/ B/C/D/E	National Service Scheme /National Cadet Corps / Physical Education Yoga /Music	HSS	**0**	**0**	**0**	**28**	**100**	**-**	**100**		**PP**
11.	SEC	B25SKL411	Skill Laboratory	Concerned Dept.	**0**	**0**	**30**	**0**	**100**	**-**	**100**	**-**	**1**
								TOTAL	**700**	**400**	**1100**		**21**

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Environmental Science Project: The Environmental Science Project is an applied learning component designed to develop students' awareness, understanding, and responsibility toward the environment. It provides an opportunity to study real-world environmental issues and apply scientific and engineering principles to design feasible and sustainable solutions.

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

Semester- III					
Probability, Statistics and Complex Variables **Category: ASC** **(Common to RA & CV)**					
Course Code	:	**B25MCR301**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:28:0:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To explain the basic concepts of probability, random variables, probability distribution
2.	To 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.	To ability to formulate a variational problem for a given geometric setting.

Module-1	**No.of hrs**
Probability Distribution: Review of basic probability theory. Random variables (discrete and continuous), Probability Mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson, Exponential and Normal distributions- problems (Derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative Examples.	10
Module-2	**No.of hrs**
Curve Fitting &Statistical Methods: 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.	10
Module-3	**No.of hrs**
Complex Variable –I: Review of afunction of a Complex variable, Limits, Continuity and Differentiability. Analytic function and It's properties, Cauchy-Riemann equations in Cartesian and Polar forms, Milne-Thomson method. **Transformations:** Conformal Transformations, Discussion of Transformations: $w = z^2$, $w = e^z$ and $w = z + (1/z)(z \neq 0)$.Bilinear transformations- problems.	10
Module-4	**No.of hrs**
Complex Variable –II: Complex Line Integral and It's properties, Cauchy's theorem, Consequences of Cauchy's theorem, Cauchy'sintegral formula, Generalized Cauchy's Integral formula, Laurent's series , Singularity and Residue, formulae for the Residue at the pole, Cauchy's Residue theorem (without proof) and problems.	10
Module-5	**No.of hrs**
Calculus Of Variations: Introduction to variation of functionals, Extremal of functional, Euler equation– Special cases, problems. Geodesics, Hanging cable and Brachistochroneproblems.	10

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply probability concepts and distributions to engineering problems.
CO2	Analyze statistical data using correlation and regression methods.
CO3	Apply the fundamental concepts of multivariate statistics, complex analysis, partial differential equations and variational problems
CO4	Apply the concept of complex variables and their applications in signal transformation.
CO5	Apply 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. 4. C. Ray Wylie, Louis C. Barrett : "Advanced Engineering Mathematics", 6th Edition, 2. McGraw
2.	C. Ray Wylie, Louis C. Barrett : "Advanced Engineering Mathematics", 6" Edition, 2. McGraw
3.	B.V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 208.

Web links and Video lectures (e-Resources)
• https://nptel.ac.in/courses/12286025
• VTUEDUSATPROGRAMME –20
• http://www.class-central.com/subject/math(MOOCs)

ASSESSMENT STRUCTURE:
The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

Component	**Type of Assessment**	**Max. Marks**	**Max. Marks Scaling Down to**	**Total Marks**
Theory	**Internal Assessment1**	**50**	**40 (Average of Best two Assessments)**	**50**
	Internal Assessment2	**50**		
	Internal Assessment3	**50**		
Self Learning	**Any Two Assessments as per regulations**	**10+10**	**10**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Grand Total				**100**

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

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

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

Semester - III					
Solid and Fluid Mechanics **Category: PCC**					
Course Code	:	**B25RA302**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To gain knowledge of linear elastic properties and stress train relations.
2.	To derive and solve problems on Principal stresses developed in structures and shafts
3.	To gain the knowledge of basic properties of fluids.
4.	To gain the knowledge of types of fluid flows.
5.	To apply conservation of mass, momentum and energy equation and to determine the discharge of fluid flow.

Module-1	**No. of Hours**
Simple Stress and Strain: 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	**No. of Hours**
Compound Stresses &Torsion of Circular Shafts: Introduction, Concept of Plane stress, Stress tensor for plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Torsion of Circular Shafts: Introduction, Torsion equation –assumptions and derivation, Tensional rigidity / Stiffness of shafts. Power transmitted by solid and hollow circular shafts, Simple numerical problems. Demo: Torsion Test using Tensional Testing Machine.	9
Module-3	**No. of Hours**
Properties of Fluids and Fluid Statics: Properties of Fluids: Introduction, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapor pressure and cavitations. 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.	9
Module–4	**No. of Hours**
Fluid Statics and Fluid Kinematics: Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid. Fluid Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Coordinates only), velocity and acceleration.	9
Module–5: Fluid Dynamics	**No. of Hours**
Fluid Dynamics: Introduction equation of motion, Euler's equation of motion, and Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation. Applications of Bernoulli's equation: Venturimeter and pitot tube	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 concepts of fluid statics, kinematics and dynamics while addressing problems in engineering and to determine the fluid flow through open and closed channel.
CO4	Analyze different types of fluid flow.
CO5	Gain the knowledge of applications of Bernoulli's equation.

Text Books	
1.	A Text Book of Fluid Mechanics Dr. R. K BansalLaxmiPublishers
2.	Mechanics of Materials by JBKDas& Dr. PL SrinivasaMurthy.
3.	Strength of Materials by R K Rajput, S. Chandand Company Pvt, 2014.
4.	Strength of Materials",S.S.Rattan,TataMcGrawHill,2009.

Reference Text 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, TataMcGrawHill3rdEdition, 2014.

ASSESSMENT STRUCTURE:
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CONTINUOUS INTERNAL EVALUATION (CIE):

Component	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment1**	**50**	**40 (Average of Best two Assessments)**	**50**
	Internal Assessment2	**50**		
	Internal Assessment3	**50**		
Self Learning	**Any Two Assessments as per regulations**	**10+10**	**10**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Grand Total				**100**

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping

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

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

Semester-III					
Analog and Digital Electronics **Category: IPCC**					
Course Code	:	**B25RA303**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:28:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3Hrs

Course Learning Objective is	
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
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, Incompletely specific functions (Don't care terms) Simplifying Max term equations,	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

LABORATORY

Practical Component of IPCC

Sl. No	**List of experiments**
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

Course Outcomes: At the end of the course, the students will be able to	
CO1	Analyze 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.

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 Text 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 STRUCTURE:
The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

Component	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment1**	**50**	**40 (Average of Best two Assessments)**	**50/2 = 25**
	Internal Assessment2	**50**		
	Internal Assessment3	**50**		
Self Learning	**Any two assessments as per regulations**	**10+10**	**10**	
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks*12 expts.**	**10**	**25**
	Lab Internal Test	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Grand Total				**100**

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.
4. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

CO-PO Mapping:

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

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

Semester-III					
Robotic Materials & Fabrication **Category: PCC**					
Course Code	:	**B25RA304**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To introduce students to different methods of fabrication used in the manufacturing of robotic components.
2.	To develop an understanding of the materials used in robotic component fabrication and their properties.
3.	To familiarize students with traditional manufacturing processes commonly employed in the robotics industry.
4.	To provide an overview of additive manufacturing techniques and their applications in robotics.
5.	To 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 languages (G-code and M-code), Programming techniques and syntax for CNC machining operations. **CNC Machining Operations:** Detailed study of CNC machining processes such as turning, milling, and drilling, machining strategies and tool selection for specific operations, troubleshooting common	9

issues in CNC machining. **CNC Machining of Robotic Components:** Programming and machining of simple 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.

Text Books	
1.	SeropeKalpakjian Illinois Institute of Technology Steven R. Schmid The University of Notre Dame SI Conversion by Hamldon Musa UniversitiTeknologi 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, 3rd Edison, Pearson Educational International, 2020.
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)
Robotics Online (https://www.robotics.org/) Description: This website provides comprehensive resources related to robotics, including articles, industry news, and information on fabrication methods.
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 STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

Component	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment1**	**50**	**40 (Average of Best two Assessments)**	**50**
	Internal Assessment2	**50**		
	Internal Assessment3	**50**		
Self Learning	**Any Two Assessments as per regulations**	**10+10**	**10**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Grand Total				**100**

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

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					
Robot Mechanics and Control **Category: PCC**					
Course Code	:	**B25RA305**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understand and discuss the fundamental elementary concepts of Robotics.
2.	To provide insight into different types of robots.
3.	To explain intelligent module for robotic motion control.
4.	To educate on various path planning techniques.
5.	To illustrate the working of an innovative robotic device

Module– 1	**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	**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	**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	**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	**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).

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)

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

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

Component	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment1**	**50**	**40 (Average of Best two Assessments)**	**50**
	Internal Assessment2	**50**		
	Internal Assessment3	**50**		
Self Learning	**Any Two Assessments as per regulations**	**10+10**	**10**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Grand Total				**100**

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

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

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

Semester- III					
Modeling and Design Lab **Category: PCCL**					
Course Code	:	**B25RAL306**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0 : 0 : 28 : 2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
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	**No.of Hrs**
Geometrical Dimensioning Thread Forms and Fasteners and Tolerances (GD&T) (only for CIE): 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. **Thread Forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External) **Fasteners:** Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly)	02
Module – 2	**No.of Hrs**
Part Modeling- converting in to orthogrphic projections: Conversion of pictorial views into orthorapghic projections of simple machine parts (with and without section). Hidden line conventions. Precedence of lines.	04
Module – 3	**No.of Hrs**
Assembly of Joints, couplings (using 3D environment): (Part drawings shall be given) **Joints:** Like Cotter joint (socket and spigot), knuckle joint (pin joint). **Couplings:** Like flanged coupling (protected), universal coupling	06
Module – 4	**No.of Hrs**
Assembly of Machine Components (using 3D environment): (Part drawings shall be given) 1. Lifting devices (screw jack) 2. Bearings (Plummer block) 3. I.C. Engine components (piston) 4. I.C. Engine components (connecting rod) 5. Machine tool components (machine vice)	18

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 DBhatt,“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 maximum of 30 Marks and submission of print out maximum of 20 Marks 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)

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

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

Semester-III					
Applications of MATLAB **Category: AEC**					
Course Code	:	**B25RAL307**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0:0:28:2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
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	**Name of the Programs / List of the experiments**
1.	Introduction to MATLAB through matrices, and general Syntax
2.	Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB
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 STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct one experiment each from both Part A and Part B.
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- In SEE component, Part A must be evaluating as 40% and Part B will be evaluating as 60%.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

Component	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluate each expt. for 10 marks*12 expts.**	**15**	**50**
	Laboratory Test 1: After 6 expts.	**50**	**15**	
	Laboratory Test 2: After 12 expts.	**50**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Grand Total				**100**

Semester - IV					
Theory of Applied Robotics **Category: PCC**					
Course Code	:	**B25RA401**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:28:0:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Learning Objective is	
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 of free 1-DOF mechanical systems.

Module - 1	**No. of Hrs**
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, Grubler's criterion. **Mechanisms:** Quick return motion mechanisms. Whitworth mechanism and Crank and slotted lever Mechanism and Peaucellier's mechanism. **Intermittent Motion mechanisms:** Geneva wheel mechanism, Ratchet and Pawl mechanism, toggle mechanism, Ackerman steering gear mechanism.	14
Module - 2	**No. of Hrs**
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.	14
Module - 3	**No. of Hrs**
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 problems. **Gyroscope:** Gyroscopic couple, Effect of gyroscopic couple on plane disc, Aeroplane, Ship (Without numerical problems).	14
Module– 4	**No. of Hrs**
Cams: Types of cams, types of followers. Displacement, velocity and acceleration curves for uniform velocity, Simple Harmonic Motion, Uniform Acceleration and Retardation. **Cam profiles:** disc cam with reciprocating / oscillating follower having knife-edge, roller and follower inline and offset (Without derivations).	14
Module– 5	**No. of Hrs**
Governors: Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power (no Numerical problem) **Mechanical Vibrations:** Basic elements of vibrating system, Types of free vibrations, Longitudinal vibrations- Equilibrium method. Damped free vibrations: Under damped, over damped and critically damped systems. Logarithmic decrement. Simple Problems.	14

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 free, damped free vibration phenomenon.

Text Books	
1.	Theory of Machines Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, Ed 2009.
2.	Theory of Machines Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Ed 2006.
3.	Mechanism and Machine Theory G. Ambekar PHI 2009.
4.	Mechanical Vibrations by J B K Das and Dr. P L Srinivasamurthy.

Reference Books	
1.	Theory of Machines. Thomas Bevan. CBS Publication 1984.
2.	Design of Machinery Robert L. Norton, McGraw Hill 2001.
3.	Mechanisms and Machines- Kinematics, Dynamics and Synthesis Michael M Stanisicengage Learning 2016.

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

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Grand Total				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping

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

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

Semester-IV					
Sensors and Transducers **Category: PCC**					
Course Code	:	**B25RA402**	CIE	:	50 Marks
Teaching Hours L : T : P:S	:	42:28:0:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3Hrs

Course Learning Objective is	
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 between transducer 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.	14
Module– 2	**No. of Hours**
Static characteristics: accuracy, precision, resolution, sensitivity, linearity, span and range – Dynamic Characteristics, Mathematical model of transducer: zero, first and second, Response to impulse, step, ramp and sinusoidal inputs, Selection criteria of sensor.	14
Module– 3	**No. of Hours**
Electrical actuation system: Electrical systems, Mechanical switches, solenoids, Relays, DC/AC motors, Stepper motors & Servo Motors. **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.	14
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.	14
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.	14

Course Outcomes: At the end of the course, the students will be able to	
CO1	Comprehend, classify and analyze the behavior of different types of sensors.
CO2	Analyze the characteristics and performance measures of sensors and select suitable sensor for the given industrial 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)
• **https://onlinecourses.nptel.ac.in/noc19_ee41/preview**

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

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

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

Semester-IV					
Microcontrollers **Category: IPCC** **(Common to EEE & R&A)**					
Course Code	:	**B25EE403**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:28:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To learn the basic structure, memory, registers, flags, I/O ports, and interfacing features of the 8051 microcontrollers.
2.	To gain skills in writing and running 8051 assembly programs using arithmetic, logic, and control instructions.
3.	To learn how to program the 8051 in C for data handling, I/O control, and timer applications.
4.	To understand serial communication, interrupts, and how to connect 8051 with devices like motors.
5.	To get an overview of ARM processor architecture, types, and its role in embedded systems

Module– 1	**No. of Hours**
Introduction to Digital Fundamentals: Number Systems, Boolean Algebra, Logic Gates, Encoders, Decoders, Multiplexers, and Flip-Flops. **8051 Microcontroller Basics**: Microcontrollers and Embedded Processors, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pin diagram of 8051, Interfacing with External ROM And RAM. 8051 Addressing Modes.	9
Module– 2	**No. of Hours**
8051 Assembly Programming, Addressing Modes and Memory Interfacing: Introduction to 8051 assembly programming, assembling and running an 8051 program, data types and assembler directives, arithmetic and logic instructions, jump, loop and call instructions, I/O port programming, addressing modes of 8051, and interfacing with external ROM and RAM.	9
Module– 3	**No. of Hours**
8051 Programming in C: Data types and time delay in 8051C, IO programming in 8051C, Logic operations in 8051 C, Data conversion program in 8051 C, accessing code ROM space in 8051C, Data serialization using 8051C **8051 Timer Programming in C:** Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051 C.	8
Module– 4	**No. of Hours**
8051 Serial Port Programming in Assembly and C: Basics of serial communication, 8051 connections to RS232, 8051 serial port programming in assembly, serial port programming in 8051 C. **8051 Interrupt Programming in Assembly and C:** 8051 interrupts, Programming timer, external hardware, serial communication interrupt, Interrupt priority in 8051/52, Interrupt programming in C. **Interfacing 8051**: Interfacing of 8051 to DC motor and Stepper motor	8
Module– 5	**No. of Hours**
ARM Processor Fundamentals: Introduction to ARM - ARM Architecture - Operation and control – ARM Processor and Microcontroller Families - List and comparison of ARM cores and ARM cortex – Embedded system hardware and software.	8

LABORATORY

Sl. No	List of experiments
1.	ALP to do Arithmetic Operations: addition ,subtraction, multiplication and division
2.	ALP to find the sum of first 10 integer numbers.
3.	ALP to find the largest number
4.	ALP to arrange the numbers in ascending and descending order
5.	ALP to exchange data
6.	ALP to complement a data byte
7.	ALP to perform hexa decimal up counter and down counter
8.	ALP to perform BCD up counter and down counter
9.	Program to generate delay
10.	Stepper motor interface.
11.	DC motor interface
12.	Study of ARM evaluation system

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the architecture, internal memory structure, special function registers, and addressing modes of the 8051 microcontroller to support embedded system development.
CO2	Develop and simulate assembly language programs for the 8051 microcontroller using arithmetic, logic, jump, loop, call, and I/O instructions.
CO3	Write and execute C programs for the 8051 microcontroller to perform data processing, delay generation, I/O control, data conversion, and code memory access
CO4	Implement serial communication, interrupt handling, and peripheral interfacing such as DC and stepper motors using both assembly and C programming for the 8051.
CO5	Explain the fundamentals of ARM processors, including architecture, core families, and the role of hardware and software in embedded systems.

Text Books	
1.	The 8051 Microcontroller and Embedded Systems Using Assembly and C, Muhammad Ali Mazadi, Pearson, 2nd Edition, 2008.
2.	Microprocessor and Interfacing – Programming and Hardware, Hall D. V., Tata McGraw-Hill Publishing Company Limited, 3rd Edition, 2008.
3.	ARM Architecture Reference Manual, Edited by David Seal, Addison-Wesley, 2nd Edition, 2001. The definitive reference for the ARM architecture definition.

Reference Text Books	
1.	Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, 8051 Microcontroller and Embedded Systems using Assembly and C Programming.
2.	Kenneth Ayala, The 8051 Microcontroller, Cengage Learning, 3rd Edition, 2005.
3.	William Hohl, ARM Assembly Language: Fundamentals and Techniques, CRC Press.

Web links and Video lectures (e-Resources)
• https://archive.nptel.ac.in/courses/106/105/106105193/

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment1	50	40 (Average of Best two Assessments)	50/2 = 25
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any One Assessment as per Regulations	10+10	10	
Laboratory	Lab Conduction & Record	Evaluating each expt. for 10 marks	10	25
	Lab Internal Test	50	15	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.
4. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.
5. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
6. 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	3	2	2	2	-	-	-	-	-	-
CO3	3	3	2	2	3	-	-	-	-	-	-
CO4	3	3	3	2	3	-	-	-	-	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-

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

Semester-V					
Artificial Intelligence for Automation **Category: PCC**					
Course Code	:	**B25RA404**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understand the fundamentals of Artificial Intelligence and its role in automation systems.
2.	To apply search strategies and knowledge representation techniques for intelligent decision-making.
3.	To understand machine learning concepts for automation, robotics and industrial applications.
4.	To analyze AI-based perception techniques using sensors, vision and data-driven methods.
5.	To apply AI techniques for planning, control, fault diagnosis and smart automation systems.

Module– 1	**No. of Hours**
Introduction to Artificial Intelligence and Automation: Introduction to Artificial Intelligence, need and importance of AI in automation, robotics and smart manufacturing. Characteristics of intelligent agents, structure of agents, rational agents, task environment and PEAS representation. Types of agents: simple reflex agents, model-based agents, goal-based agents, utility-based agents and learning agents. Applications of AI in industrial automation, robotic systems, autonomous vehicles, smart factories, process automation and Industry 4.0. Introduction to AI-based decision-making in automated systems.	9
Module– 2	**No. of Hours**
Problem Solving and Search Techniques: Problem formulation, state space representation and production systems. Uninformed search techniques: breadth-first search, depth-first search, depth-limited search and uniform-cost search. Informed search techniques: greedy best-first search and A* search algorithm. Heuristic functions and their importance in automation problems. Local search methods: hill climbing and simulated annealing. Applications of search techniques in robot path planning, automated material handling, scheduling and navigation.	9
Module– 3	**No. of Hours**
Knowledge Representation and Reasoning: Introduction to knowledge representation and reasoning. Propositional logic and predicate logic, facts, rules and inference. Semantic networks, frames and rule-based systems. Forward chaining and backward chaining. Expert systems: architecture, knowledge base, inference engine and explanation facility. Fuzzy logic concepts: fuzzy sets, membership functions, fuzzy rules and fuzzy inference system. Applications of knowledge-based and fuzzy systems in process control, robotic decision-making, fault diagnosis and automation.	8
Module– 4	**No. of Hours**
Machine Learning for Automation: Introduction to machine learning and its relevance to automation. Types of learning: supervised, unsupervised and reinforcement learning. Classification algorithms: decision tree, k-nearest neighbour, support vector machine and random forest. Regression techniques for prediction and control. Clustering techniques: k-means clustering and anomaly detection. Model training, testing, accuracy, confusion matrix and performance evaluation. Applications of machine learning in predictive maintenance, quality inspection, process optimization, robotic control and intelligent automation.	8
Module– 5	**No. of Hours**
AI-based perception in automation: Sensor data processing and intelligent interpretation of temperature, pressure, vibration, proximity and vision sensor data. Basics of computer vision for automation: image acquisition, preprocessing, object detection and visual inspection. Introduction to reinforcement learning for robotic control. AI-based planning and task scheduling for automated systems. Applications of AI in robotic pick-and-place, automated inspection, warehouse automation, autonomous mobile robots, smart manufacturing, digital twins and industrial fault diagnosis. Ethical and safety considerations in AI-enabled automation.	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the fundamentals of Artificial Intelligence and intelligent agents for automation systems.
CO2	Apply search algorithms for problem solving, path planning and decision-making in automation.
CO3	Use knowledge representation, reasoning and fuzzy logic techniques for intelligent control applications.
CO4	Apply machine learning algorithms for classification, prediction and anomaly detection in automation systems.
CO5	Analyze AI-based perception, planning and industrial automation applications.

Text Books	
1.	Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2021/2022.
2.	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow, 3rd Edition, O'Reilly Media, 2022.

Reference Text Books	
1.	Anuradha Srinivasa raghavan, Vincy Joseph "Machine Learning", Wiley, 2019
2.	Rajiv Chopra, "Deep Learning", 1st edition, Khanna Publishing House,2018.

Web links and Video lectures (e-Resources)
• YouTube: Automation Systems Overview by Siemens • YouTube: Python AI Programming by NPTEL

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment1**	**50**	**40 (Average of Best two Assessments)**	**50**
	Internal Assessment2	**50**		
	Internal Assessment3	**50**		
AAT	**Any Two Assessments as per regulations**	**20**	**10**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

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

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

Semester- IV					
Robot Programming and Simulation Lab **Category: PCCL**					
Course Code	:	**B25RAL406**	CIE	:	50 Marks
Teaching Hours L : T : P: S	:	0:0:28:2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To introduce different types of robotics and demonstrate them to identify different parts and components.
2.	To write Robot programming for simple operations.
3.	To demonstrate simulation for different 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).
9.	Robot programming and simulation for writing practice.
10.	Robot programming and simulation for multi process.
11.	Robot programming and simulation for 3D printing.

Course Outcomes: At the end of the course, the students will be able to	
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.
CO3	Use of robot simulation Software to calculate the Payload and Reach (Max. and Min.) for different robots.

ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct Two experiments
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

Component	**Type of Assessment**	**Max. Marks**	**Max. Marks Scaling Down to**	**Total Marks**
Laboratory	**Lab Conduction & Record**	**Evaluate each expt. for 10 marks**	**15**	**50**
	Laboratory Test 1	**50**	**15**	
	Laboratory Test 2	**50**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

CO-PO Mapping

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

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

Semester-IV					
Arduino and Raspberry Pi Lab **Category: AEC** **(Common to EEE & R&A)**					
Course Code	:	**B25EEL407**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0:0:28:2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3Hrs

Course Learning Objective is	
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

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) 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) 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.

ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct Two experiments
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	Lab Conduction & Record	Evaluate each expt. for 10 marks.	15	50
	Laboratory Test 1	50	15	
	Laboratory Test 2	50	20	
SEE	Semester End Examination	100	50	50
Grand Total				100

CO-PO Mapping

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

Level3 –High, Level2–Moderate, Level1 -Low