MANAKULA VINAYAGAR
INSTITUTE OF TECHNOLOGY
An Autonomous Institution
Affiliated to Pondicherry University, Approved by AICTE, New Delhi,
Accredited by NBA, New Delhi and NAAC with 'A' Grade
Kalitheerthalkuppam, Puducherry- 605 107.

DEPARTMENT OF ROBOTICS AND AUTOMATION

CURRICULUM AND SYLLABUS

(Regulations -2025)

B.Tech. - ROBOTICS AND AUTOMATION

B.Tech - ROBOTICS AND AUTOMATION

CURRICULUM FROM THE ACADEMIC YEAR 2025-26

I - SEMESTER										
Sl.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**TM**
Theory										
1.	25UMAT11	Matrices and Calculus	BS	3	1	0	4	40	60	100
2.	25UPHT12	Physical science for robotic engineers	BS	3	0	0	2	40	60	100
3.	25UMET13	Fundamentals of Mechanical Engineering	ES	2	1	0	3	40	60	100
4.	25URAT14	Electron Devices	ES	3	0	0	3	40	60	100
Integrated course										
5.	25UCSI15	Programming in C	ES	2	0	4	4	50	50	100
6.	25UHSI16	Professional Communication for Engineers	HS	1	0	4	4	50	50	100
Practical										
7.	25UPHP17	Physical science lab	BS	0	0	2	1	60	40	100
8.	25UGEP18	Engineering Graphics	ES	0	0	2	1	60	40	100
9.	25UGEP19	Design Thinking & Idea Lab	ES	0	0	2	1	60	40	100
Employability Enhancement Course										
10.	25UPCE11	Career Development Skills	EEC	2	0	0	0	100	-	100
Mandatory Course										
11.	25UMCC11	IKS –Concepts and applications in Engineering and Science	MCC	1	0	1	0	100	-	100
12.	25UMCC12	Environmental Sciences and Sustainability	MCC	2	0	0	0	100	-	100
			Total Credits				23	740	460	1200

B.Tech - ROBOTICS AND AUTOMATION

CURRICULUM FROM THE ACADEMIC YEAR 2025-26

II - SEMESTER										
Sl.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**TM**
Theory										
1.	25UMAT21	Differential equations and Transforms	BS	3	1	0	4	40	60	100
2.	25UHST22	Universal Human Values II	HS	2	0	0	2	40	60	100
3.	25URAT23	Electrical circuits and machines	ES	3	0	0	3	40	60	100
4.	25URAT24	Sensors and Actuators	PC	3	0	0	3	40	60	100
Integrated course										
5.	25UCSI25	Problem solving using Python	ES	2	0	4	4	50	50	100
Practical										
6.	25URAP26	Electrical and Electronics Lab	ES	0	0	2	1	60	40	100
7.	25URAP27	Sensors and Actuators Lab	PC	0	0	2	1	60	40	100
8.	25UGEP28	Fabrication lab	ES	0	0	2	1	60	40	100
Employability Enhancement Course										
9.	25UPCE21	Commmunication Skills	EEC	0	0	2	0	100	-	100
10.	25UCCCXX	Certification Course I	CCC	0	0	4	0	100	-	100
Mandatory Course										
11.	25UMCC21	IKS in Humanities and Social Science	MCC	1	0	1	0	100	-	100
12.	25UMCC22	Holistic Wellness	MCC	0	0	1	0	100	-	100
			Total Credits				19	790	410	1200

B.Tech - ROBOTICS AND AUTOMATION

CURRICULUM FROM THE ACADEMIC YEAR 2025-26

III - SEMESTER										
Sl.No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	TM
Theory										
1.	25UMAT31	Fourier Series, Probability and Statistics	BS	3	1	0	4	40	60	100
2.	25URAT31	Strength of Materials	ES	2	1	0	3	40	60	100
3.	25URAT32	Fundamentals of Robotics	PC	3	0	0	3	40	60	100
4.	25URAT33	Hydraulics and Pneumatics	PC	3	0	0	3	40	60	100
5.	25URAT34	Signal and Systems	ES	2	1	0	3	40	60	100
Integrated course										
6.	25URAI31	Analog and Digital Electronics	ES	3	0	2	4	50	50	100
Practical										
7.	25URAP31	Hydraulics and Pneumatics Lab	PC	0	0	2	1	60	40	100
8.	25URAP32	Robotics Lab	PC	0	0	2	1	60	40	100
9.	25URAP33	Modeling and Simulation for Robotics Lab	PC	0	0	2	1	60	40	100
Employability Enhancement Course										
10.	25UPCE31	Personality Development Skills	EEC	2	0	0	0	100	-	100
11.	25UCCCXX	Certification Course -II	CCC	0	0	4	0	100	-	100
Mandatory Course										
12.	25UMCC31	Indian Constitution and Human Rights	MCC	2	0	0	0	100	-	100
						Total Credits	23	730	470	1200

B.Tech - ROBOTICS AND AUTOMATION

CURRICULUM FROM THE ACADEMIC YEAR 2025-26

IV - SEMESTER										
Sl.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**TM**
Theory										
1.	25UMAT42	Linear Algebra and Numerical Methods	BS	3	1	0	4	40	60	100
2.	25URAT41	Programmable Logic Controller	PC	3	0	0	3	40	60	100
3.	25URAT42	Kinematics and Dynamics of Machines	PC	2	1	0	3	40	60	100
4.	25UHST43	Organizational Behaviour and Financial Management	HS	3	0	0	3	40	60	100
Integrated course										
5.	25URAI41	Control Systems	PC	3	0	2	4	50	50	100
6.	25URAI42	Power Electronics and Drives	PC	3	0	2	4	50	50	100
Practical										
7.	25URAP41	Kinematics and Dynamics of Machines Lab	PC	0	0	2	1	60	40	100
8.	25URAP42	Programmable Logic Controller Lab	PC	0	0	2	1	60	40	100
Employability Enhancement Course										
9.	25UPCE41	Professionalism and Basic Aptitude	EEC	2	0	0	0	100	-	100
10.	25UCCCXX	Certification Course - III	CCC	0	0	4	0	100	-	100
Mandatory Course										
11.	25UMCC41	Entrepreneurial skills and concepts	MCC	2	0	0	0	100	-	100
			Total Credits				23	680	420	1100

B.Tech - ROBOTICS AND AUTOMATION

CURRICULUM FROM THE ACADEMIC YEAR 2025-26

V - SEMESTER										
Sl.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**TM**
Theory										
1.	25URAT51	Robot Kinematics and Dynamics	PC	3	0	0	3	40	60	100
2.	25URAT52	CNC Machine and Metrology	PC	3	0	0	3	40	60	100
3.	25URAT53	Embedded Systems and Programming	PC	3	0	0	3	40	60	100
4.	25URAT54	Drone Design and Applications	PC	3	0	0	3	40	60	100
5.	25UHSE51	Humanities-I	HS	3	0	0	3	40	60	100
Integrated course										
6.	25URAI51	Robotic Control System	PC	3	0	2	4	50	50	100
Practical										
7.	25URAP51	Embedded Systems and Programming Lab	PC	0	0	2	1	60	40	100
8.	25URAP52	CNC Machine and Metrology Lab	PC	0	0	2	1	60	40	100
Employability Enhancement Course										
9.	25UPCE52	Quantitative and Verbal Aptitude	CCC	0	0	4	0	100	-	100
10.	25UCCCXX	Certification Course - IV	CCC	0	0	4	0	100	-	100
Mandatory Course										
11.	25UMCC51	Professional Ethics	MCC	2	0	0	0	100	-	100
			Total Credits				21	670	430	1100

B.Tech - ROBOTICS AND AUTOMATION

CURRICULUM FROM THE ACADEMIC YEAR 2025-26

VI - SEMESTER										
Sl.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**TM**
Theory										
1.	25URAT61	Internet of Robotic Things (RIoT)	PC	3	0	0	3	40	60	100
2.	25URAT62	Design of Mechanical Transmission Systems	PC	3	1	0	4	40	60	100
3.	25URALXX	Professional Elective-I	PE	3	0	0	3	40	60	100
4.	25URAOXX	Open elective-I	OE	3	0	0	3	40	60	100
Integrated course										
5.	25URAI61	Programming for Robotics	PC	3	0	2	4	50	50	100
Practical										
6.	25URAP61	Automation System Design Lab	PC	0	0	2	1	60	40	100
7.	25URAW61	Mini project	CEC	0	0	2	1	60	40	100
8.	25URAW62	Internship	CEC	0	0	2	1	60	40	100
Employability Enhancement Course										
9.	25UPCE61	Analytical and Reasoning Skills	EEC	2	0	0	0	100	-	100
10.	25UCCCXX	Certification Course - V	CCC	0	0	4	0	100	-	100
Mandatory Course										
11.	25UMCC61	Advanced English Proficiency and Graduate Aptitude Training	MCC	2	0	0	0	100	-	100
						Total Credits	19	690	410	1100

B.Tech - ROBOTICS AND AUTOMATION

CURRICULUM FROM THE ACADEMIC YEAR 2025-26

VII - SEMESTER										
Sl.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**TM**
Theory										
1.	25URALXX	Professional Elective –II	PE	3	0	0	3	40	60	100
2.	25URALXX	Professional Elective –III	PE	3	0	0	3	40	60	100
3.	25URAOXX	Open elective-II	OE	3	0	0	3	40	60	100
4.	25URAOXX	Open elective-III	OE	3	0	0	3	40	60	100
5.	25UHST71	Humanities-II	HS	3	0	0	3	40	60	100
Integrated course										
6.	25URAI75	Artificial Intelligence for Robotics	PC	3	0	2	4	50	50	100
Practical										
7.	25URAW71	Project phase-I	CEC	0	0	6	2	60	40	100
8.	25URAW72	Seminar	CEC	0	0	2	1	60	40	100
Mandatory Course										
9.	25UMCC71	Intellectual Property Rights	MCC	2	0	0	0	100	-	100
			Total Credits				22	470	430	900

B.Tech - ROBOTICS AND AUTOMATION

CURRICULUM FROM THE ACADEMIC YEAR 2025-26

VIII - SEMESTER										
Sl.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**TM**
Theory										
1.	25URALXX	Professional Elective –IV	PE	3	0	0	3	40	60	100
2.	25URAOXX	Open elective-IV	PE	3	0	0	3	40	60	100
Integrated course										
3.	25URAI81	Totally Integrated Automation	PC	3	0	2	4	50	50	100
Practical										
4.	25URAW81	Project phase-II	CEC	0	0	6	8	60	40	100
Mandatory Course										
5.	25UMCC81	Industrial Robotics and Automation Standards	MCC	2	0	0	0	100	-	100
			Total Credits				18	290	210	500

PROFESSIONAL ELECTIVE COURSE										
Sl.No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	TM
Theory										
1.	25URAL01	Robot Trajectory and Path Planning	PE	3	0	0	3	40	60	100
2.	25URAL02	Cognitive Robotics	PE	3	0	0	3	40	60	100
3.	25URAL03	Field and Service Robotics	PE	3	0	0	3	40	60	100
4.	25URAL04	Medical Robotics	PE	3	0	0	3	40	60	100
5.	25URAL05	Humanoid Robotics	PE	3	0	0	3	40	60	100
6.	25URAL06	Automation system design	PE	3	0	0	3	40	60	100
7.	25URAL07	Robot Vision and Control	PE	3	0	0	3	40	60	100
8.	25URAL08	Collaborative Robotics	PE	3	0	0	3	40	60	100
9.	25URAL09	Wireless Sensor Networks for Robotics	PE	3	0	0	3	40	60	100
10.	25URAL10	Autonomous Mobile Robots	PE	3	0	0	3	40	60	100

OPEN ELECTIVE COURSE										
Sl.No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	TM
Theory										
1.	25URAO01	Robot Operating Systems	OE	3	0	0	3	40	60	100
2.	25URAO02	Robotic Process Automation	OE	3	0	0	3	40	60	100
3.	25URAO03	Industrial Robotics and Material handling	OE	3	0	0	3	40	60	100
4.	25URAO04	Fundamentals of Electric Vehicles and Automation	OE	3	0	0	3	40	60	100
5.	25URAO05	Autonomous Robotics and Telecherics	OE	3	0	0	3	40	60	100
6.	25URAO06	Robots and Systems in Smart Manufacturing	OE	3	0	0	3	40	60	100
7.	25URAO07	Micro Robotics	OE	3	0	0	3	40	60	100
8.	25URAO08	Agricultural Robotics and Automation	OE	3	0	0	3	40	60	100
9.	25URAO09	Computer Vision and Deep Learning	OE	3	0	0	3	40	60	100
10.	25URAO10	Virtual Instrumentation	OE	3	0	0	3	40	60	100

B.Tech - Robotics and Automation

HONOUR DEGREE COURSE							
S.No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
Advanced Robotics and Intelligent Control							
1.	25URAH01	Intelligent Control of Robotic Systems	**PC**	3	1	0	4
2.	25URAH02	Automation for Robotics	**PC**	3	1	0	4
3.	25URAH03	Nonlinear Control of Robotic Systems	**PC**	3	1	0	4
4.	25URAH04	Adaptive Control of Robot Manipulators	**PC**	3	1	0	4
5.	25URAH05	Robotics and Automation in the Food Industry	**PC**	3	1	0	4

MINOR DEGREE COURSE							
S.No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
Drone Technology							
1.	25URAM01	Introduction to Drone Technology	**PC**	3	1	0	4
2.	25URAM02	Theory of Drones	**PC**	3	1	0	4
3.	25URAM03	Engineering Materials for Unmanned Aerial Vehicles	**PC**	3	1	0	4
4.	25URAM04	Introduction to UAV Electronics	**PC**	3	1	0	4
5.	25URAM05	Drone Metrology, Assembly and Maintenance	**PC**	3	1	0	4
Robotic Process Automation							
1.	25URAM06	Fundamentals of Robotic Process Automation	**PC**	3	1	0	4
2.	25URAM07	Uipath Development	**PC**	3	1	0	4
3.	25URAM08	Advanced and Cognitive Automation	**PC**	3	1	0	4
4.	25URAM09	RPA Analytics and Process Optimization	**PC**	3	1	0	4
5.	25URAM10	Enterprise and Cloud Aautomation	**PC**	3	1	0	4

SEMESTER – I

25UMAT11	MATRICES AND CALCULUS	Category	L	T	P	Credit
		BSC	3	1	0	4

Course Prerequisite

Higher Secondary Level Mathematics

Course Objective

- To understand and gain the knowledge of matrix algebra, partial differentiation, double integration, triple integration and their application, curl, divergence.
- To familiar with vector differential operators, integral theorems (Green's, Stoke's, Gauss divergence).

Course Outcome

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

CO1	Find eigen values and eigen vectors, verify the Cayley-Hamilton theorem, and perform orthogonal diagonalization.	Apply (K3)
CO2	Compute partial derivatives, determine total derivatives, Jacobians, employ Taylor's series, and find extremes of functions of two variables.	Apply (K3)
CO3	Demonstrate proficiency in evaluating double integration and triple integration and using them to compute area and volume.	Apply (K3)
CO4	Compute gradients, divergence, curl, directional derivatives, and apply vector identities to solve vector field problems.	Apply (K3)
CO5	Apply Green's theorem, Stoke's theorem and Gauss divergence theorem.	Apply (K3)

SYLLABUS

UNIT I MATRICES (12)

Eigen values and Eigen vectors of a real matrix, Characteristic equation, Properties of Eigen values and Eigen vectors-Cayley-Hamilton Theorem, Diagonalization of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation -Nature of quadratic forms.

UNIT II FUNCTIONS OF SEVERAL VARIABLES (12)

Partial derivatives-Total derivative- Differentiation of implicit functions, Change of variables- Jacobians and their properties-Taylor's series for functions of two variables- Maxima and minima, Lagrange's method of undetermined multipliers**.**

UNIT III INTEGRAL CALCULUS (12)

Multiple Integral – Change of order of integration (Cartesian form). Applications: Areas as a double integral (Cartesian form) – Volume as a triple integral (Cartesian form).

UNIT IV VECTOR DIFFERENTIATION (12)

Scalar and vector valued functions-gradient, tangent plane – directional derivative – divergence and curl – scalar and vector potentials. Statement of vector identities – simple problems

UNIT V VECTOR INTEGRATION (12)

Line, surface and volume integrals- statements of Green's, Stoke's and Gauss Divergence theorems – verification and evaluation of vector integrals using them.

TOTAL PERIODS: 60

TEXT BOOKS

1. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal. B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.

REFERENCE BOOKS

1. Bali. N., Goyal. M and Watkins. C, "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain. R.K and Iyengar. S.R.K, "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
3. Narayanan. S and Manicavachagom Pillai. T. K, "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
4. Ramana. B.V, "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
5. Sivaramakrishna Das. P, Vijayakumari. C, "Engineering Mathematics", PearsonEducation India, 4th Edition 019.

Online Courses/NPTEL/SWAYAM:

1. https://nptel.ac.in/courses/111106051 **Topics Covered**: Eigen values, Eigenvectors, Diagonalization, Cayley-Hamilton Theorem, Quadratic forms.
2. https://nptel.ac.in/courses/111104124 **Topics Covered:** Partial Derivatives, Jacobians, Taylor Series, Maxima & Minima, Lagrange Multipliers.
3. https://nptel.ac.in/courses/111104121 **Topics Covered:** Double and Triple Integrals, Change of Order, Applications to Area and Volume.

4. https://nptel.ac.in/courses/111103070 **Topics Covered:** Gradient, Divergence, Curl, Tangent Plane, Vector Identities.
5. https://nptel.ac.in/courses/111107108**Topics Covered:** Line, Surface, Volume Integrals, Green's, Stoke's, Gauss Divergence Theorems.

CO-PO -PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2						1		1
CO2	3	2	2	2						1		1
CO3	3	2	2	2						1		1
CO4	3	2	2	2						1		1
CO5	3	2	2	2						1		1

Assessment Methodology	**Assessment Tools**	**Marks**
Continuous Assessment Test	Written Test / Quiz/ Assignment	25
Problem based Assignment	Moodle / Google form	5
Simulation Based Project assignment (Python/MATLAB/Scilab)	Demo and viva	5
Attendance	Attendance record	5
Total		**40**

25UPHT14	PHYSICAL SCIENCE FOR ROBOTIC ENGINEERS	Category	L	T	P	Credit
		BSC	3	0	0	3

Course Prerequisite

- Higher Secondary Physics (Mechanics, Kinematics, Dynamics and Electromagnetism)
- Basics of Engineering Mathematics (Differentiation, Integration, Vectors)
- Fundamentals of Engineering Mechanics

Course Objective

- To introduce the fundamental principles of mechanics and kinematics applied to robotic motion.
- To apply force, work, energy, and dynamics in the analysis of robotic systems.
- To explore wave phenomena, lasers, and Fiber optics relevant to robotic communication and sensing.
- To apply heat transfer, thermal expansion, and thermal management in robotic components.
- To understand material properties and smart material applications in robotic design.

Course Outcome

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

CO1	Describe the basic principles of mechanics and kinematics relevant to robotic motion	Understand (K2)
CO2	Apply Newton's laws and energy concepts to evaluate forces, stability and dynamics in robotic mechanisms	Apply (K3)
CO3	Explain wave behavior, laser operation, and fiber optic principles for robotic communication and sensing	Understand (K2)
CO4	Apply heat transfer principles to propose thermal management solutions for robotic components.	Apply (K3)
CO5	Identify and classify engineering and smart materials used in robotic structures and components	Remember (K1)

SYLLABUS

UNIT I MECHANICS OF ROBOTIC MOTION (12)

Physical quantities, dimensions and unit systems – Vectors, scalars and coordinate systems – Linear and angular motion – Position, velocity and acceleration analysis – Kinematics of rigid bodies – Motion trajectories in industrial manipulators and mobile platforms – Transformation matrices for robotic motion – Degrees of freedom and workspace analysis.

UNIT II DYNAMICS AND ENERGY IN ROBOTIC SYSTEMS (12)

Newton's laws applied to robotic mechanisms – Force analysis on joints and end-effectors – Friction in robotic grippers and locomotion – Work, power and energy balance – Potential and kinetic energy in linkages – Impulse-momentum principle – Stability in mobile robots – Collision and impact dynamics – Basics of vibration in robotic arms.

UNIT III WAVES, LASERS AND FIBER OPTICS (12)

Oscillatory motion – Forced and damped oscillations – Plane progressive waves – Wave equation – Laser principles: population inversion, Einstein coefficients, optical amplification – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture, acceptance angle – Types of optical fibers – Losses in optical fibers – Fiber optic sensors: pressure and displacement.

UNIT IV THERMAL PHYSICS (12)

Transfer of heat energy – Thermal expansion of solids and liquids – Expansion joints – Bimetallic strips – Thermal conduction, convection and radiation – Heat conduction in solids – Thermal conductivity – Forbe's and Lee's disc method: theory and experiment – Conduction through compound media (series and parallel) – Thermal insulation – Applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT V MATERIAL SCIENCE FOR ROBOTICS (12)

Classification of engineering materials – Properties: strength, toughness, stiffness, hardness, wear resistance – Metals, polymers, ceramics, composites for robotic applications – Lightweight materials for mobile and aerial robots – Smart materials: shape memory alloys, piezoelectric and magneto strictive materials – Tribology in robotic joints – Surface coatings for wear reduction – Biocompatible and nanomaterials – Material selection for optimal robotic design.

TOTAL PERIODS: 60

TEXTBOOKS

1. Azar, Reza N. Theory of Applied Robotics: Kinematics, Dynamics, and Control. 3rd ed. Cham: Springer, 2021.
2. Beiser, Arthur. Concepts of Modern Physics. 8th ed. New York: McGraw-Hill, 2003.
3. Gaur, R.K., and S.L. Gupta. Engineering Physics. 8th ed. New Delhi: Dhanpat Rai Publications, 2017

REFERENCE BOOKS

1. Lynch, Kevin M., and Frank C. Park. Modern Robotics: Mechanics, Planning, and Control. Cambridge: Cambridge University Press, 2017.
2. Craig, John J. Introduction to Robotics: Mechanics and Control. 4th ed. Boston: Pearson, 2018.
3. Saleh, Bahaa E. A., and Malvin Carl Teich. Fundamentals of Photonics. 3rd ed. Hoboken, NJ: Wiley, 2019.
4. Nag, P.K. Engineering Thermodynamics. 6th ed. New Delhi: McGraw-Hill Education, 2017.

5. Callister, William D., Jr., and David G. Rethwisch. Materials Science and Engineering: An Introduction. 10th ed. Hoboken, NJ: Wiley, 2018.
Online Courses/NPTEL/SWAYAM: 1. https://archive.nptel.ac.in/courses/112/105/112105249/ 2. https://youtu.be/jab5panFHTo

CO-PO -PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	1					1		3	2
CO2	3	3	3	2	2					1		3	3
CO3	2	2	2	3	3					1		2	3
CO4	2	2	3	2	2					1		3	3
CO5	2	1	2	2	3					1		2	3

Assessment Methodology	**Assessment Tools**	**Marks**
Continuous Assessment Test	Written Test / Quiz/Assignment	25
MCQ unit wise 10 questions	Moodle / Google form	5
Virtual lab-based assignment	Demo and viva	5
Attendance	Attendance record	5
Total		**40**

25UMET13	FUNDAMENTALS OF MECHANICAL ENGINEERING	Category	L	T	P	Credit
		ESC	2	1	0	3

Course Prerequisite

- Engineering Physics / Materials Science
- Basic Thermodynamics
- Engineering Mechanics

Course Objective

To provide students with foundational knowledge in mechanical engineering principles relevant to robotics, including robot structural design, material selection based on environmental conditions, mechanical components, manufacturing processes, and basic concepts of thermodynamics and fluid mechanics, thereby enabling them to understand and contribute effectively to the design and development of robotic systems.

Course Outcome

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

Explain the laws of thermodynamics and the working principles of energy conversion devices and cycles	Understand (K2)
Identify the properties of fluids, types of fluid flow, and common hydraulic machines.	Remember (K1)
Determine principal stresses, shear force, bending moment, and stresses due to flexural and torsional loading	Apply (K3)
Analyze particle motion and apply energy, momentum, and impact principles to solve dynamics problems.	Apply (K3)
Select appropriate manufacturing processes and apply suitable machining, forming, and joining operations for given engineering applications.	Apply (K3)

SYLLABUS

UNIT I INTRODUCTION TO THERMODYNAMICS & ENERGY CONVERSION DEVICES (12)

Work, Heat, Equilibrium, Enthalpy, Entropy, Internal Energy, Laws of thermodynamics, Heat cycles – Carnot, Otto and Diesel, Properties of Steam. Boilers, Steam and Gas Turbines, SI and CI Engines, Refrigeration and Air Conditioning.

UNIT II FLUID MECHANICS AND MACHINERY (12)

Fluid Properties and Fluid Statics, Types of Fluid Flow, Work and Energy of Moving Fluids, Hydraulic Pumps, Hydraulic Turbines.

UNIT III MECHANICS OF MATERIAL (12)

Materials and Mechanical Properties, Stress and Strain Concepts, Stress-Strain Diagrams for Ductile and Hard Materials, Principal Stresses and Strains, Shear Force and Bending Moments, Flexural and Torsional Loading.

UNIT IV KINEMATICS AND KINETICS OF PARTICLES (12)

Equations of motion – Rectilinear motion, curve linear motion, relative motion, D'Alembert's principle, work-Energy equation – conservative forces and principle of conservation of energy, Impulse – momentum, Impact – Direct central impact and oblique central impact

UNIT V MANUFACTURING PROCESSES (12)

Types of Manufacturing Processes, Machining Operations, Turning, Drilling, Milling and Grinding, Forming and Forging Operations, Joining Processes, Soldering, Brazing and Welding.

TOTAL PERIODS: 60

TEXT BOOKS

1. D. S. Kumar., "Fundamentals of Mechanical Engineering and Mechatronics", S.K. Kataria & Sons, 2021.
2. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, 2019.Publishing Company, Chennai 2008.

REFERENCE BOOKS

1. Sadhu Singh, "Principles of Mechanical Engineering", S. Chand, 2010.
2. P. K. Nag, "Engineering Thermodynamics", McGraw Hill Education, 2017.
3. S. S. Rattan, "Theory of Machines", McGraw Hill Education, 2019.
4. S. S. Rattan, "Strength of Materials", McGraw Hill Education, 2017.

Online Courses/NPTEL/SWAYAM:

1. https://archive.nptel.ac.in/courses/112/105/112105123/
2. https://archive.nptel.ac.in/courses/112/105/112105206/
3. https://archive.nptel.ac.in/courses/112/105/112105268/
4. https://archive.nptel.ac.in/courses/112/107/112107219/

CO-PO -PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3								1	2	3
CO2	3	2					2				1	2	2
CO3	3	2	2			2	2				1	1	3
CO4	2											2	2
CO5	2						1					3	2

Assessment Methodology	**Assessment Tools**	**Marks**
Continuous Assessment Test	Written Test / Quiz/Assignment	25
Assignments / Quiz / Participation	Problem-solving assignment	5
Simulation / Practical Component	Demo and report	5
Attendance	Attendance record	5
Total		**40**

25URAT14	FUNDAMENTALS OF ELECTRONIC DEVICES	Category	L	T	P	Credit
		ESC	3	0	0	3

Course Prerequisite

Basic Electrical Engineering

Course Objective

- To understand semiconductor physics and device operation principles.
- To analyze characteristics of diodes, transistors, and FETs under various conditions.
- To develop circuit analysis skills using device models and equivalent circuits.
- To explore semiconductor device applications in circuits and systems.
- To introduce advanced semiconductor technologies and emerging device structures.

Course Outcome

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

Explain PN-junction diode operation, characteristics, temperature effects, and breakdown mechanisms.	Understand (K2)
Understand principles and applications of specialized diodes, power devices, and optoelectronic devices.	Understand (K2)
Analyze BJT configurations, apply h-parameters, and evaluate switching characteristics.	Apply (K3)
Compare JFET and MOSFET operation, analyze characteristics, and apply small-signal models.	Analyze (K3)
Explore advanced semiconductor structures and specialized devices for modern applications.	Understand (K2)

SYLLABUS

UNIT I PN-JUNCTION DIODE (12)

Operation of PN-Junction Diode, Diode Equation, Volt-Ampere (V-I) Characteristics, Temperature Dependence of V-I Characteristics, Ideal Versus Practical Diode, Static and Dynamic Resistances, Breakdown Mechanisms in semiconductor Diodes, Diode Switching Characteristics, Zener Diode Characteristics.

UNIT II POWER AND DISPLAY DEVICES (12)

Principle and Operation of Tunnel Diode, Varactor Diode, Schottky Barrier Diode, DIAC, TRIAC, SCR, and Uni-Junction Transistor (UJT), Photodiode, LED.

UNIT III TRANSISTOR (12)

PNP-NPN Transistors Operation, BJT Symbol, Transistor as an Amplifier, Common Emitter, Common Base and Common Collector Configurations, and its H-Parameters, Thermal Runaway, Transistor as a switch, Transistor switching times, Limits of Operation, BJT Specifications.

UNIT IV FIELD EFFECT TRANSISTOR (12)

Junction Field Effect Transistor: Construction, Principle of Operation, Symbol - Pinch-Off Voltage – Volt-Ampere Characteristics, Small Signal Model of JFET & MOSFET, MOSFET Characteristics in Enhancement and Depletion Modes, Application of Transistor.

UNIT V SPECIAL SEMICONDUCTOR DEVICES (12)

Metal-Semiconductor Junction- MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, LASER diode, LDR, CCD.

TOTAL PERIODS: 60

TEXT BOOKS

1. Electronic Devices and Circuits - J. Millman, Christos C. Halkias, 1991 edition, 2008, TMH.
2. Electronic Devices and Circuits- R.L. Boylestad and Louis Nashelsky, 9th edition, 2006, PHI.
3. Electronic Devices and Circuits – David A. Bell, Fifth Edition, 2008, Oxford University press.

REFERENCE BOOKS

1. Integrated Electronic - J.Millman and C.C.Halkias, Satyabratajit, 2nd edition, 1998, TMH.
2. Electronic Devices and Circuits - K. Lal kishore, 2nd edition, 2005, BSP.
3. Introduction to Electronic Devices and Circuits – Rober T. Paynter, PE
4. Electronic Devices and Circuits – S. Salivahan, N.Suresh Kumar, A. Vallavaraj, 2nd Edition, 2008, TMH.

Online Courses/NPTEL/SWAYAM:

1. https://nptel.ac.in/courses/113106062
2. https://nptel.ac.in/courses/108108112
3. https://nptel.ac.in/courses/108108122
4. https://nptel.ac.in/courses/108107586

CO-PO -PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2								2	2
CO2	3	1	2	2								2	2
CO3	3	2	2	2								2	2
CO4	3	2	2	2								2	2
CO5	3	3	2	2								2	2

Assessment Methodology	**Assessment Tools**	**Marks**
Continuous Assessment Test	Written Test / Quiz/Assignment	25
Application based Hobby circuits	Presentations	5
Simulation (MATLAB, TCAD, PSPICE, LT SPICE) Project based assignment	Demo and viva	5
Attendance	Attendance record	5
Total		**40**

25UCSI16	PROGRAMMING IN C	Category	L	T	P	Credit
		ES	3	0	2	4

Course Prerequisite

Basic programming skills.

Course Objective

- To impart the knowledge of basic programming constructs of C language, arrays and strings, functions, structures, pointers and input/output file handling.

Course Outcome

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

CO1	Demonstrate knowledge on C Programming constructs and develop simple programming using basic constructs.	Understand(K2)
CO2	Apply arrays and string operations to solve basic problems using C	Apply(k3)
CO3	Develop modular programs using functions, recursion, and pointers	Apply(k3)
CO4	Implement user-defined data types using structures, unions, and manage memory dynamically.	Apply(K3)
CO5	Implement file operations and manage memory dynamically using pointers and preprocessor directives.	Apply(K3)

SYLLABUS

UNIT I INTRODUCTION TO PROGRAMMING PARADIGMS (9)

Introduction to programming paradigms – Applications of C Language – Structure of C program – C programming: Data Types – Constants – Enumeration Constants – Keywords – Operators: Precedence and Associativity – Expressions – Input/Output statements, Assignment Statements-Decision making statements –Switch statement– Looping statements– Preprocessor directives– Compilation process**.**

UNIT II DECISION MAKING, ARRAYS AND STRINGS (9)

Introduction to Arrays: Declaration, Initialization – One dimensional array –Two dimensional arrays – String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT III FUNCTIONS AND POINTERS (9)

Modular programming– Function prototype, function definition, function call, Built-in functions (string functions, math functions) –Recursion, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing:

UNIT IV STRUCTURES AND UNION (9)

Structure – Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation – Singly linked list – typedef – Union – Storage classes and Visibility.

UNIT V FILE MANAGEMENT AND DYNAMIC MEMORY ALLOCATION (9)

Files- Types of file processing, I/O Operations of File, Random access file, Command line arguments. Dynamic memory allocation- Linked list, types, Preprocessor directive, Macro substitution, Compiler.

TOTAL PERIODS: 45

TEXTBOOKS:

1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. E. Balagurusamy, "Programming in C" McGraw-Hill, 8th Edition, 2019.
3. Kernighan. B, Wand Ritchie. D.M, "The C Programming language", Second Edition, Pearson

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", 8thedition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press, 2013.

Online Courses/NPTEL/SWAYAM:

1. https://www.coursera.org/learn/c -for-everyone
2. https://onlinecourses.swayam2.ac.in/cec24_cs05/preview
3. https://onlinecourses.npt el.ac.in/noc22_cs40/ preview
4. https://nptel.ac.in/courses/108107586

PRACTICE EXERCISES:

1. Study of Compilation and execution of simple C programs
2. Simple computational problems using arithmetic expressions (Arithmetic Operations, Area & circumference of a circle).
3. Problems involving if-then-else structures (ODD/EVEN numbers, Greatest Numbers).
4. Iterative problems e.g., sum of series (Factorial, Sum of Digits).
5. 1D and 2D, multi-dimensional arrays, traversal.

6. Matrix problems, String operations (Addition, Subtraction, Multiplication, Palindrome String Operations, String Handling Functions).
7. Simple functions (nCr Program, Swapping using call-by-reference)

CO-PO Mapping

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

Assessment Methodology	**Assessment Tools**	**Marks**
Theory Test		15
Coding assignments	Online submission	10
Mini project implementation	Code demo and documentation	10
Model Practical		10
Attendance	Attendance record	5
Total		50

25UHSI16	PROFESSIONAL COMMUNICATION FOR ENGINEERS	Category	L	T	P	Credit
		HS	1	0	4	3

Prerequisite:

Basics of English Language

Course Objective

- To improve the communicative competence of learners
- To help learners use language effectively in academic /work contexts
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To develop learners' ability to read and write complex texts, summaries, articles, blogs,definitions, essays and user manuals.
- To use language efficiently in expressing their opinions via various media.

Course Outcome

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

CO1	Understand and demonstrate the use of foundational communication skills such as introductions, telephone etiquette, email writing, and interpreting technical messages in professional contexts.	Understand (K2)
CO2	Understand and narrate personal and reported events using appropriate structure and vocabulary. Interpret and summarize content from podcasts, biographies, blogs, and reports in spoken and written form.	Understand (K2)
CO3	Explain product and process descriptions through listening and reading. Effectively describe, instruct, and present products/processes in both spoken and written formats.	Understand (K2)
CO4	Interpret scientific talks, articles, and non-verbal data like charts and graphs. Summarize information and make clear recommendations through spoken and written communication.	Apply (K3)
CO5	Analyze multiple viewpoints in debates, discussions, and coherently through group discussions, role plays, and essay writing. Attend interview with assertiveness	Analyze (K4)

SYLLABUS

UNIT I INTRODUCTION TO COMMUNICATION (3)

EFFECTIVE COMMUNICATION:

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

FUNDAMENTALS OF COMMUNICATION:

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Who/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

LAB ACTIVITY: Extempore (Oral), Conversation on asking directions, Listening – Telephone conversation; Speaking Self-introduction; Telephone conversation – Video conferencing etiquette. **(12)**

UNIT II NARRATION AND SUMMATION (3)

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

LAB ACTIVITY: Listening – Travel podcast; Speaking – Narrating and sharing personal experiences through a podcast, Autobiography of a famous Personality **(12)**

UNIT III DESCRIPTION OF A PROCESS / PRODUCT (3)

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

LAB ACTIVITY: Listening – Railway / Airport Announcements, Travel Vlogs; Speaking – Describing a place or picture description **(12)**

UNIT-IV VISUALIZATION AND CLASSIFICATION (3)

Listening – TED talks Speaking – Interviewing a celebrity/Famous Personality Reading – Company profiles, Business Letters Vocabulary– Discourse Markers, Linking words and Phrases Collocation. Grammar – Pronouns, Conjunction, Preposition Writing – Interpretation of Charts and Graphs

LAB ACTIVITY: Picture Description, about purchasing a product, Summarizing a TED talk, Role play, Narrating an unforgettable event **(12)**

UNIT V EXPRESSION COMMUNICATION **(3)**
Listening – Watching Movies / Listening to Dialogues and Conversations Speaking – Role play, Panel Discussion, Debate Reading – Blogs, Novels, Short Stories Vocabulary – Phrasal Verbs Grammar– Simple/Compound/Complex Sentences, Error Spotting, Punctuation. Writing – Descriptive Essay, Dialogue Writing **LAB ACTIVITY:** Listening /Reading Comprehension, Developing a story using given Vocabulary, Mini Presentation on General topic (ICT tools), Group Discussion **(12)**

Text Book
1. Technical Communication: Principles and Practice Meenakshi Raman & Sangeeta Sharma Oxford University Press 3rd Edition (or latest). 2. Communication SkillsSanjay Kumar & Pushp Lata, Oxford University Press 2nd Edition (2015). 3. Effective Technical Communication*:* M. Ashraf Rizvi, McGraw-Hill Education 2nd Edition (2017)
Reference Book & Web Resources
1. A Course Book on Technical English by Lakshmi Narayanan, Scitech Publications (India) Pvt. Ltd. 2. English For Technical Communication (With CD) By Aysha Viswamohan, McGrawHill Education, ISBN : 0070264244. 3. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House. 4. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	1	-	-	2	-	-	-	-	**3**	2		1
CO2	1	2	-	-	2	-	-	2	-	**3**	2		1
CO3	1	2	-	-	-	-	-	1	-	**3**	2		1
CO4	1	3	-	-	3	-	1	2	-	**3**	2		1
CO5	1	2	-	-	2	-	1	3	-	**3**	2		1

Assessment Methodology	**Assessment Tools**	**Marks**
Test		15
Listening and reading Comprehension	Online tool	5
Speaking assessment (Oral)	review	10
Online assessment test	Online tool	10
Content creation Competition	Peer review	5
Attendance	Attendance record	5
Total		**50**

25UPHP14	PHYSICAL SCIENCE LAB FOR ROBOTICS ENGINEERING	Category	L	T	P	Credit
		BS	0	0	2	1

Course Prerequisite

Basic knowledge of elasticity, heat conduction, light properties is essential.

Course Objective

- To provide an experimental foundation for the theoretical concepts introduced in the lectures
- To help students understand the role of direct observation in physics and to distinguish between inferences based on theory and the outcomes of experiments.
- To introduce the concepts and techniques which have a wide application in experimental science

Course Outcome

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

CO1	Determine fundamental physical constants using classical and modern physics experiments.	Apply (K3)
CO2	Evaluate mechanical properties of materials through experimental methods.	Evaluate (K4)
CO3	Analyze thermal, optical, and fluid properties using standard laboratory techniques.	Analyze(K4)
CO4	Apply wave and laser-based methods for precise measurement of physical parameters.	Apply(K3)
CO5	Interpret and validate experimental results with theoretical concepts in physics.	Analyze(K4)

SYLLABUS

LIST OF EXPERIMENTS

1. Determination of Acceleration due to Gravity using a Simple Pendulum.
2. Determination of Moment of Inertia using a Torsional Pendulum
3. Determination of Young's modulus of given material by non-uniform bending method.
4. Determination of viscosity of the given liquid using Poiseuille' s method.
5. Determination of Thermal conductivity of a bad conductor –Lee's Disc method
6. Determination of the thickness of a given thin material– Air wedge method
7. Determination of the wavelength of Laser and particle size of given powder
8. Determination of the angle of divergence of a laser beam using semiconductor
9. Determination of band gap of a semiconductor diode.
10. Determination of radius of curvature of lens Newtons ring method.

Text Book

1. Arora, C. L. 2001. Practical Physics. New Delhi: S. Chand & Company Ltd.
2. Worsnop, B. L., and H. T. Flint. 1971. Advanced Practical Physics for Students. London: Methuen & Co. Ltd.

Reference Book & Web Resources

1. Prakash, Indu, and Ramakrishna. 2016. A Text Book of Practical Physics. New Delhi: Kitab Mahal.
2. Kumar, S. Suresh. 2013. Engineering Physics Practicals. New Delhi: Vikas Publishing House.
3. Gupta, S. L., and V. Kumar. 2010. Practical Physics. Meerut: Pragati Prakashan.
4. Ghatak, Ajoy. 2017. Optics. 6th ed. New Delhi: McGraw Hill Education.
5. Pillai, S. O. 2015. Solid State Physics. 8th ed. New Delhi: New Age International Publishers.

Web resources

1. https://vlab.co.in
2. https://ocw.mit.edu
3. https://nptel.ac.in/courses/115
4. http://hyperphysics.phy-astr.gsu.edu

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	0	3	0	1	1	1	1	0	2	1	0
CO2	2	2	2	0	0	0	1	1	1	0	2	1	0
CO3	2	2	2	2	0	0	1	1	1	0	2	1	0
CO4	2	1	1	1	0	0	1	1	1	0	1	0	0
CO5	2	2	1	1	1	0	1	1	1	0	1	0	0

Assessment Methodology	**Assessment Tools**	**Marks**
Laboratory Conduction	Observation	10
Record work		10
Model exam		15
Viva		5
Virtual lab assignment	Review	5
STEM based model creation	Presentation	5
Attendance	Attendance record	10
Total		60

25UGEP19	ENGINEERING GRAPHICS AND AUTOCAD	Category	L	T	P	Credit
		ES	0	0	2	2

Course Prerequisite

Basic knowledge of geometry and fundamentals of computer operation.

Course Objective

This laboratory course provides hands-on training in engineering drawing techniques and the use of AutoCAD software. The objective is to equip students with the skills to produce accurate 2D

Course Outcome

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

CO1	Use drawing instruments and follow BIS standards in manual drawings.	Understand (K2)
CO2	Develop orthographic and isometric projections manually	Analyze (K4)
CO3	Create and modify 2D drawings using AutoCAD	Apply(K3)
CO4	Generate sectional and dimensioned views in AutoCAD.	Evaluate(K4)
CO5	Apply CAD tools to visualize and plot engineering components.	Apply(K3)

SYLLABUS

LIST OF PRACTICAL EXERCISES

1. Introduction to drawing instruments, BIS conventions, and lettering.
2. Geometrical constructions using instruments.
3. Orthographic projection of simple objects (manual drawing).
4. Isometric drawing of regular solids (manual drawing).
5. Sectional views of solids (manual drawing).
6. Introduction to AutoCAD: Interface, basic settings, and units.
7. Drawing tools in AutoCAD: Line, Circle, Arc, Rectangle, Polygon.
8. Modify tools in AutoCAD: Move, Copy, Mirror, Rotate, Trim, Extend.
9. Using Layers, Text, and Dimensioning in AutoCAD.
10. Creating orthographic projections in AutoCAD.
11. Creating isometric views in AutoCAD.
12. Creating sectional views and hatching in AutoCAD.
13. Plotting and printing drawings in AutoCAD.

Mini-project: Preparing a combined sheet of manual and CAD drawings

Text Book

1. Bhatt, N. D. 2014. Engineering Drawing, Charotar Publishing House.
2. Jolhe, Dhananjay A. 2017.Engineering Drawing with AutoCAD. New Delhi: Tata McGraw-Hill.

Reference Book & Web Resources

1. Gill, P. S., and J. S. Dhillon. 2015. Engineering Drawing. Ludhiana: Katson Books.
2. Venugopal, K., and V. Prabhu Raja. 2011. Engineering Graphics. New Delhi: New Age International Publishers.
3. Luzadder, Warren J., and Jon M. Duff. 1993. Fundamentals of Engineering Drawing. Upper Saddle River, NJ: Prentice Hall.
4. AutoDesk. 2025. "Official Tutorials." https://www.autodesk.com/learning.
5. French, Thomas E., Charles J. Vierck, and Robert J. Foster. 2004. Engineering Drawing and Graphic Technology. New York: McGraw-Hill.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3		-	-	-	-	-	-	-	-	-	1	-
CO3	-	-	3	-	3	-	-	-	-	-	-	1	-
CO4	-	-	2	-	2	-	-	-	-	-	-	1	-
CO5	-	-	-	-	2	-	-	-	-	-	-	1	-

Assessment Methodology	Assessment Tools	Marks
Laboratory Conduction	Observation	10
Record work		10
Model exam		15
Viva		5
Real Model Drawing	Review	5
CAD Simulation Test		5
Attendance	Attendance record	10
Total		60

25UGEP18	DESIGN THINKING AND IDEA LAB	Category	L	T	P	Credit
		ES	0	0	2	1

Course Prerequisite

Basic Knowledge of Science and interest in creative problem solving

Course Objective

- To introduce students to the principles, methodologies, and frameworks of design thinking for solving real-world problems.
- To cultivate user-centric, empathetic, and creative thinking through experiential learning and hands-on activities.
- To enable students to prototype, test, and present innovative solutions using collaborative tools and idea lab resources.

Course Outcome

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

CO1	Explain the fundamental concepts and stages of Design Thinking and their relevance to problem solving.	Understand (K2)
CO2	Describe different learning styles, memory processes, and the role of empathy in user-centric design	Understand K2
CO3	Apply engineering tools such as schematic design, PCB layout, 3D printing, and laser cutting to create prototypes.	Apply (K3)
CO4	Analyze real-world user challenges and evaluate creative problem-solving approaches to develop innovative product designs.	Analyze(K4)
CO5	Interpret feedback from prototype testing and iteratively improve the design to better align with user needs.	Analyze(K4)

SYLLABUS

UNIT I: Learning, Emotions, and Foundations of Design Thinking (3)

Understanding the learning process, Kolb's learning styles, Assessing and interpreting learning types, Understanding the memory process, Memory retention issues, Memory enhancement techniques, Understanding emotions – experience and expression, Assessing and applying empathy, Definition and need for Design Thinking.

Writing Skills: Emails/letters introducing oneself-Tone, structure, grammar

UNIT II: Ideation, Product Design, and Prototyping (3)

Objectives of Design Thinking, Stages of Design Thinking with examples (Empathize, Define, Ideate, Prototype, Test), Understanding creative thinking, Understanding problem-solving, Testing creative problem-solving, Engineering product design process, Examples of innovative product designs, Introduction to prototyping and its purpose, Rapid prototyping and testing methods.

UNIT III: Customer-Centric Innovation and Iterative Design (3)

Understanding individual uniqueness, Team activities for diversity appreciation, Real-life customer challenge examples, Applying Design Thinking to improve customer experience, Parameters of customer-centric product experience, Aligning product design with user expectations, Feedback loop and user testing, User-focused design and ergonomic considerations, Final product pitch and presentation.

UNIT IV: List of Lab Activities and Experiments (Phase-1) (3)

1. Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.
2. Machining of 3D geometry on soft material such as softwood or modelling wax.
3. 3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.
4. 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
5. 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.

UNIT V: List of Lab Activities and Experiments (Phase-2) (3)

1. Familiarity and use of welding equipment.
2. Familiarity and use of normal and wood lathe.
3. Embedded programming using Arduino and/or Raspberry Pi.
4. Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.
5. Discussion and implementation of a mini project.
6. Documentation of the mini project (Report and video).

Text Book

1. Tim Brown,Change by Design: How Design Thinking Creates New Alternatives for Business and Society, Harper Business, 2009.
2. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, McGraw-Hill Education, 2015.

Reference Book

1. Peter G. Rowe, Design Thinking: Understanding How Designers Think and Work**,** MIT Press, 1991.
2. Don Norman, The Design of Everyday Things, Basic Books, 2013.
3. Tom Kelley and David Kelley, Creative Confidence: Unleashing the Creative Potential Within Us All, Crown Business, 2013.
4. Todd Zaki Warfel, Prototyping: A Practitioner's Guide, Rosenfeld Media, 2009.
5. Clive L. Dym, Patrick Little, Elizabeth J. Orwin, Engineering Design: A Project-Based Introduction**,** Wiley, 2011.

Web Resources

https://onlinecourses.nptel.ac.in/noc23_mg72

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	1	2	1	1	-	2	1	-
CO2	2	2	1	1	3			1	1	-	1	1	-
CO3	3	2	3	2	1	1	1	1	2	-	2	1	-
CO4	3	3	3	3	3	1	1	1	2	-	2	1	-
CO5	3	3	3	-	-	1	2	1	1	-	2	1	-

Assessment Methodology	Assessment Tools	Marks
Laboratory Conduction	Observation	10
Record work		10
Model /Prototype Evaluation	Rubric-based evaluation	15
Viva / Presentation		5
Virtual Lab / Online Assignment	Review	5
STEM-Based Model Creation		5
Attendance	Attendance record	10
Total		60

25UPCE11	CAREER DEVELOPMENT SKILLS	Category	L	T	P	Credit
		EEC	0	0	2	1

Course Prerequisite

Basic communication skills and foundational knowledge of workplace behavior

Course Objective

To empower students with the skills for self-discovery, goal achievement, effective time management, and personal effectiveness, alongside foundational knowledge in career planning, emotional intelligence, higher education, competitive exams and entrepreneurship

Course Outcome

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

CO1	Help students assess themselves, explore career options, and set actionable goals through structured planning.
CO2	Develop motivation, enhance personality effectiveness, and instill discipline for personal and professional growth.
CO3	Build awareness and practice of grooming, hygiene, positive attitudes, manners, and professional behaviour.
CO4	Strengthen self-awareness, time and stress management, and emotional intelligence for balanced personal development.
CO5	Introduce students to higher education paths, competitive exams, and the fundamentals of entrepreneurship and business planning

SYLLABUS

UNIT I **(10)**

Career Planning: Introduction to Career Planning - Self-Assessment for Career Planning - Exploring Career Options- Developing a Career Plan;

Goal Settings: Understanding Goal Setting - Setting Effective Goals - Action Plan Development - Practical Exercises

UNIT II **(10)**

Motivation – I: Definition and Importance of Motivation - Types of Motivation - Theories of Motivation - Factors Affecting Motivation

Personality Effectiveness: Components of Personality Effectiveness - Communication Skills - /Interpersonal Skills - Practical Exercises

Building Personality and Discipline: Introduction to Personality Development - Building Positive Habits - Discipline and Self-Control - Practical Application

UNIT III **(10)**

Grooming, hygiene and Cleanliness: Personal Hygiene Practices - Body Grooming Techniques - Environmental Cleanliness - Mental and Social Impact of Grooming and Hygiene.

Attitudes, Manners and Behaviour: Understanding Attitudes - Developing Positive Attitudes - Manners and Etiquette - Procedures and Protocols

UNIT IV **(10)**

Self- Awareness & Self Confidence: Introduction to Self-Awareness- Understanding Strengths and Weaknesses- Building Self-Confidence- Practical Application

Time Management: Introduction to Time Management - Planning and Prioritizing Tasks-Overcoming Procrastination- Practical Time Management

Stress Management: Understanding Stress- Stress Management Techniques-Coping Strategies-Practical Application

Emotional Intelligence: Introduction to Emotional Intelligence- Managing Emotions- Social Awareness and Relationship Management-Practical Exercises

UNIT V **(8)**

Introduction to Higher Education, Competitive exams: Overview of Higher Education- Competitive Exams Overview - Exam Preparation Techniques

Introduction to Entrepreneurship: Understanding Entrepreneurship- Developing a Business Idea - Business Planning

Text Book

1. Soft skills for Managers by Dr. T. KALYANA CHAKRAVATHI

2.Personal Development and Soft Skills by BARUN K MITRA, Oxford Higher Education

Reference Book

1. The Emotionally Intelligent Workplace by DANIEL GOLEMAN.
2. Communication skills and soft skills an integrated approach by E. SURESH KUMAR, P. SREEHARI, J SAVITHRI.

3.Top Talking in English (international communication skills) by CHARLES T. RAJENDRA

4.Soft skills by RAJ LAKSHMI SURYAVANSHI, Gurucool Publishing

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								**2**	**2**	**2**	**2**
CO2					**2**			**2**			**2**
CO3							**2**	**2**			**2**
CO4								**2**	**2**		**2**
CO5						**2**	**2**				**2**

Assessment Methodology	**Assessment Tools**	**Marks**
Resume & Cover Letter	Instructor Evaluation	10
Interview Simulation	Mock Interview	10
Grooming &Behaviour Demo	Role Play Assessment	10
Emotional & Time Management	Stress Management Activity	10
Career Portfolio & Reflection		10
Presentation Skills		5
Attendance	Attendance record	5
Total		60

25UMCC11	IKS – CONCEPTS AND APPLICATIONS IN ENGINEERING AND SCIENCE	Category	L	T	P	Credit
		MCC	1	0	1	0

Course Prerequisite

- Basic understanding of science and engineering fundamentals

Course Objective

- Familiarize students with traditional Indian knowledge systems and their scientific foundations.
- Explore the integration of ancient wisdom with modern engineering practices.
- Understand sustainable technologies and innovations rooted in Indian traditions.
- Develop appreciation for indigenous knowledge in solving contemporary challenges.
- Foster research mindset towards validating and modernizing traditional practices.

Course Outcome

CO1	Understand the historical development and scientific basis of Indian Knowledge Systems	Understand
CO2	Analyze traditional Indian practices in mathematics, astronomy, metallurgy, and medicine	Analyze
CO3	Apply IKS principles to contemporary engineering and scientific problems	Apply
CO4	Evaluate the sustainability aspects of traditional Indian technologies	Evaluate
CO5	Create innovative solutions by integrating traditional knowledge with modern science	Create

SYLLABUS

UNIT I INTRODUCTIONTO INDIAN KNOWLEDGE SYSTEMS (6)

Historical overview of Indian Knowledge Systems-Scientific methodology in ancient India – Major texts and scholars: Vedas, Upanishads, Charaka Samhita, Sushruta Samhita- Transmission and preservation of knowledge- Contemporary relevance and global recognition.

UNIT II: MATHEMATICS AND ASTRONOMY INANCIENT INDIA (6)

Indian contributions to mathematics: Zero, decimal system, trigonometry- Aryabhata, Brahmagupta, Bhaskara's contributions- Astronomical observations and calendar systems- Navigation techniques and geographical knowledge- Applications in modern engineering calculations

UNIT III: METALLURGY, MATERIALS, AND ARCHITECTURE (6)

Ancient Indian metallurgy: Iron pillar of Delhi, Wootz steel-Traditional building materials and techniques -Architectural marvels: Structural engineering principles-Water harvesting and management systems-Sustainable construction practices.

UNIT IV: RENEWABLE ENERGY AND CLIMATE CHANGE (6)

Ayurveda: Principles and scientific validation-Traditional agricultural practices and crop management– Biodiversity conservation methods- Food preservation techniques- Biotechnology applications in traditional practices.

UNIT V: INTEGRATION WITH MODERN SCIENCE AND TECHNOLOGY (6)

Validating traditional knowledge through modern scientific methods - Case studies of successful IKS-modern science integration-Intellectual property and traditional knowledge protection -Research opportunities and career prospects- Future directions and challenges

TEXTBOOKS:

1. Subhash Kak, "The Natureof Physical Reality", Mount Meru Publishing,2016
2. B.V. Subbarayappa,"Indian Astronomy: A Source Book", Nehru Centre, 2008
3. KapilaVatsyayan, "Traditional Indian Art and Culture", Cambridge University Press,2015

REFERENCE BOOKS&WEB RESOURCES

1. P. Divakaran, The Mathematics of India: Concepts, Methods, Connections", Springer, 2018
2. S.N. Sen, "Ancient Indian History and Civilization", New Age International, 2010
3. National Mission for Manuscripts-www.namami.gov.in
4. Digital Library of Traditional Ecological Knowledge-www.frlht.org
5. CSIR Traditional Knowledge Digital Library-www.tkdl.res.in

CO-PO Mapping

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

Assessment Methodology	Assessment Tools	Marks
Continuous Assessment	Quizzes, short assignments, concept mapping, reflection journals on ancient texts and scholars	15
Case Study / Report Writing	Analytical report on IKS integration in modern science, IP protection, or sustainable practices	10
Presentation / Seminar	Oral presentation on topics like ancient metallurgy, astronomy, or Ayurveda applications	10
Project / Model Demonstration	Mini-project or model based on traditional engineering or agricultural techniques	10
Group Discussion / Role Play	Role play on ancient knowledge transmission, group discussion on contemporary relevance	10
Attendance	Attendance record	05
Total		60

25UMCC12	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	Category	L	T	P	Credit
		MCC	2	0	0	0

Course Prerequisite

Basic knowledge of chemistry, biology, and physics

Course Objective

This course provides comprehensive understanding of environmental science principles and sustainability concepts essential for engineering professionals. The objectives are to:

- Understand fundamental concepts of environmental science and ecology
- Analyze environmental problems and their engineering solutions
- Develop awareness about sustainable development and green technologies
- Explore renewable energy systems and waste management strategies.
- Foster environmental consciousness and responsible engineering practices

Course Outcome

CO1	Understand fundamental principles of environmental science and ecosystem dynamics	Understand (K2)
CO2	Analyze various types of pollution and their impact on human health and environment	Analyze(K4)
CO3	Apply principles of sustainable development in engineering design and decision-making	Apply(K3)
CO4	Evaluate renewable energy technologies and waste management systems	Evaluate(K4)
CO5	Design environmentally sustainable solutions for engineering problems	Design(K4)

SYLLABUS
UNIT I: Introduction to Environmental Science and Ecology (6) Definition, scope and importance of environmental science - Structure and function of ecosystems - Biogeochemical cycles: Carbon, nitrogen, phosphorus, sulfur cycles - Biodiversity and its conservation - Environmental impact assessment principles
UNIT II: Environmental Pollution and Control (6) Air pollution: Sources, effects, and control measures - Water pollution: Industrial and domestic sources, treatment methods - Soil pollution: Causes, effects, and remediation techniques - Noise pollution: Sources, effects, and control - Solid waste management: 3R principles, waste-to-energy
UNIT III: Sustainable Development and Green Technologies (6) Concept of sustainable development and SDGs - Life cycle assessment (LCA) principles - Green building concepts and LEED certification - Cleaner production and industrial ecology - Environmental management systems (ISO 14001)
UNIT IV: Renewable Energy and Climate Change (6) Solar energy systems: Photovoltaic and thermal applications - Wind energy: Technology and site assessment - Hydroelectric and geothermal energy systems - Climate change: Causes, effects, and mitigation strategies - Carbon footprint and carbon trading mechanisms.
UNIT V: Environmental Regulations and Case Studies (6) Environmental laws and regulations in India - Environmental clearance procedures - Corporate environmental responsibility - Case studies of environmental disasters and lessons learned - Future trends in environmental technology

Text Book

1. G. Tyler Miller Jr., "Environmental Science: Working with the Earth", Cengage Learning, 2019
2. C. Anil Kumar, "Environmental Science and Engineering", PHI Learning, 2018
3. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, 2017

Reference Book & Web Resources

1. Richard T. Wright, “Environmental Science: Toward a Sustainable Future”, Pearson, 2017
2. Daniel B. Botkin, “Environmental Science: Earth as a Living Planet”, Wiley, 2018
3. Central Pollution Control Board - www.cpcb.nic.in
4. Ministry of Environment and Forests - www.moef.gov.in
5. UN Environment Programme - www.unep.org
6. NPTEL Environmental Science Courses - nptel.ac.in

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	1	-	-	1	-	2	1	2	1	3
CO2	3	2	2	1	2	-	1	1	2	2	3
CO3	3	3	2	2	2	1	2	2	2	2	2
CO4	2	2	2	2	3	2	3	2	3	3	3

Assessment Methodology	**Assessment Tools**	**Marks**
Conceptual Understanding	Written test / quiz on ecology & resources	10
Pollution & Control	Case study, poster / infographic	10
Sustainability Practices	Field survey, SDG mapping report	10
Climate & Energy	Debate, carbon-footprint calculation, infographic	10
Environmental Law & Ethics	Short report, viva / MCQ	10
Presentation Skills	Rubric-based seminar / report evaluation	5
Attendance	Attendance record	5
Total		60

SEMESTER - II

25UMAT21	DIFFERENTIAL EQUATIONS AND TRANSFORMS	Category	L	T	P	Credit
		BS	3	1	0	4

Course Prerequisite:

Matrices and Calculus

Course Objective

- To introduce mathematical tools to solve first order differentiation equations.
- To gain knowledge of problem-solving techniques of PDE.
- To understand concept of the Laplace transform.
- To inculcate the computation knowledge in Laplace transforms..
- To acquaint with Fourier Transform techniques used in a wide variety of situations involving functions that are not necessarily periodic.

Course Outcome

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

CO1	Solve higher order differential equations	Apply(K3)
CO2	Formulate and solve various types of partial differential equations	Apply(K3)
CO3	Apply Laplace transforms and initial and final value theorems to solve engineering problems involving step, impulse and periodic functions.	Apply(K3)
CO4	Apply Laplace transforms to solve ordinary differential equations with constant coefficients and simultaneous ordinary differential equations	Apply(K3)
CO5	Apply Fourier transform techniques, including Fourier integral theorem, properties of Fourier transforms, convolution, and Parseval's identity	Apply(K3)

SYLLABUS

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (12)

Differential Equations (Higher order): Linear differential equations of higher order – with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients - simultaneous linear differential equations, solution by variation of parameters method.

UNIT II	PARTIAL DIFFERENTIAL EQUATIONS	(12)

Formation of partial differential equations- Solutions of standard types of first order partial differential equations- Lagrange's linear equation- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT III	LAPLACE TRANSFORM	(12)

Existence conditions-Transforms of elementary functions- Properties, Transform of unit step function and unit impulse function -Transforms of derivatives and integrals- Transforms of Periodic Functions- Initial and final value theorems.

UNIT IV	INVERSE LAPLACE TRANSFORM	(12)

Inverse Laplace Transforms – Properties, Convolution theorem, Application - Solution of ordinary differential equations with constant coefficients -Solution of simultaneous ordinary differential equations.

UNIT V	FOURIER TRANSFORM	(12)

Fourier Integral theorem (statement only), Fourier transform and its inverse – Properties, Fourier sine and cosine transform - Properties, Convolution and Parseval's identity.

TOTAL PERIODS: 60

Text Book

1. Veerarajan T., "Engineering Mathematics – I and II",Tata McGraw-Hill, New Delhi, 2014 and 2015.
2. Dr. M.K. Venkataraman, "Engineering Mathematics – Volume I and Volume II", The National Publishing Company, Chennai 2008.

Reference Book & Web Resources

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2015.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.
3. Bali N.P and Manish Goyal., "A Text Book of Engineering Mathematics", Laxmi Publications(P) Ltd, 2011.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 9th Edition, 2011.

Online Courses/NPTEL/SWAYAM:

1. https://nptel.ac.in/courses/111106139
2. https://nptel.ac.in/courses/111101153
3. https://nptel.ac.in/courses/111107119

CO-PO -PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2					1		1		
CO2	3	2	2	2					1		1		
CO3	3	2	2	2					1		1		
CO4	3	2	2	2					1		1		
CO5	3	2	2	2					1		1		

Assessment Methodology	Assessment Tools	Marks
Continuous Assessment		25
Mathematical modeling assignment	Analytical solution presentation	5
Transform applications project (MATLAB/Python)	Demo and viva	5
Attendance	Attendance register	5
Total		**40**

25UHST22	UNIVERSAL HUMAN VALUES II	Category	L	T	P	Credit
		HS	2	0	0	2

Course Prerequisite:

Universal Human Values - I

Course Objective

- To enable students to grasp the relevance of value-based living for personal and societal well-being.
- To help students identify the components of human existence and differentiate their individual needs.
- To promote an understanding of key human values that foster harmonious relationships.
- To develop an awareness of the symbiotic relationship between humans and nature.
- To encourage ethical and humanistic behaviour, particularly in professional and social contexts.

Course Outcome

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

CO1	Understand the importance of value education in achieving happiness, prosperity, and holistic human development.	Understand(K2)
CO2	Distinguish between the needs of the self and the body to ensure inner harmony and well-being.	Understand(K2)
CO3	Illustrate trust, respect and justice in the family and society build harmony in human relationships.	Understand(K2)
CO4	Recognize the interconnectedness and mutual fulfilment among all orders of nature to live in harmony with existence.	Remember (K1)
CO5	Describe the importance of ethical conduct based on natural acceptance of human values.	Understand(K2)

SYLLABUS

UNIT I INTRODUCTION TO VALUE EDUCATION (9)

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education); Understanding Value Education; Self-exploration as the Process for Value Education; Continuous Happiness and Prosperity – the Basic Human Aspirations; Happiness and Prosperity – Current Scenario; Method to Fulfill the Basic Human Aspirations: Exploring Natural Acceptance

UNIT II HARMONY IN THE HUMAN BEING (9)

Understanding Human Being as the Co-existence of the Self and the Body; Distinguishing between the Needs of the Self and the Body; Exploring the Difference of Needs of Self and Body; The Body as an Instrument of the Self; Understanding Harmony in the Self; Harmony of the Self with the Body; Programme to Ensure Self-regulation and Health; Exploring Harmony of Self with the Body.

UNIT III HARMONY IN THE FAMILY AND SOCIETY (9)

Harmony in the Family – the Basic Unit of Human Interaction; 'Trust' – the Foundational Value in Relationship; 'Respect' – as the Right Evaluation; Other Feelings, Justice in Human-to-Human Relationship; Understanding Harmony in the Society; Vision for the Universal Human Order.

UNIT IV HARMONY IN THE NATURE / EXISTENCE (9)

Understanding Harmony in the Nature; Interconnectedness, Self-regulation and Mutual Fulfillment among the Four Orders of Nature: Exploring the Four Orders of Nature; Realizing Existence as Co-existence at All Levels; The Holistic Perception of Harmony in Existence: Exploring Co-existence in Existence.

TEXT BOOKS

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethic", Excel Books, 2nd Revised Edition, New Delhi, 2019.

2. RR Gaur, R Asthana, G P Bagaria, "Teachers‟ Manual for A Foundation Course in Human Values and Professional Ethics", Excel Books, 2nd Revised Edition New Delhi, 2019.

REFERENCE BOOKS:

1. Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak," Jeevan Vidya" 1999.

2. A.N. Tripathi, "Human Values" New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth".

Web Resources:

1.https://nptel.ac.in/courses/109/104/109104115/

2. https://www.ugc.ac.in/pdfnews/8504234_Value-Education.pdf

3. https://www.aicte-india.org/sites/default/files/UHV%20Model%20Curriculum.pdf

4. http://www.rguktn.ac.in/value-education

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1						3		3					
CO2						3	3	3			3		
CO3						3		3	3				
CO4						3	3	3		3			
CO5											3		

Assessment Methodology	**Assessment Tools**	**Marks**
Continuous Assessment		25
Case study analysis	Group discussion and report	5
Value-based project proposal	Presentation and peer evaluation	5
Attendance	Attendance register	5
Total		**40**

25URAT23	ELECTRICAL CIRCUITS AND MACHINES	Category	L	T	P	Credit
		ESC	3	0	0	3

Course Prerequisite

Basic knowledge of Physics (electricity and magnetism), elementary Mathematics (algebra and calculus), and fundamental concepts of electrical quantities (voltage, current, resistance, power*).*

Course Objective

To provide foundational knowledge of electrical circuits and machines by introducing basic laws, analysis techniques, network theorems, transient behaviour, and the principles of operation, characteristics, and applications of transformers, DC machines, and AC machines in engineering and automation.

Course Outcome

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

CO1	Apply fundamental laws, conversion techniques, analysis methods, network theorems, and transient response analysis to DC electrical circuits.	Apply (K3)
CO2	Analyze AC circuits using mesh and nodal analysis; evaluate resonance, transient response and three-phase systems.	Apply (K3)
CO3	Understand the concepts of magnetic circuits and transformer operation, and apply basic methods to analyze transformer performance and applications.	Understand (K2)
CO4	Understand the construction, operation, types, characteristics, and control of DC machines, and their applications in robotics.	Understand (K2)
CO5	Understand the construction, operation, types, and control of AC machines, with applications in robotics.	Understand (K2)

SYLLABUS

UNIT I DC CIRCUITS (12)

Ohm's Law-Kirchhoff's Laws: KCL and KVL -Star-Delta (Y-Δ) and Delta-Star (Δ-Y) Conversion-Mesh Analysis and Nodal Analysis for DC circuits - Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem -Transient Response of RL, RC and RLC Series Circuit with DC Excitation.

UNIT II AC CIRCUITS (12)

Fundamental of AC circuits -Active, reactive, and apparent power - Power Factor -Mesh and Nodal Analysis of AC Circuits -Series and Parallel Resonance in RLC Circuits - Transient Response of RL, RC and RLC Series Circuit with Sinusoidal & Exponential Excitation -Three-Phase Circuits: Balanced and unbalanced systems, Star (Y) and Delta (Δ) Connections, Star-delta transformation– Three Phase Power Measurement using Two Wattmeter method.

UNIT III MAGNETIC CIRCUITS AND TRANSFORMERS (12)

Magnetic Circuits: Concept of MMF, flux and magnetic reluctance, Self and mutual inductances, Dot convention, coefficient of coupling and coupled circuits. Single-phase transformer: Construction, working principle, EMF equation, ideal transformer, no-load and load operation-Equivalent circuit and phasor diagram-Voltage regulation, losses, and efficiency of transformer.

UNIT IV DC MACHINES (12)

Construction of DC Machines - Working Principle of DC Generator: EMF Equation - Working Principle of DC Motor: Torque Equation, Back EMF - Types of DC Machines -Performance Characteristics of DC Motors - Starting of DC Motors:3-point Starter ,4-point Starter-Applications of DC motors in robotics and automation.

UNIT V AC MACHINES (12)

Three-Phase Induction Motors **:**Construction and operating principle -Types: Squirrel cage and slip ring - Torque-speed characteristics -Starting and speed control methods-Single-Phase Induction Motors :Construction and principle of operation – Types of single-phase Induction motor.

TOTAL PERIODS: 60

TEXT BOOKS

1. Kothari, D. P., and I. J. Nagrath. Basic Electrical Engineering. Vol. 2. Tata McGraw-Hill Education, New Delhi, 2010.

2.Wildi, Theodore. Electrical machines, drives, and power systems. Pearson Educactión, 2006

REFERENCE BOOKS

1. William, H. A. R. T., Jack E. Kemmerly, and Steven M. Durbin. Engineering circuit analysis. McGraw-Hill Higher Education, 2007.
2. Charles K. Alexander and Matthew N.O. Sadiku**,***Fundamentals of Electric Circuits*, McGraw-Hill Education.
3. Bimbhra, P. S., and G. C. Garg. Electrical machines-I. Khanna Publishing House, 2014.
4. J Chapman, Stephen. "Electric Machinery Fundamentals." (2004).
5. D.C. Kulshreshtha**,***Basic Electrical Engineering*, McGraw-Hill Education.

Online Courses/NPTEL/SWAYAM:

1. https://onlinecourses.nptel.ac.in/noc23_ee81
2. https://onlinecourses.nptel.ac.in/noc21_ee24

CO-PO -PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	-	2	-
CO2	3	3	2	2	2	-	-	-	-	-	-	2	1
CO3	3	3	2	2	2	-	-	-	-	-	-	3	2
CO4	3	3	2	2	2	-	-	-	-	-	-	3	3
CO5	3	3	2	2	2	-	-	-	-	-	-	3	3

Assessment Methodology	**Assessment Tools**	**Marks**
Continuous Assessment		25
Assignments / Quiz / Participation	Problem-solving assignment	5
Simulation analysis (MATLAB/Multisim)	Demo and report	5
Attendance	Attendance register	5
Total		**40**

25URAT24	SENSORS AND ACTUATORS	Category	L	T	P	Credit
		PC	3	0	0	3

Course Prerequisite

- Basic knowledge of Physics and Electronics at the higher secondary level.
- Familiarity with basic electrical measurements and circuit theory.
- Understanding of fundamental mechanical engineering concepts such as force, motion, and torque.

Course Objective

- Introduce measurement systems and transducer characteristics.
- Develop knowledge of displacement, pressure, and temperature sensors.
- Familiarize with advanced sensors and robotic applications.
- Explain construction, working, and selection of motors and actuators for robotics.
- Equip with skills for integrating sensors and actuators into robotic systems.

Course Outcome

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

CO1	Explain the elements of measurement systems and classify transducers based on their characteristics.	Understand (K2)
CO2	Analyze the working principles and performance parameters of displacement, pressure, and temperature sensors.	Analyze(K4)
CO3	Evaluate advanced sensors and apply sensor fusion techniques in robotic applications.	Apply (K3)
CO4	Compare different types of electric motors and actuators and select appropriate ones for specific robotic systems.	Understand (K2)
CO5	Perform actuator sizing calculations and integrate sensors and actuators into robotic systems through case studies.	Apply (K3)

SYLLABUS
UNIT 1 SCIENCE OF MEASUREMENT & BASIC TRANSDUCERS (9) Measurement System & Instrumentation: Elements of a measurement system, functional block diagram, Classification of measuring instruments. Transducers: Classification & Characteristics- Classification: active/passive, analog/digital, contact/non-contact., Static characteristics: accuracy, precision, sensitivity, resolution, linearity, hysteresis. Dynamic characteristics: speed of response, time constant, fidelity. Errors & Calibration- Types of errors: systematic, random, gross; methods to minimize. Statistical analysis: mean, standard deviation, uncertainty. Calibration methods: primary and secondary standards.
UNIT II DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS (9) Displacement Measurement- Strain Gauge: gauge factor, sensing elements, configuration, unbonded strain gauge. Capacitive transducer: various arrangements. Inductive transducer, LVDT: principle, characteristics, applications. Pressure Measurement -Bourdon tube, diaphragm, piezoresistive pressure sensors (intro). Temperature Measurement -RTD: materials & range, resistance vs. temperature characteristics. Thermistor: characteristics, applications. Thermocouple: types, characteristics, laws of thermoelectricity
UNIT III ADVANCED SENSORS AND ROBOTIC APPLICATIONS (9) Vision Sensors: RGB cameras, Stereo vision, Time-of-Flight (ToF) cameras, Structured light sensors, LiDAR (Light Detection and Ranging): principles, types (2D, 3D), and robotic applications, Basics of image processing for robotic vision systems. Tactile and Force Sensors: Pressure sensors, Torque sensors, Piezoelectric sensors, Force-torque sensors for robotic manipulators and grippers. Environmental Sensors: Temperature sensors, Humidity sensors, Gas sensors. Navigation Sensors: Compass (Magnetometer), GPS, RFID, Inertial Measurement Units (IMU), Wheel encoders. Sensor Fusion Techniques: Basic concepts of sensor fusion, Kalman Filter: brief introduction and role in sensor fusion.
UNIT IV: ELECTRIC MOTORS FOR ROBOTICS (9) DC Motors: Brushed DC: construction, torque-speed characteristics, applications. Brushless DC (BLDC): electronic commutation, hall sensors, advantages. AC Motors : Permanent Magnet Synchronous Motors (PMSM): principle, advantages. Servo Motors: DC servo and AC servo, working, feedback, closed-loop control. Stepper Motors : Permanent magnet, variable reluctance, hybrid; step angle, micro stepping.

UNIT V: LINEAR AND SPECIAL ACTUATORS WITH INTEGRATION (9)

Linear Actuators: Electric linear actuators: screw-driven, belt-driven; selection factors. Piezoelectric Actuators: Principle, micro-motion applications. Motor Drivers & Feedback Devices: H-bridge, ESC, servo drivers; encoders, resolvers. Actuator Selection &Integration: Sizing calculations (torque, speed, safety factors). Coupling with gearboxes, thermal considerations. Applications & Case Studies: Actuator choice in manipulators, mobile robots, autonomous systems.

TOTAL PERIODS:45

TEXT BOOK

1. Sawhney, A. K. A Course in Electrical and Electronic Measurements and Instrumentation. Delhi: Dhanpat Rai & Co. Pvt. Ltd.
2. Siegwart, Roland, Illah R. Nourbakhsh, and Davide Scaramuzza. *Introduction to Autonomous Mobile Robots*. 3rd ed. Cambridge, MA: MIT Press, 2022.
3. D. Patranabis"Sensors and Transducers"PHI Learning Pvt. Ltd., 2nd Edition.
4. Bolton, W."Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering"Pearson Education, 7th Edition.

REFERENCE BOOK

1. R. K. Rajput"Instrumentation and Control Systems"S. Chand Publishing.
2. John Turner & Martyn Hill"Instrumentation for Engineers and Scientists" Oxford University Press
3. SabrieSoloman"Sensors Handbook"McGraw-Hill Education.
4. Ida, Nathan. *Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction*. Boca Raton, FL: CRC Press, 2014.
5. Alegria, Francisco André Corrêa. Sensors and Actuators. Singapore: World Scientific Publishing, 2023.

Online Courses/NPTEL/SWAYAM:

https://archive.nptel.ac.in/courses/108/108/108108147/

https://onlinecourses.nptel.ac.in/noc21_ee32/preview

CO-PO -PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	2	–	–	–	–	1	1	3	2
CO2	3	3	2	1	2	–	–	–	–	1	1	3	2
CO3	3	3	2	2	3	–	1	–	–	1	1	3	3
CO4	3	2	2	2	3	–	–	–	1	2	2	3	3
CO5	3	3	3	2	3	–	1	–	1	2	2	3	3

Assessment Methodology	**Assessment Tools**	**Marks**
Continuous Assessment Test		25
Real time-based Sensor application – mini project	Hardware demo and report	5
Instrumentation simulation (MATLAB/LabVIEW/Multisim)	Demo and viva	5
Attendance	Attendance Register	5
Total		**40**

25UCSI25	PROBLEM SOLVING USING PYTHON	Category	L	T	P	Credit
		ES	2	0	4	4

Course Prerequisite:

None Course

Course Objective

To introduce fundamental programming concepts using Python for problem-solving, data handling, control structures, and basic web development.

Course Outcome

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

CO1	Understand the fundamental Python syntax and control structures to develop simple programs and algorithms	Understand (K2)
CO2	Construct modular programs using functions and string operations	Understand (K2)
CO3	Implement basic and advanced data structures (list, tuple, set, dictionary) to solve real-world problems	Apply (K3)
CO4	Develop file-handling routines, reusable modules, and object-oriented programs for small applications.	Apply (K3)
CO5	Use Python libraries (NumPy, Matplotlib, OpenCV, PySerial) to interface with sensors and perform automation or simulation tasks.	Apply (K 3)

SYLLABUS

UNIT I: Python Fundamentals and Control Structures (9)

Introduction to Python and IDEs (IDLE, Anaconda, Jupyter, VS Code); Basic syntax, indentation, and keywords; Data types: int, float, string, boolean; Variables and input/output operations; Operators and expressions; Conditional statements (if, if-else, if-elif-else); Looping structures: for, while, break, continue; Flowcharts and pseudocode for algorithm design; Fundamentals of computing and algorithm development: statements, control flow, functions, and recursion**.**

Illustrative problems: find minimum in a list, insert a card into a sorted list, number guessing game, Towers of Hanoi.

UNIT II: Functions, Strings, and Algorithmic Thinking (9)

Function definition and invocation, parameters and return values, function composition, recursion, local and global scope; String creation, indexing, slicing, string methods, immutability; String module usage and operations.

Illustrative problems: swap values of two variables, check palindrome, calculate distance between two points, compute square root, GCD, and exponentiation using functions.

UNIT III: Data Structures – Lists, Tuples, Sets, and Dictionaries (9)

List creation, indexing, slicing, list methods; Tuple creation, immutability, tuple packing/unpacking; Set operations: creation, membership, union, intersection, difference; Dictionary structure, key-value operations, updating and iteration; Differences between data structures; Nested data structures; Iteration using for/while; List/set/dictionary comprehensions.

Illustrative problems: basic list operations, frequency count using dictionary, remove duplicates with sets, store and retrieve data using dictionaries, find common elements, iterate over nested structures.

UNIT IV: File Handling, Modules, and Object-Oriented Programming (9)

File operations: open, read, write, close; Text file processing and manipulation; Working with Python standard modules: math, random, os; Creating and importing user-defined modules; Object-oriented programming concepts: defining classes and creating objects; Constructors (__init_) and destructors; Encapsulation, basic inheritance, and polymorphism

Illustrative problems: read/write data from files, handle invalid inputs gracefully, build and use reusable custom modules, resistor color code decoder, basic circuit component manager.

UNIT V: Python Libraries for Robotics and Automation (9)

Introduction to NumPy- creating and manipulating arrays, performing mathematical and matrix operations, Matplotlib - 2D plotting for visualization of sensor data, control signals, and system behavior, OpenCV basics- image loading, color-to-grayscale conversion, edge detection techniques;Python in automation: serial communication with external hardware using PySerial, basic sensor interfacing;Overview of simulation environments: introduction to PyBullet or ROS-Py for robotics simulation and control.

Illustrative applications: plot sensor data using Matplotlib, detect edges in images with OpenCV, send and receive data over serial using PySerial, simulate simple robotic motion in PyBullet/RO.

Text Book

1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and programming”, 1st Edition, BCS Learning & Development Limited, 2017.

Reference Book & Web Resources

1. Paul J. Deitel , Harvey Deitel "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. Wes McKinney, Python for Data Analysis, 2nd Ed., O'Reilly Media..
4. Lentin Joseph, Mastering ROS for Robotics Programming, 2nd Ed., Packt Publishing

Web link(s):

1. https://python.swaroopch.com/
2. https://goalkicker.com/PythonBooks/PythonNotesForProfessionals.pdf
3. https://www.w3schools.com/python/
4. https://diveintopython3.problemsolving.io/

CO-PO -PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1			-	-	-	-	-	-	2	3
CO2	3	2	3	-		-	-	-	-	-	-	1	3
CO3	3	2	3	1	1	1	1	-	-	-	1	2	3
CO4	3	2	3	2	2	-	-	-	-	-	1	2	3
CO5	3	2	3	2	3	1	-	-	-	-	1	2	3

Assessment Methodology	**Assessment Tools**	**Marks**
Test		25
Mini Project – Real-Time Python Application		5
Simulation / Lab Exercise		5
Attendance	Attendance Register	5
Total		**40**

25URAP26	ELECTRICAL AND ELECTRONICS LAB	Category	L	T	P	Credit
		ESC	0	0	2	1

COURSE PREREQUISITE

- Fundamental concepts of electrical circuits, machines, and electronic components.
- Basic knowledge of logic gates and Boolean algebra in analyzing digital circuits.

Course Objective

- Understand and verify fundamental electrical laws and circuit behaviors
- Perform load tests and analyze performance characteristics of electrical machines
- Apply speed control techniques and power measurement methods in electrical systems
- Explore semiconductor device characteristics and their applications in basic circuits
- Design and test basic analog and digital electronic circuits for signal processing and logic operations

Course Outcome

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

CO1	Verify electrical laws and theorems through circuit-based experiments	(Apply – K3)
CO2	Analyze the performance characteristics of transformers, DC motors, and induction motors under different loading conditions.	(Analyze – K4)
CO3	Demonstrate speed control techniques for DC motors using field and armature control methods**.**	(Apply – K3)
CO4	Construct and test analog electronic circuits using diodes, BJTs, and amplifiers.	(Apply – K3)
CO5	Implement and verify Boolean expressions and basic combinational logic circuits such as adders and subtractors	(Apply – K3)

SYLLABUS

LIST OF EXPERIMENTS

PART A – ELECTRICAL EXPERIMENTS

1. Verification of Ohm's Law and Kirchhoff's Laws
2. Series and Parallel Resonance in RLC Circuits
3. Load Test on a Single Phase Transformer
4. Load Test on DC Shunt motor.
5. Speed Control of DC Motor (Armature/Field control methods)
6. Measurement of Three-Phase Power using Two-Wattmeter Method
7. Load Test on a Three Phase Induction Motor

PART B – ELECTRONICS EXPERIMENTS

1. Study of PN Junction Diode Characteristics (Forward and Reverse Bias)
2. Zener Diode Voltage Regulation
3. Input and Output Characteristics of BJT in CE Configuration
4. Half Wave and Full Wave Rectifiers with and without Filter
5. Construction and Testing of a Simple RC Coupled Amplifier
6. Logic Gates – Verification of Truth Tables (AND, OR, NOT, NAND, NOR, XOR)
7. Implementation of Boolean Expressions and Basic Combinational Circuits (Adder, Subtractor)

TEXT BOOKS

1. Susan S. Mathew and Saji T. Chacko. Fundamentals of Electrical and Electronics Engineering (with Lab Manual). New Delhi: Khanna Publishing House, 2021.
2. Bernstein, Gary H. An Introduction to Electrical Engineering with Lab Activities. New York: McGraw-Hill Education, 2018.

REFERENCE BOOKS

1. Boylestad, Robert L., and Louis Nashelsky. Electronic Devices and Circuit Theory. 11th ed. Upper Saddle River, NJ: Pearson, 2013.
2. Mehta, V.K., and Rohit Mehta. Principles of Electronics. New Delhi: S. Chand & Company Ltd., 2020.
3. Chapman, Stephen J. Electric Machinery Fundamentals. 5th ed. New York: McGraw-Hill Education, 2012.
4. Kulshreshtha, D.C. Basic Electrical Engineering. New Delhi: Tata McGraw-Hill Education, 2009.
5. Sudhakar, A., and Shyammohan S. Palli. Circuits and Networks: Analysis and Synthesis. 5th ed. New Delhi: McGraw-Hill Education, 2015.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1								1	1	
CO2	3	3	2								2	1	
CO3	3	3	2								2	1	
CO4	3	3	2								3	1	
CO5	3	3	2								3	1	

Assessment Methodology	Assessment Tools	Marks
Laboratory Conduction	Observation	10
Record work		10
Model exam		15
Viva		5
Virtual lab assignment	Review	10
Attendance	Attendance Register	10
Total		60

25URAP27	SENSORS AND ACTUATORS LAB	Category	L	T	P	Credit
		ESC	0	0	2	1

COURSE PREREQUISITE

- Basic knowledge of electrical and electronic components, Ohm's law, circuit theory, transducers, and measurement principles.
- Fundamental understanding of microcontroller programming, control systems, and signal conditioning concepts.

Course Objective

- Understand the working principles and characteristics of common sensors and actuators used in automation and robotics.
- Calibrate and analyze various transducers for measurement of physical quantities such as displacement, temperature, strain, and level.
- Interface sensors and actuators with microcontrollers for data acquisition and control.
- Implement closed-loop control systems using sensor feedback for precise actuation.
- Develop basic virtual instrumentation systems for data visualization and monitoring applications.

Course Outcome

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

CO1	Demonstrate the working principles of displacement, temperature, strain, level, and distance sensors through experimentation.	(Understand – K2)
CO2	Calibrate various transducers (LVDT, RTD, Thermistor, Strain Gauge) and determine their sensitivity and linear range.	(Apply – K3)
CO3	Interface sensors and actuators with microcontrollers to measure, monitor, and control physical parameters.	(Apply – K3)
CO4	Design and implement closed-loop control systems (speed, position, and temperature control) using PWM and feedback techniques.	(Analyze – K4)
CO5	Acquire and visualize real-time data using virtual instrumentation tools such as LabVIEW or MATLAB.	(Create – K6)

SYLLABUS

LIST OF EXPERIMENTS

1. Study and Calibration of LVDT.
2. Temperature Measurement using Thermistor, RTD, and Thermocouple.
3. Measurement of Strain using Strain Gauge and Wheatstone Bridge.
4. Measurement of Level in a tank
5. Distance and Obstacle Detection using Ultrasonic Sensor.
6. Speed Control of DC Motor using PWM
7. Position Control of Servo Motor using Microcontroller
8. Step Angle Control of Stepper Motor.
9. Closed-Loop Temperature Control System
10. Data Acquisition through Virtual Instrumentation

TEXT BOOKS

1. D. Patranabis, Sensors and Transducers, 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2019.
2. John G. Webster and Halit Eren, Measurement, Instrumentation, and Sensors Handbook, 2nd Edition, CRC Press, 2014.

REFERENCE BOOKS

1. Godfrey C. Onwubolu, Mechatronics: Principles and Applications, Butterworth-Heinemann, 2005.
2. A.K. Sawhney and Puneet Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Sons, 2020.
3. Gary W. Johnson and Richard Jennings, LabVIEW Graphical Programming, 5th Edition, McGraw-Hill, 2017.
4. Nitaigour Premchand Mahalik, Mechatronics: Principles, Concepts and Applications, Tata McGraw-Hill Education Pvt. Ltd., 2002.
5. R. S. Gaonkar, Microprocessor and Microcontroller Systems, 6th Edition, Penram International Publishing (India) Pvt. Ltd., 2017

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1								1	1	
CO2	3	3	2								2	1	
CO3	3	3	2								2	1	
CO4	3	3	2								3	1	
CO5	3	3	2								3	1	

Assessment Methodology	Assessment Tools	Marks
Laboratory Conduction	Observation	10
Record work		10
Model exam		15
Viva		5
Virtual lab assignment	Review	10
Attendance	Attendance Register	10
Total		60

25UGEP28	FABRICATION LAB	Category	L	T	P	Credit
		ES	0	0	2	1

Course Prerequisite

- Basic knowledge of engineering graphics and workshop tools.
- Understanding of mechanical and electronic components.
- Awareness of lab safety and material handling procedures.

Course Objective

•To explore open-source tools and techniques for modern fabrication and prototyping

•To develop practical skills in electronics design, simulation, and PCB fabrication

•To understand software prototyping methodologies and rapid development techniques

•To gain hands-on experience with digital fabrication tools like 3D printing and laser cutting

•To integrate multiple technologies for complete product development and demonstration

Course Outcome

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

CO1	Understand open-source principles and effectively use open-source tools for electronics and software development	Understand (K2)
CO2	Design and simulate electronic circuits using open-source tools and develop functional PCBs	Create (K6)
CO3	Develop software prototypes and user interfaces using modern development frameworks and no-code platforms	Create (K6)
CO4	Create physical prototypes using digital fabrication techniques including 3D printing and laser cutting	Create (K6)
CO5	Integrate electronics, software, and mechanical components to demonstrate complete functional prototypes	Evaluate (K5)

SYLLABUS

UNIT I INTRODUCTION TO OPEN-SOURCE TOOLS AND TECHNIQUE (3)

Explore the concept of open-source, its underlying principles and its contrast with proprietary software. Discuss the advantages of using open-source tools, such as lower costs, increased innovation, educational value, and community support. Walk through to the commonly used open-source tools for electronics design (KiCad, FreeCAD), software development (Python, Eclipse), and fabrication (Cura, LinuxCNC).

Practical Activities: - Installation and setup of open-source tool suite - Comparison exercise between open-source and proprietary tools - Community platform exploration (GitHub, forums, documentation)

UNIT II ELECTRONICS FUNDAMENTALS AND TOOLS (6)

Introduction to basic electronic components (resistors, capacitors, transistors, etc.). Understanding of electronic circuits and their functions. Hands-on practice with CircuitJS and Falstad. Simulating and analysing electronic circuits. Introduction to Arduino and Raspberry Pi, exploring their capabilities and applications. Designing PCBs using KiCad and EasyEDA. Understanding PCB fabrication processes.

Practical Activities: - Circuit simulation using CircuitJS and Falstad - Arduino programming and interfacing exercises - Raspberry Pi setup and basic projects - PCB design workflow using KiCad - PCB fabrication process demonstration

UNIT III SOFTWARE PROTOTYPING AND TOOLS (6)

Benefits of rapid prototyping in product development. Iterative design and testing. Wireframing tools (Balsamiq, Figma). UI design tools (Sketch, Figma). Programming languages (Python, JavaScript). Testing frameworks (Selenium). No-code platforms (Bubble, Adalo, Wix, AppGyver). Building functional prototypes without extensive coding.

Practical Activities: - Wireframe creation using Figma - Mobile app prototype using no-code platforms - Simple web application development - User testing and iteration exercises - API integration in prototypes

UNIT IV FABRICATION AND PROTOTYPING **(7)**

Overview of fabrication techniques (3D printing, laser cutting, CNC machining). Prototyping methods for physical products, using tools like Blender, TinkerCAD, or Fusion 360. Creating 3D models for physical prototypes. Hands-on experience with laser cutting and engraving. Understanding their applications and limitations.

Practical Activities: - 3D modeling using TinkerCAD and Fusion 360 - 3D printing workflow and hands-on printing - Laser cutting design and fabrication - Material selection and testing - Post-processing and finishing techniques

UNIT V SIMULATION & DEMONSTRATION **(8)**

Integrated project demonstration, explaining the design process, technical choices, and outcomes. Simulation showcase to demonstrate their understanding of various technical tools and prototyping techniques.

Practical Activities: - Integrated project development - System integration and testing - Documentation and presentation preparation - Peer review and feedback sessions - Final demonstration and evaluation

TOTAL PERIODS: 30

TEXT BOOKS

1. Neil Gershenfeld, “Fab: The Coming Revolution on Your Desktop”, Basic Books, 2007.
2. Anna Kaziunas France, “Make: 3D Printing Projects”, Maker Media, 2016.

REFERENCE BOOKS

1. Massimo Banzi, “Getting Started with Arduino”, 3rd Edition, Maker Media, 2014.
2. Simon Monk, “Programming the Raspberry Pi”, 2nd Edition, McGraw-Hill, 2016.
3. Shawn Wallace, “KiCad Like a Pro”, Independently Published, 2019.
4. Ryan Whitwam, “Beginning 3D Printing”, Apress, 2015.

ONLINE RESOURCES

- KiCad Documentation
- Arduino Project Hub
- Thingiverse 3D Models
- Figma Design Resources
- Fusion 360 Learning

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1	3	2	2	2	2	1	3	2	2
CO2	3	2	3	3	3	2	1	3	2	1	2	3	3
CO3	2	2	3	2	3	2	1	3	3	2	3	3	3
CO4	2	2	3	3	3	2	1	3	2	1	2	3	2
CO5	3	3	3	3	3	3	2	3	3	2	3	3	3

Assessment Methodology	**Assessment Tools**	**Marks**
Laboratory Conduction	Observation	10
Record work		10
Model exam		15
Viva		5
PCB design and fabrication	Working prototype demo	5
3D Model contest	Review	5
Attendance	Attendance Register	10
Total		60

25UPCE21	COMMMUNICATION SKILLS	Category	L	T	P	Credit
		EEC	0	0	2	1

Course Prerequisite:

Carrier Development Skills

Course Objective:

- Ability to plan and manage their career paths effectively.
- It focuses on developing self-assessment, goal setting, and decision-making skills.
- Students will learn to research career options and align them with personal strengths and values.

Course Outcome

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

CO1	Develop sustained motivation and enhance interpersonal skills for effective communication and teamwork.
CO2	Build active listening and conversation skills essential for collaborative and respectful team interactions
CO3	Strengthen reading comprehension and writing clarity through critical analysis and audience-focused expression.
CO4	Improve public speaking and presentation skills while fostering self-assessment through SWOT analysis.
CO5	Promote team collaboration and communication through practical activities like debates and group problem-solving

SYLLABUS

UNIT I: **(10)**

Motivation – II: Intrinsic vs. Extrinsic Motivation- Goal Setting and Achievement - Building and Sustaining Motivation

Interpersonal skills: Effective Communication - Active Listening - Conflict Resolution - Teamwork and Collaboration

UNIT II: **(10)**

Listening Skills: Roles and Responsibilities in a Team - Building Trust and Respect Among Team Members – Effective Team Communication

Conversation skills: Starting and Maintaining a Conversation - Non-Verbal Communication Cues- Active Listening and Responding.

UNIT III: **(10)**

Reading Skills: Skimming and Scanning Techniques – Critical reading and Interpretation

Writing Skills: Grammar and Syntax - Clarity and Conciseness- Audience Awareness

UNIT IV: **(10)**

Presentation Speaking Skills: Speech Structure and Organization – Verbal Delivery Techniques

Public speaking skills: Confidence and overcoming Anxiety –Effective message Delivery

SWOT Analysis: Identifying Internal Factors – Analyzing External Factors

UNIT V: **(8)**

Team Building: Roles and Responsibilities in a team – Communication and Trust – Conflict resolution and Problem Solving

Active Sessions: Debate – Picture Connector

Text Books

1. Soft skills for Managers by Dr. T. KALYANA CHAKRAVATHI.
2. Personal Development and Soft Skills by BARUN K MITRA, Oxford Higher Education

Reference Book

1. The Emotionally Intelligent Workplace by DANIEL GOLEMAN.
2. Communication skills and soft skills an integrated approach by E. SURESH KUMAR, P. SREEHARI, J SAVITHRI.
3. Top Talking in English (international communication skills) by CHARLES T. RAJENDRA
4. Soft skills by RAJ LAKSHMI SURYAVANSHI, Gurucool Publishing

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1:								2	2	2	2
CO2:									3	3	
CO3:										3	
CO4:								2		2	2
CO5:									3	3	

Assessment Methodology	**Assessment Tools**	**Marks**
Continuous Assessment	Quizzes, reflective journals, Assignments	15
Role-Play / Group Discussion	Role-play rubric,peer feedback forms	10
Presentation / Public Speaking	Presentation rubric	10
SWOT Analysis & Report	self-assessment sheet	10
Debate / Active Session	Debate rubric	5
Attendance	Attendance Register	10
Total		60

25UMCC21	IKS IN HUMANITIES AND SOCIAL SCIENCE	Category	L	T	P	Credit
		MCC	0	0	2	0

Course Prerequisite

Basic understanding of Indian history and culture

Course Objective

This course explores Indian Knowledge Systems in the context of humanities and social sciences, providing students with a deeper understanding of India's intellectual heritage. The objectives are to:

- Understand the philosophical foundations of Indian knowledge traditions
- Explore Indian contributions to social sciences, literature, and arts
- Analyze the relevance of ancient wisdom in contemporary social contexts
- Develop appreciation for cultural diversity and heritage

Foster critical thinking about knowledge systems and their applications

Course Outcome

On the successful completion of the course, students will be able to:

CO1	Understand the philosophical foundations and methodologies of Indian knowledge systems in humanities
CO2	Analyze Indian contributions to literature, arts, social organization, and governance systems
CO3	Apply principles from Indian philosophical traditions to contemporary social and ethical issues
CO4	Evaluate the relevance and adaptability of traditional knowledge in modern social contexts
CO5	Create connections between ancient wisdom and contemporary challenges in society

SYLLABUS
Module I: Philosophical Foundations of Indian Knowledge Systems (6) Darshanas (Schools of Philosophy): Samkhya, Yoga, Nyaya, Vaisheshika, Mimamsa, Vedanta - Epistemology in Indian philosophy: Pramanas (means of knowledge) - Ethics and moral philosophy in Indian traditions - Concept of Dharma, Artha, Kama, and Moksha - Comparative study with Western philosophical traditions.
Module II: Indian Literary and Artistic Traditions (6) Sanskrit literature: Vedas, Upanishads, Puranas, Epics (Ramayana, Mahabharata) - Classical poetry and drama: Kalidasa, Bhartrhari, Bhasa - Regional literature and folk traditions - Indian classical music and dance: Theoretical foundations - Visual arts: Sculpture, painting, and architectural styles - Aesthetics in Indian tradition: Rasa theory and Alamkara shastra
Module III: Social Organization and Governance (6) Ancient Indian social structure and organization - Varna and Ashrama systems: Historical context and evolution - Village self-governance: Panchayati Raj origins - Arthashastra: Principles of statecraft and administration - Justice system: Dharmashastra and Rajadharma - Economic systems: Trade, agriculture, and crafts
Module IV: Educational Systems and Knowledge Transmission (6) - Gurukula system: Teacher-student relationship - Ancient universities: Nalanda, Takshashila, Vikramshila - Oral tradition and preservation of knowledge - Women's education in ancient India - Integration of spiritual and material learning - Comparison with modern educational approaches
Module V: Contemporary Relevance and Applications (6) Indian knowledge systems in modern governance - Traditional conflict resolution mechanisms - Environmental consciousness in Indian traditions - Community-based development models - Gender studies: Women in Indian philosophical traditions - Relevance of Indian ethics in corporate governance - Cultural preservation and modernization challenge

Text Book

1. S. Radhakrishnan, “Indian Philosophy”, Oxford University Press, 2008
2. A.L. Basham, “The Wonder That Was India”, Rupa Publications, 2017
3. Kapila Vatsyayan, “Traditional Indian Art and Culture”, Cambridge University Press, 2015

Reference Book & Web Resources

1. Heinrich Zimmer, “Philosophies of India”, Princeton University Press, 1989
2. Romila Thapar, “Early India: From the Origins to AD 1300”, Penguin Books, 2015
3. K.M. Munshi, “The History and Culture of the Indian People”, Bharatiya Vidya Bhavan
4. Digital Library of India: https://www.dli.gov.in
5. Sahapedia - Encyclopedia of Indian Culture: https://www.sahapedia.org
6. Indian Council of Historical Research: https://ichr.ac.in
7. Archaeological Survey of India: https://asi.nic.in

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	1	-	-	1	-	2	2	2	3	3	-	-
CO2	2	2	1	1	2	1	2	3	3	3	3	-	-
CO3	2	2	2	2	3	2	3	3	3	3	3	-	-
CO4	2	2	2	2	3	3	3	3	3	3	3	-	-
CO5	3	3	3	3	3	3	3	3	3	3	3	-	-

Assessment Methodology	**Assessment Tools**	**Marks**
Thematic Essay Writing	Essay Rubric	15
Cultural Interpretation Project	Project Rubric	10
Comparative Analysis Presentation	Peer Feedback Form	10
Case Study Report	Case Study Rubric	10
Interactive Seminar / Debate	Debate Rubric	10
Attendance	Attendance Register	05
Total		60

25UMCC22	HOLISTIC WELLNESS	Category	L	T	P	Credit
		MCC	0	0	1	0

Course Prerequisite

Basic physical fitness and medical clearance

Course Objective

This course promotes physical fitness, mental well-being, and holistic development ofstudents. The objectives are to:

- Develop physical fitness and motor skills through sports activities
- Learn yoga techniques for stress management and mental clarity
- Understand the importance of physical activity for academic performance
- Promote teamwork, leadership, and sportsmanship.
- Establish lifelong habits for health and wellness

Course Outcome

On the successful completion of the course, students will be able to:

CO1	Demonstrate improved physical fitness and coordination through regular sports participation
CO2	Apply yoga techniques for stress management and mental well-being
CO3	Exhibit teamwork, leadership, and fair play in sports activities
CO4	Analyze the relationship between physical activity and academic performance
CO5	Develop personal fitness plans for lifelong health and wellness

SYLLABUS

UNIT I: Introduction to Physical Fitness (3)

Importance of physical fitness for students - Components of fitness: strength, endurance, flexibility, coordination - Fitness assessment and goal setting - Safety guidelines and injury prevention - Warm-up and cool-down techniques

UNIT II: Sports Activities (9)

Option A: Team Sports (Choose any two) - Cricket: Basic skills, rules, and match play - Football: Fundamental techniques and game strategies - Basketball: Shooting, dribbling, and team coordination - Volleyball: Serving, spiking, and court positioning - Badminton: Strokes, footwork, and doubles play

Option B: Individual Sports (Choose any two) - Athletics: Running, jumping, and throwing events - Table Tennis: Basic strokes and match play - Tennis: Forehand, backhand, and court coverage - Swimming: Basic strokes and water safety - Cycling: Technique and endurance building.

UNIT III: Yoga and Mindfulness (3)

Introduction to yoga philosophy and benefits - Basic yoga asanas (postures): Sun salutation, standing poses, seated poses - Pranayama (breathing techniques): Deep breathing, alternate nostril breathing - Meditation and mindfulness practices - Relaxation techniques and stress management

Practical Activities

Sports Training Sessions: - Skill development workshops - Regular practice sessions - Inter-class tournaments - Sports day participation - Fitness challenges and competitions

Yoga Sessions: - Daily morning yoga practice - Guided meditation sessions - Breathing exercise workshops - Stress relief techniques - Mindfulness activities

Text Book

1. "Complete Guide to Physical Fitness" - Physical Education Department Manual.
2. B.K.S. Iyengar, "Light on Yoga", Harper Thorsons, 1991

Reference Book & Web Resources

1. "Sports Training Principles" by Frank W. Dick, A&C Black, 2007
2. Swami Muktibodhananda, "Hatha Yoga Pradipika", Yoga Publications Trust, 2012
3. Yoga Alliance - Professional Yoga Resources: https://www.yogaalliance.org
4. Sports Authority of India Training Materials
5. Olympic training videos and resources
6. Isha Foundation Yoga Programs: https://isha.sadhguru.org

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	1	-	1	2	2	2	1	-	-
CO2	-	-	-	-	2	-	2	2	2	2	2	-	-
CO3	-	-	-	-	2	2	3	3	3	3	3	-	-
CO4	1	1	-	1	2	1	2	2	2	2	2	-	-
CO5	-	-	-	1	3	2	3	3	3	3	3	-	-

Assessment Methodology	**Assessment Tools**	**Marks**
Physical Fitness & Goal Setting	Personal fitness plan submission	15
Sports Skills & Participation	Peer evaluation during games	10
Yoga & Mindfulness	Demonstration of yoga asanas and pranayama	10
Practical Record / Wellness Journal	Daily or weekly log of sports practice, yoga sessions, and fitness activities	10
Presentation / Viva	Short seminar or viva on personal wellness plan, safety guidelines, or mindfulness benefits	10
Attendance	Attendance Register	05
Total		60

III SEMESTER

FOUREIR SERIES, PROBABILITY AND STATISTICS			
(COMMON TO CSE, ICB, AIML & RA)			
Course Code:	25UMAT31	**Course Type:**	BS
Teaching Periods / Week (L: T: P):	3:1:0	**Credits:**	4
Total Teaching Periods:	60	**CAM+ESE Marks:**	40+60
Teaching Department:	Mathematics		

Course Objectives:

- To enable the students to expand functions in to Fourier series using change of intervals
- To gain knowledge in application of Fourier series
- To acquire knowledge in discrete random variable.
- To familiarize the student about the continuous random variables and their applications.
- To study the basic concepts of Statistics

Unit I	**FOURIER SERIES**	**12 Periods**

Dirichlet 's conditions – General Fourier series - Expansion of periodic function into Fourier series – Fourier series for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Related problems.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit II	**PARSEVAL'S THEOREM & HARMONIC ANALYSIS**	**12 Periods**

Root Mean Square Value – Parseval 's theorem on Fourier Coefficients. Complex form of Fourier series – Harmonic Analysis.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit III	**DISCRETE RANDOM VARIABLES**	**12 Periods**

Random Variables and their event spaces – The probability mass function – Distribution functions – Binomial – Geometric – Negative Binomial and Poisson (Excluding Derivation of Mean, variance and MGF)

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit IV	**CONTINUOUS RANDOM VARIABLES**	**12 Periods**

Probability density function – Exponential distribution – Gamma – Uniform – Gaussian distributions (Excluding Derivation of Mean, variance and MGF)

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit IV	**CONTINUOUS RANDOM VARIABLES**	**12 Periods**

Probability density function – Exponential distribution – Gamma – Uniform – Gaussian distributions (Excluding Derivation of Mean, variance and MGF)

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit V	STATISTICS	12 Periods
Measures of central tendency – Arithmetic Mean, Median, Mode and Standard deviation – Correlation – Rank correlation and regression.		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: Theory: Apply (K3)	
Total		**60 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Expand periodic functions into Fourier series using Dirichlet's conditions and half-range series.

CO2: Solve engineering problems on Fourier series expansion of complex functions, Harmonic analysis and Parseval's theorem.

CO3: Apply the concept of probability in random variables.

CO4: Solve the problem using continuous random variables.

CO5: Apply the concepts of measures of central tendency, standard deviation, correlation, rank correlation and regression to solve statistical problems.

Textbooks:

1. M.K. Venkataraman, "Engineering Mathematics, The National Publishing Company, Madras, 2016.
2. Balaji, "Engineering Mathematics II and Transforms and Partial Differential Equations", Balaji publishers, 18thEdition, 2018.
3. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Co. New Delhi, 2019.
4. B.S. Grewal, "Higher Engineering Mathematics", Khanna publishers - Paperback – 3rd Edition - 2017.
5. T. Veerarajan, "Probability, Statistics and Random Processes", Tata McGraw-Hill Education, 2008.
6. Dr. A. Singaravelu, "Probability and Statistics", Meenakshi Agency, Paperback – 1,2019.

References:

1. N.P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd. New Delhi, 9th Edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition 2019.
3. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi 2018.
4. Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", McGraw-Hill, 1st Edition, 2017.
5. William Mendenhall, Robert J. Beaver, Barbara M. Beaver: "Introduction to Probability & Statistics", Cengage Learning; 15th Edition 2019.
6. Richard. A. Johnson, Irwin Miller and John E. Freund," Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.

Web links and Video Lectures(e-Resources):

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_ma11
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ma43
3. http:// www.stat110.net
4. http://www.nptel.ac.in/courses/111105035_(R.V)
5. https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ma30

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2		1				1		1		
CO2	3	2	2		1				1		1		
CO3	3	2	2		1				1		1		
CO4	3	2	2		1				1		1		
CO5	3	2	2		1				1		1		
AVG													

1 – Low, 2 – Medium, 3 – High,'-' – No correlation

STRENGTH OF MATERIALS			
Course Code:	25URAT31	**Course Type:**	ES
Teaching Periods / Week (L: T: P):	2:1:0	**Credits:**	3
Total Teaching Periods:	45	**CAM+ESE Marks:**	40+60
Teaching Department:	Mechanical Engineering		

Course Objectives:

- To provide a fundamental understanding of stress, strain, deformation, and elastic behavior of engineering materials under different loading conditions.
- To develop the ability to analyze shear force, bending moment, bending stresses, and load-carrying capacity of beams.
- To introduce the principles of torsion and enable the analysis of stresses and deformations in shafts and springs.
- To develop the ability to determine slopes and deflections of beams using classical analytical methods.
- To familiarize students with stress analysis and deformation of thin and thick pressure vessels subjected to internal pressure.

Unit I	**STRESS, STRAIN AND DEFORMATION OF SOLIDS**	**9 Periods**

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress..

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit II	**TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM**	**9 Periods**

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Analyze (K4)

Unit III	**TORSION**	**9 Periods**

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit IV	**DEFLECTION OF BEAMS**	**9 Periods**

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit V	THIN CYLINDERS, SPHERES AND THICK CYLINDERS	9 Periods
Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem.		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: Theory: Apply (K3)	
	Total	**45 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply the fundamental concepts of stress and strain, including thermal stresses and principal stresses, and analyze shear force and bending moment in various beam configurations.

CO2: Analyze normal and shear stress distributions in beams using the theory of simple bending and design beams of uniform strength under combined loading conditions.

CO3: Use the principles of torsion to solve engineering problems involving circular shafts,composite shaft systems, and spring design

CO4: Solve deflection problems in beams using double integration and moment area methods, and apply energy methods such as strain energy and virtual work principles.

CO5: Determine stresses in thin and thick-walled cylinders using Lame's theory including compound cylinders with interference fit.

Textbooks:

1. Strength of Materials- R.K.Bansal - Laxmi Publications, New Delhi, 2020
2. Strength of Materials- R.K. Rajput - S.Chand and Company Ltd., New Delhi, 2022
3. Strength of Materials- Bhavikatti. S. S - Vikas Publishing House (P) Ltd., New Delhi, 2021

References:

1. Mechanics of Materials- Beer F, Jonston E R, DeWolf J- McGraw-Hill Publications, 2020
2. Strength of Materials- U.G.Jindal- Galgotia Publication Pvt. Ltd., New Delhi, 2018

Web links and Video Lectures(e-Resources):

1. http://nptel.ac.in/courses/105106116
2. http://nptel.ac.in/courses/105102090
3. http://nptel.ac.in/courses/112107147

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	2	-	3
CO2	3	2	3	2	-	-	-	-	-	-	2	-	3
CO3	2	2	-	2	-	-	-	-	-	-	1	-	3
CO4	3	3	3	-	-	-	-	-	-	-	2	-	3
CO5	3	3	3	2	-	-	-	-	-	-	2	-	3
AVG	2.8	2.6	3	2	-	-	-	-	-	-	1.8	-	3
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													

FUNDAMENTALS OF ROBOTICS			
Course Code:	25URAT32	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	3:0:0	**Credits:**	3
Total Teaching Periods:	45	**CAM+ESE Marks:**	40+60
Teaching Department:	Robotics and Automation		

Course Objectives:

- To provide knowledge of robot fundamentals, classifications, components, and performance characteristics.
- To introduce coordinate transformations and mathematical representations used in robotic systems.
- To develop the ability to model robotic manipulators using Denavit–Hartenberg (DH) convention.
- To familiarize students with analytical techniques for solving inverse kinematics problems.
- To introduce Jacobian-based methods for robot velocity, singularity, manipulability, and static analysis.

Unit I	**INTRODUCTION TO ROBOTICS**	**9 Periods**

Fundamentals of Robotics - Advantages and Disadvantages of Robots - Robot Components: Link, Joint, Manipulator, Wrist, End-effector - Gripper: Types, Actuator and Sensor - Classification of Robots based on Geometry, Workspace, Actuation, Control and Application - Configuration Space - Joint Space - Workspace - Robot Specifications: Number of Axes: Internal and External (7-axis robot), Capacity and Speed, Reach and Stroke, Tool Orientation, Repeatability, Precision and Accuracy, Operating Environment.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Problem Based Learning
	RBT Level: Theory: Apply (K3)

Unit II	**HOMOGENEOUS TRANSFORMATIONS**	**9 Periods**

Degrees of Freedom - Matrix Representation: Representation of a point and vector in space, Global and Local Coordinate axes - Homogeneous Transformation Matrices - Transformations: Representation of pure translation, Representation of pure Rotation about X, Y, Z axes - Representation of Combined Transformations - Inverse of Transformation Matrices - Euler Angles - Roll, Pitch, Yaw angles - Quaternions - Spinors and Rotators.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Problem Based Learning
	RBT Level: Theory: Analyze (K4)

Unit III	**FORWARD KINEMATICS**	**9 Periods**

Denavit-Hartenberg Notation - Rules for assigning coordinate frames - DH parameter table - Transformation between two Adjacent Coordinate Frames - Composition of link transformations - Forward Kinematics of Two, Three, Four, Five and Six axis Robots (Planar RRR, Cylindrical RRP, Spherical RRP, Articulated RRR, SCARA, Stanford Arm, PUMA 560).

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Simulation Based Learning
	RBT Level: Theory: Apply (K3)

Unit IV	INVERSE KINEMATICS	9 Periods
Inverse Kinematics Problem - Existence and multiple solutions - Decoupling Technique - Inverse Transformation Technique - Inverse Position: Geometric Approach - Inverse Orientation - Inverse Kinematics of Two, Three, Four, Five and Six axis Robots.		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Simulation Based Learning	
	RBT Level: Theory: Apply (K3)	
Unit V	**VELOCITY KINEMATICS AND STATICS**	**9 Periods**
Angular Velocity - Linear Velocity - Jacobian representation of Linear and Angular Velocity - Geometric Jacobian - Calculation of Jacobian for Two, Three and Four axis Robots - Inverse Jacobian - Singularities: Wrist and Arm Singularities - Manipulability - Induced joint torques and forces.		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Simulation Based Learning	
	RBT Level: Theory: Apply (K3)	
	Total	**45 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Explain the fundamentals of robotics, robot components, classifications, workspaces, and performance specifications.

CO2: Apply homogeneous transformation matrices, Euler angles, and quaternions to represent robot position and orientation.

CO3: Analyze and determine forward kinematics of robotic manipulators using Denavit-Hartenberg conventions.

CO4: Solve inverse kinematics problems for industrial robot manipulators using analytical and geometric methods.

CO5: Evaluate robot velocity relationships using Jacobian matrices, identify singularities, and analyze forces and torques in robotic systems.

Textbooks:

1. John J. Craig, "Introduction to Robotics: Mechanics and Control", 4th Edition, Pearson,2018
2. R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw-Hill Education, Reprint 2017

References:

1. Saeed B. Niku, Introduction to Robotics: Analysis, Control, Applications, 3rd Edition, Wiley, 2020.
2. M. P. Groover, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill Education.
3. Richard D. Klafter, Thomas A. Chmielewski, and Michael Negin, Robotic Engineering: An Integrated Approach, Prentice Hall of India (PHI).
4. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Robot Modeling and Control, 2nd Edition, Wiley, 2020.
5. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, and Giuseppe Oriolo, Robotics: Modelling, Planning and Control, Springer, 2nd Edition, 2024.

Web links and Video Lectures(e-Resources):
1. NPTEL – Introduction to Robotics (IIT Kanpur) https://nptel.ac.in/courses/112104298
2. NPTEL – Robotics (IIT Kharagpur) https://nptel.ac.in/courses/112105249
3. NPTEL – Robotics: Basics and Selected Advanced Concepts https://nptel.ac.in/courses/112108298

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	1	-	-	-	-	-	-	3	2
CO2	3	3	2	1	2	-	-	-	-	-	-	3	3
CO3	3	3	2	2	2	-	-	-	-	-	-	3	3
CO4	3	3	2	2	2	-	-	-	-	-	-	3	3
CO5	3	3	2	2	3	-	-	-	-	-	-	3	3
AVG	3	2.8	2	1.75	2	-	-	-	-	-	-	3	2.8
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													

HYDRAULIC AND PNEUMATICS			
Course Code:	25URAT33	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	3:0:0	**Credits:**	3
Total Teaching Periods:	45	**CAM+ESE Marks:**	40+60
Teaching Department:	Robotics and Automation		

Course Objectives:

- To introduce the fundamental principles of hydraulic and pneumatic systems.
- To provide knowledge of hydraulic and pneumatic components and their operating characteristics.
- To develop the ability to analyze and design fluid power circuits for industrial applications.
- To familiarize students with electro-hydraulic and electro-pneumatic control systems
- To equip students with the skills required for selection, maintenance, troubleshooting, and industrial applications of fluid power systems.

Unit I	**FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS**	**9 Periods**

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

Teaching Learning Process	**Pedagogy:** Chalk & Talk, ICT Tools, Simulation
	RBT Level: Theory: Apply (K3)

Unit II	**HYDRAULIC ACTUATORS AND CONTROL COMPONENTS**	**9 Periods**

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories: Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

Teaching Learning Process	**Pedagogy:** Chalk & Talk, ICT Tools, Simulation
	RBT Level: Theory: Apply (K3)

Unit III	**HYDRAULIC CIRCUITS AND SYSTEMS**	**9 Periods**

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit IV	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**	**9 Periods**

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits

Teaching Learning Process	**Pedagogy:** Chalk & Talk, ICT Tools, Simulation
	RBT Level: Theory: Apply (K3)

Unit V	TROUBLE SHOOTING AND APPLICATIONS	9 Periods
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.		
Teaching Learning Process	**Pedagogy:** Chalk & Talk, ICT Tools, Simulation	
	RBT Level: Theory: Apply (K3)	
	Total	**45 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Explain the principles of fluid power systems and evaluate the performance characteristics of hydraulic pumps.

CO2: Illustrate the construction, operation, and selection of hydraulic actuators, motors, and control components for industrial applications.

CO3: Analyze and design hydraulic circuits and systems for various industrial automation applications.

CO4: Design pneumatic and electro-pneumatic circuits using cascade methods, ladder diagrams, and fluidic logic principles.

CO5: Diagnose faults, recommend maintenance practices, and apply hydraulic and pneumatic systems in industrial applications.

Textbooks:

1. Anthony Esposito, Fluid Power with Applications, 7th Edition, Pearson Education, 2013.
2. James R. Daines and Martha J. Daines, Fluid Power: Hydraulics and Pneumatics, 4th Edition, Goodheart-Willcox Publishers, 2025.

References:

1. M. Galal Rabie, Fluid Power Engineering, 2nd Edition, CRC Press, 2024
2. Joji Parambath, Electro-Pneumatics and Automation, FluidSys Training Centre Pvt. Ltd., Latest available Edition, 2023
3. S. R. Majumdar, Oil Hydraulic Systems: Principles and Maintenance, McGraw Hill Education, Reprint Edition, 2020.
4. K. Shanmugasundaram, Hydraulic and Pneumatic Controls, S. Chand Publishing, Latest Available Reprint Edition
5. Noah D. Manring and Roger C. Fales, Hydraulic Control Systems, 2nd Edition, Wiley, 2020.

Web links and Video Lectures(e-Resources):

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_me55
2. https://www.festo.com/in/en/e/technical-education-id_3776
3. https://www.realpars.com/courses/hydraulic-systems

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	2	1	-	-	-	-	-	-	3	3
CO4	3	3	3	2	2	-	-	-	-	-	-	3	3
CO5	3	3	2	3	2	-	-	-	-	-	-	3	3
AVG	3	2.8	2.5	2.33	1.67	-	-	-	-	-	-	3	2.6
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													

SIGNALS AND SYSTEMS			
Course Code:	25URAT34	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	2:1:0	**Credits:**	3
Total Teaching Periods:	60	**CAM+ESE Marks:**	40+60
Teaching Department:	Robotics and Automation		

Course Objectives:

- To provide the fundamentals of continuous-time and discrete-time signals and systems.
- To develop analytical skills for modeling and analyzing linear time-invariant systems.
- To enable students to apply Laplace and Z-transforms for system analysis.
- To introduce frequency-domain analysis using DFT and FFT techniques.
- To equip students with knowledge of sampling theory and signal processing applications in communication and control systems.

Unit I	**Introduction to Signals and Systems**	**12 Periods**

Introduction to signals - Continuous time signals - Discrete time signals – Representation of signals – Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential signals, Classification of continuous and discrete time signals -Operations on the signals - time shifting, time scaling, time reversal. Continuous time and discrete time systems: Classification of systems – Properties of systems.

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit II	**Linear Time-Invariant Systems and Convolution**	**12 Periods**

LTI continuous time systems- Differential equations – Transfer function and Impulse response – Convolution Integral- Block diagram representation and reduction -State variable techniques – State equations.

LTI Discrete time systems – Difference equations – System function and impulse response – Convolution Sum – Block diagram representation – Convolution Sum – State equations for discrete time systems - Application of convolution in robotic and control systems.

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit III	**Transform Techniques for System Analysis**	**12 Periods**

Laplace transform and inverse Laplace transform - Properties of Laplace transform - Transfer function; poles and zeros; stability analysis of continuous-time systems.

Z-transform – Introduction - Properties – Inverse Z- transform – Long Division, Partial Fraction, Residue and Convolution Method - Applications of Z-transform in discrete-time systems

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit IV	**Discrete Fourier Transform**	**12 Periods**

DFT – Properties –Computation of DFT using FFT algorithms –advantages over direct computation of DFT – radix 2 algorithms – DIT and DIF algorithms – Computation of IDFT using FFT.

Teaching Learning Process	**Pedagogy:**Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit V	Sampling and Reconstruction	12 Periods
The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.		
Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL	
	RBT Level: Theory: Apply (K3)	
	Total	**60 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply and represent continuous-time and discrete-time signals and systems using appropriate mathematical models.

CO2: Apply convolution, transfer function, and state-space techniques to determine the response of linear time-invariant systems.

CO3: Analyze continuous-time and discrete-time systems using Laplace and Z-transform techniques.

CO4: Evaluate signals and systems in the frequency domain using DFT and FFT techniques.

CO5: Analyze sampling, reconstruction, and signal processing concepts in communication, control, robotics, and automation applications.

Textbooks:

1. Simon Haykin and Barry Van Veen, Signals and Systems: International Adaptation, Revised and Updated, 2nd Edition, John Wiley & Sons, 2026
2. P. Ramesh Babu and R. Anandanatarajan, Signals and Systems, 5th Edition, Scitech Publications (India) Pvt. Ltd., 2026.
3. S. Salivahanan, A. Vallavaraj& C. Gnanapriya, Signals and Systems, 1st Edition, McGraw Hill Education (India), 2018.
4. K. Rajeswari & B. Visvesvara Rao, Signals and Systems, 2nd Edition, PHI Learning, 2025.

References:

1. A. Anand Kumar, Signals and Systems, 3rd Edition (Reprint), PHI Learning Pvt. Ltd., New Delhi, 2022.
2. S. Palani, Signals and Systems, 2nd Edition, Springer Nature, 2022.
3. Lathi, B. P., and Green, R., Linear Systems and Signals, 3rd Edition, Oxford University Press, 2017.
4. Oppenheim, A. V., Willsky, A. S., and Nawab, S. H., Signals and Systems, 2nd ed., Pearson Education, Noida, 2018.
5. Tarun Kumar Rawat, Signals and Systems, 1st Edition, Oxford University Press, Reprint 2016.

Web links and Video Lectures(e-Resources):

1. https://onlinecourses.nptel.ac.in/noc26_ee79/course
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee37
3. https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	-	-	1	2	1
CO2	3	3	2	2	2	2	-	-	-	-	2	3	2
CO3	3	3	2	3	2	2	-	-	1	-	2	3	3
CO4	3	3	2	3	3	1	-	2	2	1	2	3	3
CO5	3	3	2	3	2	2	-	2	2	2	3	3	3
AVG	3	2.8	1.8	2.75	2.2	1.75	-	2	1.667	1.5	2	2.8	2.4
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													

ANALOG AND DIGITAL ELECTRONICS			
Course Code:	25URAI31	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	3:0:2	**Credits:**	4
Total Teaching Periods:	60	**CAM+ESE Marks:**	50+50
Teaching Department:	Robotics and Automation		

Course Objectives:

- To provide the fundamentals of analog electronic circuits and amplifiers.
- To develop the ability to analyze and design operational amplifier-based circuits.
- To introduce timer circuits, voltage regulators, and data conversion techniques.
- To equip students with the fundamentals of digital number systems and combinational logic circuits.
- To develop the knowledge of sequential logic circuits, memory devices, and programmable logic devices.

Unit I	BASIC ANALOG AMPLIFIERS AND ITS APPLICATIONS	12 Periods

Diode characteristics curve, Clippers, Clampers, RC Coupled Amplifier, Feedback Amplifiers: Voltage Series, Voltage Parallel, Current Series, Current Parallel. Halfwave and Full wave Rectifiers

Practicals:

1. To construct and observe clipping and clamping for different configurations.
2. To design and construct the half wave and full wave rectifiers.

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit II	BASICS OF OPERATIONAL AMPLIFIERS	12 Periods

Functional Block Diagram – Symbol – Characteristics of an ideal operational amplifier – Circuit schematic of μA 741 – Open loop gain-CMRR – Input bias and Offset currents – Input and Output offset voltages – Offset compensation techniques, Frequency response characteristics: Stability – Limitations-Transfer characteristics, Need for single power supply op-amp, Slew rate operational amplifiers.

Practicals:

1. Design of inverting and non-inverting amplifier.
2. Design of Integrator and Differentiator.

Unit III	TIMER REGULATOR A/D AND D/A	12 Periods

Timer: Monostable and Astable operation, Voltage controlled oscillator, Phase locked loops: Principle of operation - Characteristics - Lock-in range and Capture range –Applications, IC Voltage regulators: Fixed and adjustable three terminal regulators- Digital to Analog converters: Binary weighed resistor type - R-2R Ladder type, Analog to Digital converters: Counter type Successive approximation-Single Slope-Dual slope.

Practicals:

1.Design of Active low pass, High pass filter and Band pass filter

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit IV	DIGITAL NUMBER SYSTEM AND COMBINATIONAL CIRCUITS	12 Periods

Introduction to digital Circuits, Representation of number system: Binary – Octal- Decimal Hexadecimal- 1's and 2's complement – Logic Gates: Operation – Truth table, Boolean algebra: Basic postulates – fundamental theorems – Binary adder – Binary subtractor – Decoders – Encoders Multiplexers - Demultiplexers- Karnaugh maps-3,4,5 variables

Practicals:

1. 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.
2. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483.

Unit V	SEQUENTIAL AND PROGRAMMABLE CIRCUITS	12 Periods

Flip-Flops and its Applications: Basic Bitable elements, Latches, The master-slave flip flops (pulse-triggered flip-flops): SR flip-flops, JK flip-flops-Random Access Memory (RAM) – Read Only Memory (ROM), Programmable Logic Array (PLA), Programmable Array Logic (PAL).

Practicals:

1. Design and implementation of encoder and decoder using logic gates.
2. Design and implementation of shift registers.

Total	**60 Periods**

Suggested Activities and Evaluation Methods:

Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Explain the operation and applications of analog electronic circuits, amplifiers, rectifiers, clippers, and clampers.

CO2: Design and analyze operational amplifier circuits for various analog applications.

CO3: Apply timer circuits, voltage regulators, and A/D and D/A converters in electronic system design.

CO4: Analyze and design combinational logic circuits using Boolean algebra, Karnaugh maps, and logic gates.

CO5: Design and evaluate sequential logic circuits, memory devices, and programmable logic circuits for digital applications.

Textbooks:

1. K.C. Selvam, Operational Amplifiers with Advanced Applications, Pearson India, 2024.
2. M. Morris Mano and Michael D. Ciletti, Digital Design, 6th Edition, Pearson, 2018.
3. Paul R. Gray et al., Analysis and Design of Analog Integrated Circuits, 6th Edition, Wiley, 2024.

References:

1. Thomas L. Floyd, Digital Fundamentals, 12th Edition, Pearson, 2021.
2. Dr. Sanjay Sharma, Analog and Digital Electronics, S.K. Kataria & Sons, 2024 Reprint
3. Nishit Mathur, Analog Digital and Microprocessor Electronics, Kruger Brentt Publishers, 2024.
4. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, 4th Edition, Pearson Education, 2015.
5. Donald A. Neamen, Electronic Circuit Analysis and Design, 3rd Edition, McGraw-Hill Education, 2007.

Web links and Video Lectures(e-Resources):
1. NPTEL – Analog Circuits https://nptel.ac.in/courses/108106188
2. NPTEL – Digital Electronic Circuits https://nptel.ac.in/courses/108105132
3. https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/?utm_source=chatgpt.com

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	1	2	1		-	-	-	-	3	2
CO2	3	3	3	2	3	-	-	-	-	-	1	3	2
CO3	3	3	3	2	3	-	-	-	-	-	1	3	2
CO4	3	3	3	2	3	-	-	-	-	-	1	3	2
CO5	3	3	3	3	3	1	1	-	1	1	1	3	2
AVG	3	3	2.8	2	2.8	1	1	-	1	1	1	3	2
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													

HYDRAULICS AND PNEUMATICS LAB			
Course Code:	25URAP31	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	0:0:2	**Credits:**	1
Total Teaching Periods:	30	**IAM+ESE Marks:**	60+40
Teaching Department:	Robotics and Automation		

Course Objectives:

- To provide hands-on experience in simulating, analyzing, and operating hydraulic, pneumatic, and electrical circuits using appropriate software tools
- To develop the ability to design and implement electro-pneumatic and electro-hydraulic control systems using microcontrollers, microprocessors, and PLCs.
- To familiarize students with transducers and calibration techniques used in hydraulic and pneumatic automation systems.
- To impart practical knowledge in PLC hardware, programming, and cascade sequence control for industrial automation applications.
- To apply PLC programming for controlling and integrating hydraulic and pneumatic systems in industrial automation applications.

LIST OF EXPERIMENTS	**30 Periods**

1. Simulation of basic hydraulic, pneumatic, and electrical circuits using software tools.
2. Design and Simulation of a Hopper Control System Using Electro-Pneumatic Components.
3. Study and Simulation of Electro-Pneumatic Circuits.
4. Design and Simulation of Meter-In and Meter-Out Flow Control Circuits Using a Hydraulic Cylinder.
5. Design and Simulation of a Hydraulic Cylinder Synchronization Circuit Using Fluid SIM.
6. Simulation of electro-pneumatic circuits using microcontroller / microprocessor.
7. Modeling and analysis of hydraulic and pneumatic systems using simulation software
8. Study and calibration of various transducers used in hydraulic and pneumatic systems
9. Study of PLC and its Applications.
10. Design and implementation of cascade sequence control of pneumatic actuators using PLC.

SOFTWARE REQUIRED :

1. FluidSIM (Festo Didactic) – For simulation and analysis of hydraulic, pneumatic, and electro-pneumatic circuits.
2. Delta WPLSoft – For PLC programming and cascade sequence control applications

Textbooks:

1. Anthony Esposito, Fluid Power with Applications, 7th Revised SI Units Edition, Pearson Education India, 2024.
2. Andrew Parr, Hydraulics and Pneumatics: A Technician's and Engineer's Guide, 3rd Edition, Butterworth-Heinemann, Elsevier, 2011.
3. S. R. Majumdar, Oil Hydraulic Systems: Principles and Maintenance, McGraw Hill Education (India) Pvt. Ltd., 2019

References:

1. Peter Rohner, FluidSIM Pneumatics and Hydraulics – User Manual and Training Guide, FluidSIM Version 6, Festo Didactic GmbH & Co. KG, 2021.
2. Frank D. Petruzella, Programmable Logic Controllers, 6th Edition, McGraw Hill Education (India) Pvt. Ltd., 2024.
3. John W. Webb and Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, 5th Edition, Pearson Education, 2015

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1:Operate and demonstrate the functioning of basic hydraulic, pneumatic, and electrical components used in industrial automation systems.

CO2: Design, simulate, and analyze hydraulic, pneumatic, electro-hydraulic, and electro-pneumatic circuits using appropriate simulation software tools.

CO3: Develop and implement electro-pneumatic and electro-hydraulic control systems using microcontrollers.

CO4: Calibrate, test, and evaluate transducers, AC drives, and DC drives under open-loop and closed-loop control conditions.

CO5:Configure, program, and validate PLC-based automation systems, including cascade sequence control of pneumatic actuators for industrial automation applications.

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	3	2
CO2	2	3	3	2	3	-	-	-	-	-	-	3	3
CO3	2	2	3	3	3	-	-	-	-	-	-	3	3
CO4	2	3	-	3	3	-	-	-	-	-	-	3	2
CO5	2	2	-	2	3	-	-	-	-	-	-	3	3
AVG	2.2	2.4	3	2.5	2.8	-	-	-	-	-	-	3	2.6
1–Low, 2–Medium, 3 –High, '-' – No correlation													

ROBOTICS LAB			
Course Code:	25URAP32	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	0 : 0 : 2	**Credits:**	1
Total Teaching Periods:	30	**IAM+ESE Marks:**	60+40
Teaching Department:	Robotics and Automation		

Course Objectives:

- To learn the basic concepts, components, and configurations of robots.
- To apply kinematic and dynamic principles in the analysis of robotic manipulators.
- To develop skills in programming and controlling robotic systems.
- To gain practical experience in robot modeling and simulation using software tools.
- To implement robotics concepts for industrial and automation applications.

LIST OF EXPERIMENTS	30 Periods

1. Simulation of Mathematical Model of Robot.
2. Simulation of Forward and Inverse Dynamic Analysis of a 2-DOF Robotic Manipulator
3. Design and Development of an Arduino-Based Mobile Robot for Basic Movement
4. Design and Development of an Autonomous Obstacle Avoidance Robot
5. Implementation of a Servo Motor-Based Robotic Arm for Pick-and-Place Applications
6. Implementation of an Autonomous Line-Following Mobile Robot
7. Design and 3D Modeling of a Robotic Gripper using CAD Software
8. Implementation of Closed-Loop Speed Control for a Differential Drive Mobile Robot
9. Implementation of a PID Controller for Trajectory Tracking of a Robotic Manipulator
10. Automated Pick-and-Place Operations Using a Dobot Robotic Manipulator and Conveyor System
11. Color-Based Object Identification and Sorting Using a Dobot Robotic Manipulator and Color Sensor
12. Laser Engraving Using a Dobot Robotic Manipulator

SOFTWARE REQUIRED :

1. MATLAB
2. SolidWorks
3. Arduino IDE
4. DobotStudio

Textbooks:

1. Craig, J. J., Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson, 2026.
2. Corke, P., Robotics, Vision and Control: Fundamental Algorithms in MATLAB®, 3rd Edition, Springer, 2023.
3. Saha, S. K., Introduction to Robotics, 3rd Edition, McGraw Hill, 2025.
4. Banzi, M., and Shiloh, M., Getting Started with Arduino, 4th Edition, Maker Media, 2022.
5. Siciliano, B., Villani, L., Oriolo, G., and De Luca, A., Foundations of Robotics, 1st Edition, Springer, 2025.

References:

1. Spong, M. W., Hutchinson, S., and Vidyasagar, M., Robot Modeling and Control, 2nd Edition, John Wiley & Sons, 2020
2. MathWorks, MATLAB®, Simulink®, and Robotics System Toolbox Documentation, MathWorks, Latest Release.
3. Dobot Robotics, Dobot Magician User Manual and DobotStudio User Guide, Latest Release.
4. Dassault Systèmes, SolidWorks Essentials Training Manual, Latest Release.

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Analyze and simulate mathematical models, kinematics, and dynamics of robotic systems using engineering software. (K4)

CO2: Develop Arduino-based autonomous mobile robots for navigation, obstacle avoidance, and line-following applications. (K3)

CO3: Implement robotic manipulator control techniques, including pick-and-place operations, closed-loop speed control, and PID-based trajectory tracking. (K3)

CO4: Design robotic components using CAD software and integrate robotic hardware with embedded control systems. (K3)

CO5: Demonstrate industrial robotic applications using a Dobot manipulator for automated material handling, color-based sorting, and laser engraving. (K3)

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	3	-	-	-	-	-	-	3	2
CO2	2	2	3	2	3	-	-	-	2	-	-	3	3
CO3	3	2	3	2	3	-	-	-	2	-	-	3	3
CO4	2	2	3	2	3	-	-	-	-	-	-	3	2
CO5	2	2	3	2	3	-	-	-	2	-	-	3	3
AVG	2.4	2.2	2.8	2	3	-	-	-	1.2	-	-	3	2.6

1–Low, 2–Medium, 3 –High, '-' – No correlation

MODELING AND SIMULATION FOR ROBOTICS LAB			
Course Code:	25URAP33	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	0 : 0 : 2	**Credits:**	1
Total Teaching Periods:	30	**IAM+ESE Marks:**	60+40
Teaching Department:	Robotics and Automation		

Course Objectives:

- To apply CAD and MATLAB tools for modeling and simulation of robotic systems.
- To analyze robotic kinematics using coordinate transformations and homogeneous transformation matrices.
- To design robotic components, mechanisms, and assemblies for automation applications.
- To create virtual models and simulations of robotic manipulators and motion systems.
- To evaluate the workspace, trajectory, and performance characteristics of robotic systems through simulation.

LIST OF EXPERIMENTS	30 Periods

1. 3D Modelling of a Motor Mounting Clamp
2. 3D Modelling of a GT2 Pulley and Belt Drive System
3. 3D Modelling of a Ball Screw and Nut Assembly
4. 3D Modelling and Motion Simulation of Rotational and Prismatic Joint Assemblies
5. 3D Modelling and Simulation of a Cartesian Robot
6. 3D Modelling, Assembly and Motion Simulation of a Robotic Arm
7. Introduction to MATLAB Robotics Toolbox and Robot Modeling
8. Simulation of Coordinate Transformations and Homogeneous Transformation Matrices
9. Forward Kinematic Analysis of a Serial Robot Manipulator
10. Inverse Kinematic Analysis of a Robotic Manipulator
11. Workspace Analysis and Visualization of a Robot Manipulator
12. Trajectory Planning and Motion Simulation of a Robotic Arm

SOFTWARE REQUIRED :

1. MATLAB
2. SolidWorks

Textbooks:

1. David C. Planchard, Engineering Design with SOLIDWORKS 2024: A Step-by-Step Project Based Approach Utilizing 3D Solid Modeling, SDC Publications, 1st Edition, 2024.
2. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer International Publishing, 2nd Edition, 2017

References:

1. Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control, John Wiley & Sons, 2nd Edition, 2020.
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson Education, 4th Edition, 2018
3. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani and Giuseppe Oriolo, Robotics: Modelling, Planning and Control, Springer, 1st Edition, 2009.

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1:Apply CAD tools to develop 3D models of robotic components, transmission systems, and mechanical assemblies.

CO2:Create robotic mechanisms and manipulator assemblies using appropriate modeling and simulation techniques.

CO3:Analyze the motion characteristics of robotic joints and manipulators through virtual simulation

CO4:Apply MATLAB Robotics Toolbox to model robotic systems and perform coordinate transformations and kinematic analysis.

CO5:Evaluate the workspace, kinematic performance, and trajectory planning of robotic manipulators using simulation tools.

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	2	3	-	-	-	-	-	-	2	3
CO2	2	2	3	2	3	-	-	-	-	-	-	2	3
CO3	2	3	2	3	3	-	-	-	-	-	-	3	3
CO4	3	3	2	3	3	-	-	-	-	-	-	3	
CO5	2	3	2	3	3	-	-	-	-	-	-	3	3
AVG	2.4	3	2	2.6	3	-	-	-	-	-	-	2.6	3

PERSONALITY DEVELOPMENT SKILLS			
Course Code:	25UPCE31	**Course Type:**	EEC
Teaching Periods / Week (L: T: P):	0:0:2	**Credits:**	0
Total Teaching Periods:	48	**CAM+ESE Marks:**	
Teaching Department:	Placement		

Course Objectives:

- Enable students to develop a well-rounded personality by enhancing essential personal and professional skills.
- The course aims to foster self-awareness, effective communication, interpersonal abilities, emotional intelligence, confidence, leadership, and goal-setting strategies

Unit I	**WORKPLACE PROFESSIONALISM AND MICROSOFT OFFICE APPLICATIONS**	**10 Periods**

Workplace and Email Etiquette: Professional Behavior and Dress Code – Email and Meeting Etiquette

Microsoft office suite: MS Word(Document Creation and Formatting) - MS Excel (Data Analysis and Functions) - MS PowerPoint (Creating Effective Presentations)

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory:

Unit II	**PROFESSIONAL COMMUNICATION AND CUSTOMER RELATIONSHIP SKILLS**	**12 Periods**

Business Communication: Verbal and Non - Verbal Communication – Written Communication in Business.

Sales and Negotiations : Sales Techniques and Strategies – Negotiation Tactics and Styles.

Customer Service: Effective Communication Skills- Customer support channels and Tools

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Apply (K3)

Unit III	**DECISION MAKING AND PROBLEM-SOLVING SKILLS**	**12 Periods**

Decision Making: Types of Decision Making – Decision Making models and Techniques – Cognitive Biases and Risk Assessment

Problem Solving: Problem Identification and Analysis – Creative and Critical Thinking techniques – Implementation and Evaluation techniques

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Apply

Unit IV	**EMPLOYABILITY SKILLS AND CAREER PREPARATION**	**12 Periods**

Interview Skills: Preparation and Research – Effective Communication and Presentation

Resume Building: Resume Formats and Structure – Tailoring Resumes for Specific Jobs

Mannerism: Body Language – Respect and Courtesy in Interactions

Behavioral skills: Emotional Intelligence – Adaptability and flexibility.

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Apply

Unit V	GROUP DISCUSSION AND INTERVIEW SKILLS	12 Periods
Group Discussion: Effective communication and Active Listening – Leadership and Participation skills – Critical Thinking and Topic Analysis **Monk Interview:** Common Interview Questions and Ideal Responses – Feedback and Self Assessment		
Teaching Learning Process	**Pedagogy:**	
	RBT Level: Theory: Apply (K3)	
	Total	**60 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1:Help students assess themselves, explore career options, and set actionable goals through structured planning.

CO2:Develop motivation, enhance personality effectiveness, and instill discipline for personal and professional growth.

CO3:Build awareness and practice of grooming, hygiene, positive attitudes, manners, and professional behavior.

CO4:Strengthen self-awareness, time and stress management, and emotional intelligence for balanced personal development.

CO5:Introduce students to higher education paths, competitive exams, and the fundamentals of entrepreneurship and business planning

Textbooks:

1. Personal Development and Soft Skills By BARUNKMITRA, Oxford Higher Education.
2. Seven Habits of Highly Effective People by STEPHENCOVEY.

References:

1. Communication Skills by SANJAY KUMAR, PUSHP , Oxford Higher Education
2. Communication Skills for Professionals by NIRAKONAR, PHI learning Pvt. Ltd.

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1					2				2	2			
CO2								2	2	2			
CO3	2			2							2		
CO4									2	2	2		
CO5									2	2	2		
AVG													

1 – Low, 2 – Medium, 3 – High,'-' – No correlation

INDIAN CONSTITUTION AND HUMAN RIGHTS			
Course Code:	25UMCC31	**Course Type:**	MCC
Teaching Periods / Week (L: T: P):	0:0:2	**Credits:**	0
Total Teaching Periods:	48	**CAM+ESE Marks:**	
Teaching Department:	General Engineering		

Course Objectives:

To impart knowledge on:

- Historical background, Preamble, and salient features of the Indian Constitution
- Fundamental Rights, Directive Principles of State Policy, and Fundamental Duties
- Structure and functioning of Union, State, and Local Self Governments
- Universal Human Rights principles and international protection frameworks
- Contemporary human rights issues and remedial mechanisms in India

Unit I	INTRODUCTION TO INDIAN CONSTITUTION	10 Periods

Historical Background: Making of the Constitution - Constituent Assembly and its key members - Draft Committee. Preamble: Philosophy and Core Values - Sovereign, Socialist, Secular, Democratic, Republic - Justice, Liberty, Equality, Fraternity. Salient Features of Indian Constitution: Written Constitution - Lengthy document - Blend of Rigidity and Flexibility - Federal Structure with Unitary Bias - Parliamentary System.

Teaching Learning Process	**Pedagogy:** Interactive Lecture, Think-Pair-Share, Video-based Learning (Documentary on Constituent Assembly), Group Discussion
	RBT Level: Theory: Apply (K3)

Unit II	FUNDAMENTAL RIGHTS AND DUTIES	12 Periods

Fundamental Rights (Articles 12-35): Right to Equality (Art. 14-18) - Right to Freedom (Art. 19-22) - Right Against Exploitation (Art. 23-24) - Right to Freedom of Religion (Art. 25-28) - Cultural and Educational Rights (Art. 29-30) - Right to Constitutional Remedies (Art. 32): Writs - Habeas Corpus, Mandamus, Prohibition, Certiorari, Quo Warranto. Directive Principles of State Policy (Articles 36-51): Classification - Socialistic, Gandhian, Liberal-Intellectual Principles. Fundamental Duties (Article 51A): Citizen Responsibilities - 11 Duties. Relationship and Conflict between Fundamental Rights and Directive Principles.

Teaching Learning Process	**Pedagogy:** Case Study Method, Role Play (Mock Court), Jigsaw Activity, Debate Session (FR vs DPSP), Scenario-based Learning, Problem-Based
	RBT Level: Theory: Apply (K3)

Unit III	UNION AND STATE GOVERNMENT STRUCTURE	12 Periods

Union Executive: President - Election, Powers, Position - Vice-President - Prime Minister and Council of Ministers - Cabinet Committees. Union Legislature: Parliament - Lok Sabha and Rajya Sabha - Composition, Functions - Legislative Process - Bill to Act. State Executive: Governor - Chief Minister - State Council of Ministers. State Legislature: Legislative Assembly and Council - State Law-making Process. Centre-State Relations: Legislative, Administrative, and Financial Relations - Role of Finance Commission. Local Self Government: 73rd Amendment (Panchayati Raj) - 74th Amendment (Urban Local Bodies) - Three-tier System.

Teaching Learning Process	**Pedagogy:** Collaborative Learning, Comparative Analysis (Venn Diagrams), Field Visit/Virtual Tour, Guest Lecture by Government Official
	RBT Level: Theory: Apply (K3)

Unit IV	HUMAN RIGHTS: CONCEPTS AND FRAMEWORKS	12 Periods
Evolution of Human Rights: Historical Development - Natural Rights Theory - Magna Carta - French Declaration - American Bill of Rights. Universal Declaration of Human Rights (UDHR) 1948: 30 Articles - Civil, Political, Economic, Social, Cultural Rights. International Human Rights Instruments: ICCPR - ICESCR - CEDAW - CRC - CAT - CERD. Human Rights in Indian Constitution: Part III and Part IV Provisions. National Human Rights Commission (NHRC): Composition - Functions - Powers - Procedure. State Human Rights Commissions - National Commission for Women, SC, ST, Minorities.		
Teaching Learning Process	**Pedagogy:** Video Case Study, Seminar Presentation	
	RBT Level: Theory: Apply (K3)	
Unit V	**CONTEMPORARY HUMAN RIGHTS ISSUES**	**12 Periods**
Rights of Vulnerable Groups: Women (POSH Act, Domestic Violence Act) - Children (POCSO, JJ Act) - Elderly (Maintenance Act) - Persons with Disabilities (RPWD Act 2016). Rights of Marginalized Communities: SC/ST (Prevention of Atrocities Act) - Minorities - LGBTQ+ (Navtej Singh Johar Case). Right to Information (RTI Act 2005): Provisions and Application. Right to Education (RTE Act 2009). Environmental Rights: Right to Clean Environment - Sustainable Development - PIL on Environmental Issues. Digital Rights: Right to Privacy (Puttaswamy Case) - Data Protection - Cyber Rights. Human Rights Violations and Remedies: Legal Aid - Grievance Redressal Mechanisms.		
Teaching Learning Process	**Pedagogy:** Problem-Based Learning, Panel Discussion, RTI Workshop	
	RBT Level: Theory: Apply (K3)	
	Total	**60 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1:Explain the historical evolution, Preamble, and salient features of the Indian Constitution.

CO2:Describe Fundamental Rights, Directive Principles of State Policy, and Fundamental Duties and explain their interrelationship.

CO3:Describe the structure and functions of Union, State, and Local Self Governments in India

CO4:Apply the principles of Universal Human Rights to identify international protection frameworks.

CO5:Illustrate contemporary human rights issues and demonstrate the use of remedial mechanisms available in India.

Textbooks:

1. D.D. Basu, "Introduction to the Constitution of India", 24th Edition, LexisNexis, 2020.
2. M.V. Pylee, "India's Constitution", 16th Edition, S. Chand Publishing, 2017.
3. S.K. Kapoor, "Human Rights Under International Law and Indian Law", Central Law Agency, 2018.

References:

1. Granville Austin, "The Indian Constitution: Cornerstone of a Nation", Oxford University Press, 2019.
2. J.N. Pandey, "Constitutional Law of India", 57th Edition, Central Law Agency, 2020.
3. K.K. Ghai, "Human Rights", Kalyani Publishers, 2019.
4. P.M. Bakshi, "The Constitution of India", Universal Law Publishing, 2020.

Web links and Video Lectures(e-Resources):

1. Constitution of India - https://legislative.gov.in/constitution-of-india
2. National Human Rights Commission - https://nhrc.nic.in
3. United Nations Human Rights - https://www.ohchr.org
4. SWAYAM Course on Indian Constitution - https://swayam.gov.in
5. NPTEL Course on Constitution of India - https://nptel.ac.in
6. Lok Sabha TV Documentaries - https://www.youtube.com/c/LokSabhaTVChannel
7. PRS Legislative Research - https://prsindia.org

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1						2	2				1		
CO2						3	3	1	1		2		
CO3						2	2	1			1		
CO4						3	2		2		2		
CO5						3	3	2	2		2		
AVG						2.6	2.4	1.3	1.7		1.6		

1 – Low, 2 – Medium, 3 – High,'-' – No correlation

IV SEMESTER

LINEAR ALGEBRA AND NUMERICAL METHODS			
(COMMON TO CSE, ICB, AIML & RA)			
Course Code:	25UMAT42	**Course Type:**	BS
Teaching Periods / Week (L: T: P):	3:1:0	**Credits:**	4
Total Teaching Periods:	60	**CAM+ESE Marks:**	40+60
Teaching Department:	Mathematics		

Course Objectives:

- To apply the concepts of vector spaces, subspaces, linear independence, basis and dimension.
- To construct matrix representations of linear transformations and determine null spaces, ranges and eigenvalues.
- To apply Gram-Schmidt orthogonalization process to construct orthonormal bases and compute least square approximations.
- To solve linear systems using Gauss elimination, LU decomposition and Gauss-Seidel iterative methods.
- To compute eigenvalues and eigenvectors using Power method, QR and Singular value decomposition methods.

Unit I	**VECTOR SPACES**	**12 Periods**

Vector spaces – Subspaces – Linear combinations - Linear Span – Linear dependence - Linear independence – Bases and Dimensions.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit II	**LINEAR TRANSFORMATIONS**	**12 Periods**

Linear Transformation and Diagonalization: Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigenvalues and eigenvectors - Diagonalizability.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit III	**INNER PRODUCT SPACES**	**12 Periods**

Inner Products and norms - Inner Product Spaces - Orthogonal vectors – Gram Schmidt orthogonalization process – Orthogonal complement – Least square Approximations.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit IV	**NUMERICAL SOLUTION OF LINEAR SYSTEM OF EQUATIONS**	**12 Periods**

Solution of linear system of equations – Direct methods: Gauss elimination method – Pivoting, Gauss Jordan method, LU decomposition method and Cholesky decomposition method - Iterative methods: Gauss-Jacobi Method, Gauss-Seidel Method and SOR Method

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit V	NUMERICAL SOLUTION OF EIGEN VALUE PROBLEMS AND GENERALISED INVERSES	12 Periods
Eigen value Problems: Power method – Jacobi 's rotation method – Conjugate gradient method – QR decomposition - Singular value decomposition method.		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: Theory: Apply (K3)	
Total		**60 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply the concepts of vector spaces, subspaces, linear independence, span of vectors, basis and dimension of vector spaces.

CO2: Construct matrix representations of linear transformations and determine null spaces, range spaces and verify the rank-nullity theorem.

CO3: Demonstrate Gram-Schmidt orthogonalization procedure to construct orthonormal bases and solve least squares approximation problems using orthogonal projections.

CO4: Solve linear systems using direct methods such as Gauss elimination, LU decomposition and Cholesky decomposition and iterative methods such as Gauss-Jacobi and Gauss-Seidel methods.

CO5: Compute eigenvalues and eigenvectors using Power method, Jacobi's rotation method, QR decomposition and Singular value decomposition method.

Textbooks:

1. Williams, G, "Linear Algebra with Applications", Jones & Bartlett Learning, First Indian Edition, New Delhi, 2019
2. Friedberg, A.H., Insel, A.J. and Spence, L., Linear Algebra: A Matrix Approach 2nd Edition Prentice Hall of India, New Delhi, 2019.
3. Faires, J.D. and Burden, R., "Numerical Methods", Brooks/Cole (Thomson Publications), 4th Edition, New Delhi, 2012.

References:

1. Howard Anton, Anton Kaul, "Elementary Linear Algebra", Wiley, 12th Edition, 2019.
2. Kolman, B. Hill, D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.
3. Kumaresan, S., "Linear Algebra - A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
4. Lay, D.C., "Linear Algebra and its Applications", 5th Edition, Pearson Education, 2015.
5. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
6. Gerald, C.F, and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education, 7th Edition, New Delhi, 2004.

Web links and Video Lectures(e-Resources):

1. https://nptel.ac.in/courses/111108098
2. https://nptel.ac.in/courses/111106051
3. https://nptel.ac.in/courses/111107096
4. https://nptel.ac.in/courses/111107106
5. https://onlinecourses.swayam2.ac.in

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2					1		1		
CO2	3	2	2	2					1		1		
CO3	3	2	2	2					1		1		
CO4	3	2	2	2	1				1		1		
CO5	3	2	2	2	1				1		1		
AVG													

1 – Low, 2 – Medium, 3 – High,'-' – No correlation

PROGRAMMABLE LOGIC CONTROLLER			
Course Code:	25URAT41	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	3:0:0	**Credits:**	3
Total Teaching Periods:	45	**CAM+ESE Marks:**	40+60
Teaching Department:	Robotics and Automation		

Course Objectives:

- To understand the fundamentals, architecture, hardware components, operating principles, and standards of Programmable Logic Controllers used in industrial automation.
- To develop ladder logic programs using basic programming instructions, timers, counters, comparison, and data handling functions for industrial control applications.
- To apply PLCs for interfacing with industrial sensors, actuators, motors, and analog devices in real-time automation systems.
- To understand and design PLC communication networks and Human Machine Interface (HMI) applications for monitoring and supervisory control.
- To analyze advanced PLC applications, troubleshoot industrial automation systems, and apply maintenance and safety practices.

Unit I	**PLC BASICS AND HARDWARE**	**9 Periods**

Introduction to Industrial Automation – Evolution of PLC – Need for PLC – Comparison with relay-based control – PLC architecture – CPU – Memory – Power supply – Digital and Analog I/O modules – PLC scan cycle – PLC programming devices – IEC 61131-3 programming standards – PLC selection criteria – Safety practices.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit II	**PLC PROGRAMMING AND CONTROL INSTRUCTIONS**	**9 Periods**

PLC programming languages (Ladder Diagram, Function Block Diagram, Structured Text – Introduction) – Basic ladder instructions – Contacts, coils, latching and unlatching – Timers – Counters – Comparison and arithmetic instructions – Data movement instructions – Shift registers – Sequencer instructions – Program organization – Debugging and online monitoring.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit III	**PLC INTERFACING AND INDUSTRIAL CONTROL**	**9 Periods**

PLC interfacing with sensors and actuators – Digital and Analog signal interfacing – Scaling and Analog signal processing – Motor control (DOL, Forward-Reverse, Star-Delta) – Solenoid valve control – Conveyor automation – Tank level control – Temperature control – Sequential process control – Batch process automation.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit IV	**INDUSTRIAL COMMUNICATION AND HMI**	**9 Periods**

Industrial communication fundamentals – PLC networking – Modbus RTU/TCP – PROFINET (Introduction) – Human Machine Interface (HMI) – HMI screen design – PLC–HMI communication – Introduction to SCADA.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit V	ADVANCED PLC AND TROUBLESHOOTING	9 Periods
Sequential control and interlocking – Function Blocks – Sequential Function Chart (SFC) – PID control using PLC – PLC diagnostics and troubleshooting – PLC maintenance practices-PLC integration with Variable Frequency Drives (VFDs).		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: Theory: Apply (K3)	
Total		**45 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1:Explain the fundamentals, architecture, and hardware of PLC systems.

CO2: Develop PLC programs using ladder logic, timers, counters, and basic control instructions.

CO3: Implement PLC-based interfacing and control logic for sensors, actuators, motor drives, and sequential control applications.

CO4:Design simple HMI interfaces and implement PLC networking, communication protocols, and SCADA concepts for real-time monitoring, data logging, and alarm handling.

CO5: Implement sequential control, function blocks, and troubleshooting techniques for PLC-based industrial automation systems.

Textbooks:

1. Frank D. Petruzella, Programmable Logic Controllers, 6th Edition, McGraw-Hill Education, 2023.
2. William Bolton, Programmable Logic Controllers, 6th Edition, Newnes (Elsevier), 2015
3. Gary D. Dunning, Introduction to Programmable Logic Controllers, 4th Edition, Cengage Learning, 2014.

References:

1. John R. Hackworth and Frederick D. Hackworth Jr., Programmable Logic Controllers: Programming Methods and Applications, Pearson/Prentice Hall, 2004.
2. Jon Stenerson and David M. Peter, Programmable Controllers: An Introduction to Ladder Logic, 3rd Edition, Delmar Cengage Learning, 2003

Web links and Video Lectures(e-Resources):

1. https://www.plcacademy.com
2. https://instrumentationtools.com/learn-programmable-logic-controller-plc
3. https://www.youtube.com/watch?v=1WQ70KJu6EY
4. https://www.youtube.com/watch?v=myKX0Ukrdrg
5. https://www.learnvern.com/course/plc-programming-course

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	2	-
CO2	3	2	3	-	3	-	-	-	-	-	-	3	2
CO3	3	3	3	1	3	-	-	-	-	-	-	3	2
CO4	2	2	3	1	3	-	-	-	-	-	-	3	3
CO5	2	3	2	2	3	-	-	-	-	-	-	3	2
AVG	2.6	2.4	2.75	1.33	2.8	-	-	-	-	-	-	2.8	2.25
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													

KINEMATICS AND DYNAMICS OF MACHINES			
Course Code:	25URAT42	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	3:1:0	**Credits:**	4
Total Teaching Periods:	60	**CAM+ESE Marks:**	40+60
Teaching Department:	Mechanical Engineering		

Course Objectives:

- To understand the fundamentals of machine kinematics, mechanism analysis, and cam mechanisms for motion analysis and design.
- To impart knowledge on the principles of gears and gear trains for motion and power transmission in mechanical systems.
- To impart knowledge on frictional principles and power transmission through friction drives, belt drives, and rope drives.
- To understand the kinematics, motion analysis, and design of cam and follower mechanisms.
- To develop the ability to analyze balancing and vibration characteristics of mechanical systems.

Unit I	**KINEMATIC OF MACHINES**	**12 Periods**

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit II	**GEARS and GEAR TRAINS**	**12 Periods**

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

Teaching Learning Process	**Pedagogy:** Problem based Learning
	RBT Level: Theory: Apply (K3)

Unit III	**FRICTION**	**12 Periods**

Sliding and Rolling Friction angle – friction in threads – Friction Drives –Belt and rope drives.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit IV	**KINEMATICS OF CAM MECHANISMS**	**12 Periods**

Classification of cams and followers – Terminology and Definitions – Displacement Diagrams- Uniform velocity , Parabolic , Simple Harmonic and cycloid motions – Derivatives of follower motions – Layout of plate cam profiles – Specified Contour cams – Circular arc and tangent cams – Pressure angle and undercutting – Sizing of cams.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit V	BALANCING AND VIBRATION	12 Periods
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration bending critical speed of simple shaft		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: Theory: Apply (K3)	
Total		**60 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply graphical and analytical methods to determine the motion characteristics of mechanisms and cam systems.

CO2: Apply the principles of gears and gear trains for motion and power transmission in mechanical systems.

CO3: Apply the principles of friction to analyze friction drives, belt drives, and rope drives in mechanical systems.

CO4: Apply the principles of cam mechanisms to design cam profiles and analyze follower motions.

CO5: Apply the principles of balancing and vibration analysis to mechanical systems.

Textbooks:

1. A.G. Ambekar, Mechanism and Machine Theory, PHI Learning Pvt. Ltd., 2007
2. John J. Uicker Jr., Gordon R. Pennock, and Joseph E. Shigley, Theory of Machines and Mechanisms, 5th Edition, Oxford University Press, 2017

References:

1. Thomas Bevan, Theory of Machines, 3rd Edition, CBS Publishers & Distributors Pvt. Ltd., 2018.
2. Ghosh, A. and Mallik, A.K., Theory of Mechanisms and Machines, 3rd Edition, Affiliated East-West Press Pvt. Ltd., New Delhi, 1998
3. Rao, J.S. and Dukkipati, R.V., Mechanism and Machine Theory, 1st Edition, Wiley Eastern Limited, New Delhi, 1998
4. John Hannah and R.C. Stephens, Mechanics of Machines, 2nd Edition, Viva Books Pvt. Ltd. (Viva Low-Priced Student Edition), New Delhi, 1999.
5. V. Ramamurti, Mechanics of Machines, 3rd Edition, Narosa Publishing House, New Delhi, 2019

Web links and Video Lectures(e-Resources):

1. https://nptel.ac.in/courses/112105268
2. https://nptel.ac.in/courses/112106270
3. https://nptel.ac.in/courses/112104114

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	1	2	-	-	-	-	-	1	-	1
CO2	3	3	3	1	2	-	-	-	-	-	1	-	1
CO3	3	3	3	1	2	-	-	-	-	-	1	-	1
CO4	3	3	3	1	2	-	-	-	-	-	1	-	1
CO5	3	3	3	3	2	-	-	-	-	-	1	-	1
AVG	3	3	3	1.4	2	-	-	-	-	-	1	-	1
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													

ORGANIZATIONAL BEHAVIOUR AND FINANCIAL MANAGEMENT			
Course Code:	25URAT42	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	3:0:0	**Credits:**	3
Total Teaching Periods:	45	**CAM+ESE Marks:**	40+60
Teaching Department:	Mechanical Engineering		

Course Objectives:

- To understand the fundamental concepts, principles, and models of Organizational Behaviour.
- To examine personality, perception, motivation, values, attitudes, conflict, and stress in the workplace.
- To analyze organizational structure, culture, climate, innovation, and organizational change
- To develop knowledge of bookkeeping, accounting principles, and financial statement preparation.
- To develop knowledge of depreciation methods and financial ratio analysis

Unit I	**ORGANISATIONAL BEHAVIOUR**	**9 Periods**

Introduction, Definition, Nature & Scope; Basic Concepts of OB. including, Behaviour – Individual & organizational, and Self Image [includes discussion on self-esteem & self-efficacy]; Introduction to the theoretical constructs and models of Organisational Behaviour.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching
	RBT Level: Theory: Apply (K3)

Unit II	**PERCEPTION AND LEARNING**	**9 Periods**

Personality and Individual Differences; Motivation – Content & Process Theories of Work Motivation - and Job Performance; Personal Values, Attitudes and Beliefs; Conflicts & Stress – Concept, why and how & Management.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching
	RBT Level: Theory: Apply (K3)

Unit III	**ORGANISATIONAL STRUCTURE**	**9 Periods**

Organisational Structure and its influence on personnel behaviour in organizations; Organisational Climate and Culture; Creating a culture for Innovation & Creativity; Organisational Change and Development.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching
	RBT Level: Theory: Apply (K3)

Unit IV	**BOOK-KEEPING AND ACCOUNTING**	**9 Periods**

Meaning – Definition – Objectives of Financial Accounting – Branches of Accounting: Financial, Cost and Management Accounting – Accounting Concepts and conventions – journal – Ledger – Trial Balance – Preparation of Final Accounts: Trading, Profit and Loss Account and Balance Sheet (problems) – Accounting Standards – Groups interested in Accounting Information.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: Apply (K3)

Unit V	DEPRECIATION	9 Periods
Definition – Causes – Necessity of providing for depreciation – Methods of Calculating Depreciation: Straight Line Method and Written Down Value Method -Financial Statements – Meaning – Types of financial Analysis –Techniques of Financial Analysis – Ratio Analysis – Profitability Ratios – Coverage Ratios – Turnover Ratios –Financial Ratios – Ratios to Financial Statement (problems) – uses and limitations of Ratio Analysis		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: Theory: Apply (K3)	
Total		**45 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1:Explain the fundamental concepts, principles, and models of Organizational Behaviour.

CO2:Analyze personality, perception, motivation, values, attitudes, conflict, and stress in the workplace.

CO3:Interpret organizational structure, culture, climate, innovation, and organizational change.

CO4:Prepare accounting records and financial statements using the principles of bookkeeping and

CO5:Apply depreciation methods and financial ratio analysis to evaluate financial performance.

Textbooks:

1. Fred Luthans, Brett C. Luthans, and Kyle W. Luthans, Organizational Behavior: An Evidence-Based Approach, 14th Edition, Information Age Publishing, 2021.
2. S. N. Maheshwari, Suneel K. Maheshwari, and Sharad K. Maheshwari, Financial Accounting, Vikas Publishing House Pvt. Ltd., 6th Edition, 2018.
3. N. Vinayakam and B. Charumathi, Financial Accounting, S. Chand Publishing, New Delhi, Reprint Edition, 2004

References:

1. Christopher Grey, A Very Short, Fairly Interesting and Reasonably Cheap Book About Studying Organizations, Sage Publications, 7th Edition, 2022.
2. Stephen P. Robbins and Timothy A. Judge, Organizational Behavior, 20th Edition, Pearson, 2026
3. T. S. Grewal, H. S. Grewal, G. S. Grewal, and R. K. Khosla, Double Entry Book Keeping, Sultan Chand & Sons, 2026–27 Edition.
4. I. M. Pandey, Financial Management, 13th Edition, Pearson Education, 2025.
5. M. C. Shukla, S. C. Gupta and T. S. Grewal, Financial Accounting, S. Chand Publishing, 2023 Edition.

Web links and Video Lectures(e-Resources):

1. Organizational Behaviour, IIT Hyderabad, https://nptel.ac.in/courses/110106145
2. Financial Accounting (IIT Mandi), https://onlinecourses.nptel.ac.in/noc26_mg52/preview
3. Foundations of Accounting & Finance , https://onlinecourses.nptel.ac.in/e-learning/preview/ noc26_ec06

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	-	-	-	2	-	2	2	2	1	-	-
CO2	2	2	1	-	-	2	-	2	3	2	1	-	1
CO3	2	2	2	1	-	2	1	2	3	2	1	1	1
CO4	3	2	1	-	1	-	-	1	-	1	3	1	2
CO5	3	3	2	1	1	-	-	1	-	1	3	1	2
AVG	2.4	2	1.5	1	1	2	1	1.6	2.67	1.6	1.8	1	1.5
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													

CONTROL SYSTEMS			
Course Code:	25URAI41	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	3:0:2	**Credits:**	4
Total Teaching Periods:	60	**CAM+ESE Marks:**	50+50
Teaching Department:	Robotics and Automation		

Course Objectives:

- To understand the fundamental concepts and mathematical modelling of control systems.
- To analyze the time-domain response and performance of linear control systems.
- To evaluate the stability of control systems using classical stability analysis techniques.
- To analyze the frequency response characteristics of control systems.
- To apply state-space techniques for modeling and analysis of modern control systems.

Unit I	INTRODUCTION TO CONTROL SYSTEMS	12 Periods

Basic Elements of Control Systems - Open-Loop and Closed-Loop Control Systems - Mathematical Modelling of Electrical, Mechanical and Electromechanical Systems - Electrical Analogy of Mechanical Systems - Transfer Function - Feedforward and Feedback Control Systems - AC and DC Servomotors - Block Diagram Reduction Techniques - Signal Flow Graphs - Mason's Gain Formula

Practicals:

1. Develop and simulate the mathematical model of an electrical system using differential equations in MATLAB/Simulink.
2. Develop and simulate the mathematical model of a mechanical system using differential equations in MATLAB/Simulink.
3. Obtain the transfer function of a DC motor (electromechanical system) and analyze its response.

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit II	TIME RESPONSE ANALYSIS	12 Periods

Time Response Analysis - Standard Test Input Signals - Time Response of First-Order and Second-Order Systems - Time Domain Specifications - Steady-State Error Analysis - P, PI, PD and PID Controllers - Manual PID Tuning - Ziegler-Nichols PID Tuning Method.

Practicals:

1. Simulation of the Time Response Characteristics of First-Order Systems using MATLAB/Simulink.
2. Simulation of the Time Response Characteristics of Second-Order Systems using MATLAB/ Simulink.
3. PID Controller Tuning using the Ziegler-Nichols Method.

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit III	STABILITY ANALYSIS	12 Periods

Stability Concepts - Routh-Hurwitz Stability Criterion - Root Locus Technique - Relative Stability - Controller Design using Root Locus -Design of Lead, Lag and Lead-Lag Compensators.

Practicals:

1. Simulation of Stability Analysis using the Routh-Hurwitz Stability Criterion.
2. Simulation and Analysis of the Root Locus of a Control System.
3. Simulation of Lead, Lag and Lead-Lag Compensator Design using the Root Locus Technique.

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit IV	FREQUENCY RESPONSE ANALYSIS	12 Periods

Frequency Response Concepts - Frequency Domain Specifications - Polar Plot - Bode Plot - Gain Margin and Phase Margin - Nyquist Stability Criterion - Stability Analysis using Bode and Nyquist Plots.

Practicals:

1. Simulation and Analysis of Bode Plots using MATLAB.
2. Simulation and Analysis of Nyquist Plots for Stability Determination
3. Determination of Gain Margin and Phase Margin using Bode Plots.

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit V	STATE SPACE ANALYSIS	12 Periods

State Variable Representation - State Space Models of Continuous-Time Systems - State Transition Matrix - Solution of State Equations - Controllability and Observability.

Practicals:

1. Simulation of State Space Models for Continuous-Time Systems using MATLAB.
2. Simulation and Analysis of State Responses using the State Space Approach
3. Determination of Controllability and Observability of a State Space System using MATLAB.

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

	Total	**60 Periods**

Suggested Activities and Evaluation Methods:

Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study

Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply mathematical modelling techniques to represent electrical, mechanical and electromechanical control systems.

CO2: Analyze the time response characteristics and tune PID controllers for linear control systems.

CO3: Evaluate the stability of control systems and design compensators using the Root Locus technique.

CO4: Analyze the frequency response characteristics and determine system stability using Bode and Nyquist plots.

CO5: Apply state-space methods to analyze continuous-time systems and determine controllability and observability.

Textbooks:

1. Nagrath, I. J. and Gopal, M., Control Systems Engineering, New Age International Publishers, 7th Edition, 2021.
2. Ogata, K., Modern Control Engineering, Pearson Education, 6th Edition, 2020.
3. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 14th Edition, 2021.

References:

1. Benjamin C. Kuo and Farid Golnaraghi, Automatic Control Systems, McGraw-Hill Education, 10th Edition, 2017.
2. Norman S. Nise, Control Systems Engineering, John Wiley & Sons, 8th Edition, 2020.
3. Katsuhiko Ogata, System Dynamics, Pearson Education, 4th Edition, 2004.
4. M. Gopal, Control Systems: Principles and Design, McGraw-Hill Education, 5th Edition, 2021.
5. Gene F. Franklin, J. David Powell and Abbas Emami-Naeini, Feedback Control of Dynamic Systems, Pearson Education, 8th Edition, 2020.

Web links and Video Lectures(e-Resources):

1. NPTEL – Control Engineering https://nptel.ac.in/courses/108106098
2. MATLAB Control System Toolbox Documentation https://www.mathworks.com/help/control/
3. MIT OpenCourseWare – Feedback Control Systems https://ocw.mit.edu/courses/16-30-feedback-control-systems-fall-2010/

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	1	3	2
CO2	3	3	2	1	3	-	-	-	-	-	2	3	2
CO3	3	3	3	2	3	-	-	-	-	-	2	3	3
CO4	3	3	2	2	3	-	-	-	-	-	2	3	3
CO5	3	3	2	2	3	-	-	-	-	-	2	3	3
AVG	3	2.8	2.25	1.75	2.8	-	-	-	-	-	1.8	2	2.6

1 – Low, 2 – Medium, 3 – High,'-' – No correlation

POWER ELECTRONICS AND DRIVES			
Course Code:	25URAI42	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	3:0:2	**Credits:**	4
Total Teaching Periods:	60	**CAM+ESE Marks:**	50+50
Teaching Department:	Robotics and Automation		

Course Objectives:

- To understand the characteristics, switching behaviour, gate drive requirements, isolation techniques, and protection methods of power semiconductor devices used in power electronic systems.
- To analyze the operation of AC–DC, DC–DC and DC–AC power converters and PWM techniques.
- To apply the principles of rectifiers, choppers, inverters, UPS and SMPS in power conversion and motor control applications.
- To understand the operating characteristics and selection of electrical drives used in robotics and industrial automation.
- To apply drive control techniques, closed-loop control, regenerative braking and protection methods in robotic and industrial drive systems.

Unit I	POWER SEMICONDUCTOR DEVICES	12 Periods

Power semiconductor devices: Power Diode, BJT, MOSFET and IGBT – Static and switching characteristics – Comparison and selection of power devices for motor drive applications – Gate drive circuits – Isolation techniques – Heat sinks and thermal management – Protection against over-current, over-voltage and thermal faults.

Practicals:

1. Study of Power Semiconductor Devices
2. Gate Driver and Isolation Circuit Design

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit II	POWER CONVERTERS AND PWM TECHNIQUES	12 Periods

AC–DC converters: Single-phase and three-phase controlled and uncontrolled rectifiers – Effect of load inductance. DC–DC converters: Buck, Boost and Buck–Boost converters – Operating principles and applications. Pulse Width Modulation (PWM): Duty cycle control – PWM generation – Sinusoidal PWM (SPWM) – Introduction to isolation in power converters.

Practicals:

1. Simulation of Single-Phase Controlled and Uncontrolled Rectifier
2. Design and Simulation of Buck and Boost Converters

Unit III	INVERTERS, CHOPPERS AND POWER SUPPLIES	12 Periods

Single-phase Voltage Source Inverter (VSI) – H-Bridge inverter – PWM control of inverters – Introduction to three-phase inverters. DC Choppers – Buck and Boost chopper operation – Timing pulse generation – Motor speed control applications.Introduction to Uninterruptible Power Supply (UPS) and Switched Mode Power Supply (SMPS).

Practicals:

1. PWM Generation Using a Microcontroller
2. Design and Simulation of a Single-Phase H-Bridge Inverter

Teaching Learning Process	**Pedagogy:** Lectures, PBL and SBL
	RBT Level: Theory: Apply (K3)

Unit IV	ELECTRICAL DRIVES FOR ROBOTICS	12 Periods

Basic elements of electric drives – Types of electric drives – Selection of motors for robotic applications – Loading conditions and duty cycles – Thermal considerations.Operating characteristics of DC motors – Stepper motors – BLDC motors – Servo motors.Speed–Torque characteristics and applications of electrical drives in robotics and industrial automation.

Practicals:

1. H-Bridge Control of a DC Motor
2. DC Chopper-Based Speed Control of a DC Motor

Unit V	DRIVE CONTROL FOR ROBOTICS AND AUTOMATION	12 Periods

Operating modes of electric drives – Four-quadrant operation – Closed-loop speed and current control – PID-based motor control.Introduction to PMSM drives and vector control – Regenerative braking – Energy-efficient drive systems.Protection devices for electric drives – Safety considerations in robotic and industrial automation systems.

Practicals:

1. BLDC Motor Speed Control Using Hall Sensor Feedback
2. Closed-Loop Speed Control of a DC Motor Using PID Control

	Total	60 Periods

Suggested Activities and Evaluation Methods:

Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply the characteristics, switching behaviour, gate drive requirements, isolation techniques, and protection methods of power semiconductor devices used in power electronic systems.

CO2: Analyze the operation and performance of AC–DC converters, DC–DC converters, and PWM techniques used in power conversion systems.

CO3: Apply the principles of inverters, choppers, UPS, and SMPS in power conversion and motor control applications.

CO4: Analyze the operating characteristics, selection criteria, and applications of electrical drives used in robotics and industrial automation.

CO5: Apply closed-loop drive control techniques, regenerative braking, protection methods, and safety principles in robotic and industrial drive systems.

Textbooks:

1. Ned Mohan and Siddharth Raju, Power Electronics: A First Course – Simulations and Laboratory Implementations, 2nd Edition, Wiley, 2023
2. P. S. Bimbhra, Power Electronics, 7th Revised Edition, Khanna Publishers, New Delhi, 2022
3. Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, 5th Edition, Pearson Education, 2018.

References:

1. Ion Boldea, Electric Drives, 4th Edition, CRC Press, 2025.
2. Narayanaswamy P. R. Iyer, Inverters and AC Drives: Control, Modeling, and Simulation Using
3. Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics: Converters, Applications
4. G. K. Dubey, Fundamentals of Electrical Drives, 2nd Edition, Narosa Publishing House, 2020.
5. Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson Education, 2023.

Web links and Video Lectures(e-Resources):
1. NPTEL - Power Electronics https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ee97
2. NPTEL- Fundamentals of Power Electronics https://nptel.ac.in/courses/108101126

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	-	1	3	2
CO2	3	3	2	1	3	-	-	-	-	-	1	3	3
CO3	3	3	2	3	3	-	-	-	-	-	1	2	3
CO4	3	3	3	2	1	-	-	-	-	-	1	3	3
CO5	3	3	3	3	2	2	2	-	-	1	1	3	3
AVG	3	2.8	2.2	2	2	2	2	-	-	1	1	2.8	2.8
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													

KINEMATICS AND DYNAMICS LABORATORY			
Course Code:	25URAP41	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	0 : 0 : 2	**Credits:**	1
Total Teaching Periods:	30	**IAM+ESE Marks:**	60+40
Teaching Department:	Mechanical Engineering		

Course Objectives:

7:(To supplement the theoretical concepts of kinematics and dynamics through laboratory experiments.

- To develop practical skills in analyzing the kinematic behavior of mechanisms, gear trains, cams, governors, and gyroscopic systems.
- To perform experiments for determining the dynamic characteristics of mechanical systems, including mass moment of inertia, balancing, vibrations, and critical speeds.
- To develop competency in using standard laboratory equipment and measuring instruments for experimental investigations.
- To interpret and validate experimental results by relating them to the theoretical principles of kinematics and dynamics.

LIST OF EXPERIMENTS	30 Periods

1. a) Study of gear parameters.
   b) Experimental determination of velocity ratios of simple, compound, epicyclic, and differential gear trains.
2. a) Kinematic analysis of four-bar, slider-crank, crank-rocker, double-crank, double-rocker, and oscillating cylinder mechanisms.
   b) Kinematic analysis of single and double universal joints.
3. a) Determination of mass moment of inertia of a flywheel and axle system.
   b) Determination of mass moment of inertia of axisymmetric bodies using a turntable.
   c) Determination of mass moment of inertia using bifilar suspension and compound pendulum.
4. Study of gyroscopic effect and gyroscopic couple using a motorized gyroscope.
5. Determination of range of speed, sensitivity, governor effort, and governor power of Watts, Porter, Proell, and Hartnell governors.
6. Cam profile drawing, motion curve analysis, and study of jump phenomenon.
7. a) Determination of natural frequency of a single degree of freedom spring-mass system, verification of spring laws, and determination of damping coefficient.
   b) Determination of influence coefficients of a multi-degree of freedom suspension system.
8. a) Determination of torsional natural frequencies of single and double rotor systems under undamped and damped conditions.
   b) Study of a tuned vibration absorber.
9. Study of undamped and damped vibrations of an equivalent spring-mass system.
10. Determination of critical speeds of shafts with concentrated loads.
11. a) Balancing of rotating masses.
    b) Balancing of reciprocating masses.
12. a) Transverse vibration of a free-free beam with and without concentrated masses.
    b) Forced vibration of a cantilever beam – determination of mode shapes and natural frequencies.
    c) Determination of transmissibility ratio using a vibrating table.

Textbooks:

1. Rattan, S.S., Theory of Machines, 5th Edition, McGraw Hill Education (India) Pvt. Ltd., 2019.
2. Uicker, J.J., Pennock, G.R., and Shigley, J.E., Theory of Machines and Mechanisms, 5th Edition, Oxford University Press, 2017.

References:

1. Khurmi, R.S. and Gupta, J.K., Theory of Machines, 14th Edition, S. Chand Publishing, 2019.
2. Norton, R.L., Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, 6th Edition, McGraw Hill, 2020.
3. Rao, J.S. and Dukkipati, R.V., Mechanism and Machine Theory, 2nd Edition, New Age International Publishers, 2018.
4. Rao, S.S., Mechanical Vibrations, 6th Edition, Pearson Education, 2018.
5. Ghosh, A. and Mallik, A.K., Theory of Mechanisms and Machines, 4th Edition, Affiliated East-West Press, 2010.

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Demonstrate the principles of kinematics of mechanisms, gear trains, universal joints, cams, and governors through laboratory experiments.
CO2: Determine the dynamic characteristics of mechanical systems, including mass moment of inertia, gyroscopic effects, balancing, and critical speeds.
CO3: Evaluate the vibration characteristics of single and multi-degree-of-freedom systems using experimental methods.
CO4: Operate standard laboratory equipment and measuring instruments to perform kinematics and dynamics experiments accurately.
CO5: Analyze and interpret experimental results to validate theoretical concepts of kinematics and dynamics for engineering applications.

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	2	2
CO2	3	3	-	2	3	-	-	-	-	-	-	2	3
CO3	3	3	-	3	2	-	-	-	-	-	-	2	3
CO4	2	2	-	3	3	-	-	-	2	-	-	3	2
CO5	2	3	-	3	2	-	-	-	-	2	2	2	3
AVG	2.6	2.6	-	2.75	2.4	-	-	-	2	2	2	2.2	2.6

1–Low, 2–Medium, 3 –High, '-' – No correlation

IV SEMESTER

INTELLIGENT CONTROL OF ROBOTIC SYSTEM			
Course Code:	25URAH01	**Course Type:**	PC
Teaching Periods / Week (L: T: P):	3:1:0	**Credits:**	4
Total Teaching Periods:	60	**CAM+ESE Marks:**	40+60
Teaching Department:	Robotics and Automation		

Course Objectives:

- To apply learning techniques in robotics to develop intelligent, adaptive, and autonomous robots capable of performing tasks effectively in real-world environments.
- To implement efficient learning control techniques for manipulation robots using feedforward neural networks.
- To apply fuzzy logic principles to design and synthesize fuzzy controllers for specific robotic tasks.
- To apply Genetic Algorithms to design and optimize solutions for specific robotic tasks and challenges.
- To analyze the effectiveness of neuro-fuzzy approaches in robotics through real-world examples .

Unit I	**INTRODUCTION TO INTELLIGENT CONTROL**	**12 Periods**

Hierarchical intelligent robotic systems; conventional vs. intelligent control; role of learning in robotics; taxonomy of robot learning (supervised, unsupervised, reinforcement); applications of intelligent control in robotics

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Problem based Learning
	RBT Level: Theory: Apply (K3)

Unit II	**NEURAL NETWORK APPROACH IN ROBOTICS**	**12 Periods**

Neural network models and topologies in robotics; learning rules (Hebbian, Delta, Backpropagation); stability and convergence issues; trajectory tracking and control of manipulators using feedforward neural networks.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Problem based Learning
	RBT Level: Theory: Apply (K3)

Unit III	**FUZZY LOGIC APPROACH IN ROBOTICS**	**12 Periods**

Fuzzy sets and operations; fuzzy relations; fuzzy controller architecture: fuzzification, rule base, inference mechanism, and defuzzification; design of fuzzy controllers for robotic manipulator tracking and navigation.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Problem based Learning
	RBT Level: Theory: Apply (K3)

Unit IV	**GENETIC ALGORITHMS IN ROBOTICS**	**12 Periods**

Definition, characteristics, and role of Genetic Algorithms; chromosome representation; genetic operators (selection, crossover, mutation); fitness function formulation; optimization of robotic trajectory planning and controller parameters.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Problem based Learning
	RBT Level: Theory: Apply (K3)

Unit V	HYBRID INTELLIGENT APPROACHES IN ROBOTICS	12 Periods
Neuro-Fuzzy systems (ANFIS architecture); hybrid learning algorithms; implementation of neuro-fuzzy controllers in robotics; genetic-fuzzy and neuro-genetic approaches; comparative analysis of intelligent control methods in robotics.		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Project based Learning	
	RBT Level: Theory: Apply (K4)	
Total		**60 Periods**

Suggested Activities and Evaluation Methods:
Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study
Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Understand and apply learning in robotics for enhanced capabilities and practical applications.

CO2: Develop the ability to implement efficient learning control techniques for manipulation robots by utilizing feedforward neural networks effectively.

CO3: Gain proficiency in applying fuzzy logic principles to design and synthesize fuzzy controllers tailored for specific robotic tasks.

CO4: Acquire the skills to apply Genetic Algorithms for designing and optimizing solutions tailored to specific robotic tasks and challenges

CO5: Develop the ability to analyze the effectiveness of neuro-fuzzy approaches in robotics by examining real world examples and applications.

Textbooks:

1. Katic, Dusko, and Miomir Vukobratovic. Intelligent control of robotic systems. Vol. 25. Springer Science & Business Media, 2013.
2. Behera, Laxmidhar, Swagat Kumar, Prem Kumar Patchaikani, Ranjith Ravindranathan Nair, and Samrat Dutta. Intelligent control of robotic systems. CRC Press, 2020.
3. Liu, Jinkun. Intelligent control design and Matlab simulation. Singapore: Springer, 2018

References:

1. Liu, Dikai, Lingfeng Wang, and Kay Chen Tan, eds. Design and control of intelligent robotic systems. Vol.177. Springer, 2009.
2. Raol, Jitendra R., and Ajith K. Gopal, eds. Mobile intelligent autonomous systems. CRC Press, 2016.

Web links and Video Lectures(e-Resources):
1. https://nptel.ac.in/courses/112107289 Robotics and Control : Theory and Practice, IIT Roorkee
2. https://ocw.mit.edu/courses/6-7960-deep-learning-fall-2024/ Deep Learning

CO - PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	3	2	-	-	-	0	1	1	3	3
CO2	3	3	3	3	3	-	-	-	1	2	2	3	3
CO3	3	3	3	3	3	-	-	-	1	2	2	3	3
CO4	3	3	3	3	3	-	-	-	1	2	2	3	3
CO5	3	3	3	3	3	-	-	-	1	2	2	3	3
AVG	3	2.8	2.8	3	2.8	-	-	-	1	1.8	1.8	3	3
1 – Low, 2 – Medium, 3 – High,'-' – No correlation													