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RAMDEOBABA UNIVERSITY, NAGPUR

Formerly Shri Ramdeobaba College of Engineering & Management (RCOEM) Est. 1984

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RAMDEOBABA UNIVERSITY, NAGPUR–440013

School of Engineering Sciences

Department of Mechanical Engineering

PROGRAMME SCHEME & SYLLABI

B.Tech. Robotics and Artificial Intelligence 2024-25

Semester I

SN	Course Type	Course Code	Course Name	Hours/ week		Credits	Maximum Marks				ESE Duration (Hrs.)
				L	P		Cont. Evaluation		End Sem Exam	Total	
							Th	Pr			
1	BSC	24HS05TH0104	Applied Physics	3		3	50		50	100	3
2	BSC	24HS05PR0104	Applied Physics Lab		2	1		50		50	
3	BSC	24HS03TH0104	Differential Calculus and Basics of Statistics	3		3	50		50	100	3
4	BSC	24HS03PR0102	Computational Mathematics Lab		2	1		50		50	-
5	ESC	24ES03TH0101	Mechanical Marvels	1	0	1	50	-	-	50	-
6	ESC	24ES03TH0102	Engineering Mechanics	3	0	3	50	-	50	100	3
7	ESC	24ES03TH0103	Engineering Graphics	2		2	50		50	100	3
8	ESC	24ES03PR0103	Engineering Graphics Lab		2	1		50		50	-
9	ESC	24EE07TH0106	Basics of Electrical Engineering	2		2	50		50	100	2
10	ESC	24EE07PR0106	Basics of Electrical Engineering Lab		2	1		50		50	-
11	ESC	24ES03TH0104	Programming for Problem Solving	1		1	50		50	100	2
12	ESC	24ES03PR0104	Programming for Problem Solving Lab		2	1		50		50	-
13	VEC/ HSSM	24HS02TH0104	Foundational Course in Universal Human Values	1	0	1	50	-	-	50	-
			TOTAL	**16**	**10**	**21**	**400**	**250**	**300**	**950**	**16**

Semester II

SN	Course Type	Course Code	Course Name	Hours/ week		Credits	Maximum Marks				ESE Duration (Hrs.)
				L	P		Cont. Evaluation		End Sem Exam	Total	
							Th	Pr			
1	BSC	24HS03TH0214	Linear Algebra and Integral calculus	3	0	3	50	-	50	100	3
2	ESC	24ES03TH0201	Artificial Intelligence	3	0	3	50	-	50	100	3
3	ESC	24ES03TH0202	Theory of Mechanisms & Elasticity	3	0	3	50	-	50	100	3
4	ESC	24ES03TH0203	Data Structure and Algorithms	2		2	50		50	100	2
5	ESC	24ES03PR0203	Data Structure and Algorithms Lab		2	1		50		50	-
6	ESC	24ES03TH0204	Digital Logic Design	2		2	50		50	100	2
7	ESC	24ES03PR0204	Digital Logic Design Lab		2	1		50		50	-
8	AEC/ HSSM	24HS02TH0201	English for Professional Communication	2		2	50		50	100	2
9	AEC/ HSSM	24HS02PR0201	English for Professional Communication Lab		2	1		50		50	-
10	VSEC	24ES03TH0205	Fabrication Practices	1		1	50		-	50	-
11	VSEC	24ES03PR0205	Fabrication Practices Lab		2	1		50	-	50	-
12	CCA	24HS02PR0106-01 to 14	Liberal/Performing Arts Lab	0	2	1		50		50	
13	CCA	24HS04PR0201	Sports-Yoga-Recreation	0	2	1		50		50	
			TOTAL	**16**	**12**	**22**	**350**	**300**	**300**	**950**	**15**

Semester III

SN	Course Type	Course Code	Course Name	Hours/Week			Credits	Maximum Marks			Total	ESE Duration (Hrs.)
								Cont. Evaluation		End Sem Exam		
				L	P	S		TH	PR			
1	BSC	24HS03TH0303	Probability & Statistics	3	0	1	3	50	-	50	100	3
2	PCC	24ES03TH0301	Fundamentals of Robotics	3	0	1	3	50	-	50	100	3
3	PCC	24ES03TH0302	Design of Manipulator and End effector	2	0		2	50	-	-	50	-
4	PCC	24ES03PR0302	Design of Manipulator and End effector Lab	0	2		1	-	50	-	50	-
5	PCC	24ES03TH0303	Microcontrollers and Interfacing	3	0	1	3	50	-	50	100	3
6	PCC	24ES03PR0303	Microcontrollers and Interfacing Lab	0	2		1	-	50	-	50	-
7	PCC	24ES03TH0304	Introduction to Python	2	0	1	2	50	-	-	50	-
8	PCC	24ES03PR0304	Introduction to Python Lab	0	2		1	-	50	-	50	-
9	OE	24ESOEC03TH0306	Open Elective-I/ MOOC	2	0	1	2	50	-	50	100	2
10	MDM	24ES03TH0307	MDM-I (Defense Platform)	3	0	1	3	50	-	50	100	3
11	AEC	24ES03TH0305	Design Thinking	1	0		1	50	-	-	50	-
12	AEC	24ES03PR0305	Design Thinking Lab	0	2		1	-	50	-	50	-
			TOTAL	**19**	**8**	**6**	**23**	**400**	**200**	**250**	**850**	**14**

Open Elective - I

S.N.	Course Name
1	CDPC-1
2	Technical Communication

Semester IV

SN	Course Type	Course Code	Course Name	Hours/Week			Credits	Maximum Marks			Total	ESE Duration (Hrs.)
				L	P	S		Cont. Evaluation		End Sem Exam		
								TH	PR			
1	PCC	24ES03TH0401	Kinematics of Robot	3	0	2	3	50	-	50	100	3
2	PCC	24ES03PR0401	Kinematics of Robot Lab	0	2	0	1	-	50	-	50	-
3	PCC	24EE07TH0402	Control Systems for Robotics	3	0	2	3	50	-	50	100	3
4	PCC	24EE07PR0402	Control Systems for Robotics Lab	0	2	0	1	-	50	-	50	-
5	PCC	24ES03TH0402	Machine Learning	3	0	2	3	50	-	50	100	3
6	PCC	24ES03PR0402	Machine Learning Lab	0	2	0	1	-	50	-	50	-
7	PCC	24ES03TH0403	Mechatronics	2	0	0	2	50	-	50	100	2
8	PCC	24ES03PR0403	Mechatronics Lab	0	2	0	1	-	50	-	50	-
9	CEP/FP	24ES03PR0404	Project-1 (Mini project)	0	2	3	1	-	50	-	50	-
10	OE	24ESOEC03TH0406	Open Elective-II/ MOOC	2	0	1	2	50	-	50	100	2
11	MDM	24ES03TH0407	MDM-II (Warfare systems)	3	0	1	3	50	-	50	100	3
12	AEC	CDPC	Basic Competitive Coding Lab	0	2	2	1	-	50	-	50	-
13	VEC	24HS01TH0401	Environmental Science	1	0	0	1	50	-	-	50	-
14	VEC	24HS01PR0401	Environmental Science Lab	0	2	0	1	-	50	-	50	-
			TOTAL	**15**	**12**	**13**	**24**	**300**	**300**	**250**	**850**	**16**

Open Elective - II	
S.N.	**Course Name**
1	CDPC-2
2	Logical and Quantitative Reasoning

Honors scheme Track-I: Robotics & AI (B. Tech Program)

Sr. No.	Sem	Course Code	Course Title	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	P	S		Continuous Evaluation	End Sem Exam	Total	
1	III	24ES03HT0301	Field & Service Robot	3	0	1	3	50	50	100	3
2	IV	24ES03HT0401	Advanced sensors & Actuators	3	0	1	3	50	50	100	3
3	V	24ES03HT0501	Mobile and Micro Robotics	4	0	1	4	50	50	100	3
4	VI	24ES03HT0601	Multi-Robot Systems and Swarm Intelligence	4	0	1	4	50	50	100	3
5	VII	24ES03HP0701	Project	0	8	2	4	50	50	100	3
			TOTAL	**14**	**8**	**6**	**18**				

Honors scheme Track-II: Product Design & CAM (Mechanical Engg., B.Tech. Program)

Sr. No.	Sem	Course Code	Course Title	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	P	S		Continuous Evaluation	End Sem Exam	Total	
1	III	24ES04HT0301	Geometric Dimensioning and Tolerances	3	0	1	3	50	50	100	3
2	IV	24ES04HT0401	Advanced Solid Modelling & Assembly	3	0	1	3	50	50	100	3
3	V	24ES04HT0501	Additive Manufacturing Techniques	4	0	1	4	50	50	100	3
4	VI	24ES04HT0601	Design for Manufacturing	4	0	1	4	50	50	100	3
5	VII	24ES04HP0701	Project	0	8	2	4	50	50	100	3
			TOTAL	**14**	**8**	**6**	**18**				

Minors scheme Track- I : Robotics & AI (B.Tech. Program)

Sr. No.	Sem	Course Code	Course Title	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	P	S		Continuous	End Sem Exam	Total	
1	III	24ES03MT0301	Introduction to Robotics	3	0	1	3	50	50	100	3
2	IV	24ES03MT0401	Mechatronics and Automation	3	0	1	3	50	50	100	3
3	V	24ES03MT0501	Modelling and Simulation of Robotic Systems	4	0	1	4	50	50	100	3
4	VI	24ES03MT0601	Robot safety and maintenance	4	0	1	4	50	50	100	3
5	VII	24ES03MP0701	Project	0	8	2	4	50	50	100	3
			TOTAL	**14**	**8**	**6**	**18**				

Minors scheme Track- II: Mechanical Engg. (B.Tech. Programs)

Sr. No.	Sem	Course Code	Course Title	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	P	S		Continuous Evaluatio	End Sem Exam	Total	
1	III	24ES04MT0301	Basics of Mechanical Engineering	3	0	1	3	50	50	100	3
2	IV	24ES04MT0401	Energy system and technologies	3	0	1	3	50	50	100	3
3	V	24ES04MT0501	Product Design & Digital Manufacturing	4	0	1	4	50	50	100	3
4	VI	24ES04MT0601	Automotive Technology	4	0	1	4	50	50	100	3
5	VII	24ES04MP0701	Project	0	8	2	4	50	50	100	3
			TOTAL	**14**	**8**	**6**	**18**				

MDM: Track-I: Defense Technology

Sr. No.	Sem	Course Code	Course Title	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	P	S		Continuous Evaluati	End Sem Exam	Total	
1	III	24ES03TH0307	Defense Platforms	3	0	0	3	50	50	100	3
2	IV	24ES03TH0407	Warfare system	3	0	0	3	50	50	100	3
3	V	24ES03TH0507	Weapon Systems	3	0	0	3	50	50	100	3
4	VI	24ES03TH0607	Self-Defense & Protection system	3	0	0	3	50	50	100	3

			TOTAL	12	0	0	12					

Semester I

Course Code: 24HS05TH0104			Course: Applied Physics
L: 3	T: 0	P: 0	Total Credits: 3

Course Objectives

1. To develop the ability to correlate basic physics principles involved in Robotic operations.
2. To help to improve fundamental robotic operations.

Course Outcomes

After successful completion of the course students will be able to:

1. Apply Laser beam characteristics in various robotic operations.
2. Apply principal knowledge of Ultrasonics in robotic operations.
3. Apply fundamental principles of electromagnetics to robotic operations.
4. Apply fundamental knowledge of fluid dynamics to underwater and arial robotics.
5. Apply various sensing mechanisms pertaining to various Robotic operations.

Module 1: Laser Physics

*Basics of Laser light emission***:** Spontaneous and stimulated emission of radiations, thermal equilibrium, condition for light amplification, population inversion, pumping schemes, optical resonator, He-Ne Laser/ Ruby Laser.

Laser beam characteristics: Monochromaticity, Coherence, Directionality, Focusibility, Intensity, Beam divergence and applications thereof.

Module 2: Ultrasonics

Basics of Ultrasonics: Ultrasonic waves, production and detection of ultrasonic waves, piezoelectric effect, properties and types of ultrasonic waves, measurement of ultrasonic velocity in liquids.

Applications of Ultrasonic waves in the measurement of elastic constants in liquids, application of ultrasonic waves in drilling, welding, soldering, in non-destructive testing of various materials, in generating 3D maps.

Module 3: Electromagnetism

Magneto-statics: Lorenz Force, Biot-Savart and Ampere's Laws and their applications, Magnetic vector potential, force and torque on a magnetic dipole, and applications.
Electrodynamics: Ohms law, motional emf, Faraday's law, Lenz's law, Mutual induction, energy storage in magnetic fields, Maxwell's equations and applications.

Module 4: Aeronautics Physics

Fluid mechanics for underwater and aerial robotics. Buoyancy, floatation, stability of floating body. Hydro-dynamics: Boundary layer concepts of drag, lift, its real-world applications to smart skies, mobile accelerometers, parachutes, helicopters, numerical on drag & lift forces, parachute design.

Module 5: Sensors and Actuators

Design and working principles of Sensors requited for Robotics: Strain, pressure, ultrasonic, piezoelectric, chemical, thermal, optical, electrical, etc, as required for various types of detection.

Semester I

Course Code: 24HS05PR0104			**Course: Applied Physics Lab**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course Objectives

The Physics for Robotics (Lab) course will consist of experiments illustrating the principles of physics relevant to the study of Robotics.

Course Outcomes

After successful completion of the course students will be able to

CO1. Prepare for measurements used in various experiments and analyze errors involved in the measurements.
CO2. Explore various methods for finding wavelength of light, magnetic field intensity, speed of waves.
CO3. Prepare laboratory reports on the experimental results with proper conclusions.
CO4. Interpret graphical results.
CO5. Identify principle involved in an experiment.

List of Experiments:

1. Error analysis and graph plotting.
2. To find magnetic field by deflection magnetometer.
3. To find wavelength of laser light by diffraction grating.
4. Determination of velocity of sound in liquid–standing ultrasonic waves.
5. Data analysis using Mathematica.
6. Study of Aerofoil Shapes.
7. Sensor based experiments.
8. Robot simulation on open-source software (e.g. – Gazebo, MuJoCo, SOFA, PhysX etc)
9. Mini project on sensor for application development.

Suggested References

Semester I

Course Code: 24HS03TH0104			Course: Differential Calculus and Basics of Statistics
L: 3	T: 0	P: 0	Total Credits: 3

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in Ordinary differential equation, statistics, probability and differential calculus.
It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

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

CO1. Recognize first order ordinary differential equations that can be solved by each of the four methods – Linear DE, exact DE, reducible to linear DE and reducible to exact differential equations and use the appropriate method to solve them.
CO2. Solve higher order ordinary differential equations with constant and variable coefficients.
CO3. Find best fit curve by method of least square method and calculate correlation, regressions.
CO4. Internalize multivariable calculus and apply it find Jacobean, maxima and minima of function.
CO5. Solve partial differential equation by using Variable separable method

Syllabus

Module 1: ***First order ordinary differential equations***(7 hours)
Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type, Applications of First order Differential Equations.

Module 2: ***Ordinary differential equations of higher orders*** (8 hours)
Second order linear differential equations with constant and variable coefficients, method of variation of parameters, Cauchy-Euler equation. Applications of Higher order Differential Equations.

Module 3: ***Statistics:*** (7 hours)
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolasand more general curves,correlation and regression – Rank correlation, Multiple regression and correlation and its application in Engineering.

Module 4: Differential Calculus (10 hours**)**
Taylor's and Maclaurin's series expansions, radius of curvature (Cartesian form), evolutes and involutes, Limit and continuity of functions of several variables and their partial derivatives, Eulers Theorem, chain rule, total derivative, Jacobians, Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 5: Partial differential equations (8 hours)
Partial differential equations with separation of variables, boundary value problems: vibrations of a string, heat equation, potential equation, vibrations of circular membranes.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Theory and Problems of probability and statistics : 2nded :*J. R. Spiegal ,Schaum series*
8. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune VidhyarthiGrihaPrakashan, Pune-411030 (India).
9. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Semester I

Course Code: 24HS03PR0102			**Course: Computational Mathematics Lab**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course Objectives: The computational Mathematics Lab course will consist of experiments demonstrating the principles of Mathematics relevant to the study of Science and Engineering. Students will show that they have learnt Laboratory skills that will enable them to properly acquire and analyze the data in the lab and draw valid conclusions. On successful completion of the course students shall be able to:

Proposed Course Outcomes:

By using open source software SageMath Students will be able to:

CO1. Download SageMath and use it as an advance calculator.
CO2. Sketch and analyze function graphs.
CO3. Apply the concepts of differential calculus to find extreme value of continuous functions and analyze solutions of differential equations
CO4. Evaluate improper integrals and its applications to find length, area, volume, centre of gravity and mass.
CO5. Analyze and calculate eigen values, eigen vectors, rank nullity, and solve system of linear equations of a matrix / linear map.
CO6. Analyze the data to find best fit curve.

Mapping of Course outcomes (COs) with Experiments

Exp. No.	Name of Experiments	Mapped COs
1	To use SageMath as advanced calculator	CO1
2	2D Plotting with SageMath	CO2
3	3D Plotting with SageMath	CO2
4	Applied optimization with SageMath	CO3
5	Analysis of solutions of differential equations in SageMath	CO3
6	Linear Algebra with Various applications	CO5
7	Curve Fitting to identify trends and patterns within dataset by using SageMath	CO6
8	Practical Applications of Integral Calculus with SageMath	CO4

Semester I

Course Code:24ES03TH0101			Course: Mechanical Marvels
L: 1	T: 0	P: 0	Total Credits: 1

Course Objective:

1. To create awareness about the past and recent developments in Mechanical Engineering.
2. To sensitize about the applications of Mechanical Engineering in various fields.

Course Outcomes:

CO1. To know about the evolution of Mechanical Engineering as a discipline.
CO2. To develop awareness about latest trends in Mechanical Engineering.

Syllabus:

- Industrial Revolutions (Industry 1.0 to Industry 5.0)
- Mechanical Engineering in day to day life
- Technical Disruptions
- Cutting edge technologies Drone, Robots, Electric vehicles, UAS
- Space Technology,
- Defence Technology
- Marine Technology
- Future Fuels
- Advanced Materials

- Green manufacturing
- Modern machines and infrastructure etc.

Semester I

Course Code: 24ES03TH0102			Course: Engineering Mechanics
L: 3	T: 0	P: 0	Total Credits: 3

Course Objectives
The primary objective of the study of engineering mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering.

Course Outcomes
After Completion of the syllabus, the students should be able to:

1. Understand and apply the basic principles of mechanics, including Newton's laws of motion, to analyze the behavior of physical systems.
2. Understand the physical significance of Center of Gravity, Centroid and Moments of Inertia
3. Analyze the kinematics of rigid bodies for rotation about a fixed axis, general planar motion. Apply equation of motion to solve problems involving the kinetics of rigid bodies, including the computation of forces and torques resulting from linear and angular motions.
4. Evaluate the system by Work and Energy principle as well as Impulse and Momentum principle
5. Understand and analyze the dynamics of rigid bodies in terms of translation, rotation, and general plane motion.

Unit 1: Basic concepts of Engineering Mechanics
Introduction and need of Engineering Mechanics, Units of Measurement, Force Vectors, Vector Addition of Forces, Equilibrium of a Particle, Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams (FBD), Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

Introduction to Trusses: Structural Analysis of Simple Trusses by joint and section method. Introduction to space trusses, frames.

Unit 2: Properties of surfaces & solids: Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia.

Friction: Basics of friction, ladder friction, wedge friction, rolling resistance.

Unit 3: Dynamics of Particle
Kinematics of a Particle: Rectilinear Kinematics, General Curvilinear Motion, Projectile motion.

Kinetics of a Particle: Newton's Second Law of Motion, Equation of Motion for a System of Particles

Unit 4: Work and Energy principle: The Work of a Force, Principle of Work and Energy for translation, Work-Energy applied to particle motion and connected system and fixed axis rotation, Power and Efficiency, Conservation of Energy.

Impulse and Momentum: Principle of Linear Impulse and Momentum, Angular Momentum, Relation between Moment of a Force and Angular Momentum, Principle of Angular Impulse and Momentum, Principle of Linear Impulse and Momentum for a System o f Particles

Unit 5: Dynamics of Rigid Body
Kinematics of a Rigid Body: Introduction, Types of rigid body motion, Fixed-axis rotation, Plane Motion.
Kinetics of rigid body: Equation of plane motion, Fixed-axis rotation, Rolling Bodies, General Plane Motion.

Text Books

1. R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
2. F. L. Singer, Engineering Mechanics, Statics & Dynamics, BS Publications

Reference Books

1. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, Pearson Educations, Forth edition, 2003.
2. Beer and Johnson, Vector Mechanics for Engineers, Vol.1 "Statics" and Vol.2 "Dynamics, McGraw Hill International Edition, 1995.
3. S.S. Bhavikatti, Engineering Mechanics, New Age Publications

Semester I

Course Code: 24ES03TH0103			**Course: Engineering Graphics**
L: 2	**T: 0**	**P: 0**	**Total Credits: 2**

Course Outcomes:
The expected learning outcome is that, the students shall be able to:

CO1. Draw and interpret technical drawings
CO2. Convert 2-D to 3-D drawing and vice versa.
CO3. Represent the various positions of planes and solids in different orientations.
CO4. Develop the solid surface for sheet metal working

UNIT 1: Introduction to Engineering Drawing and Engineering Curves: Principles of Engineering Graphics and their significance, usage of drawing instruments, Lettering and dimensioning, Engineering Curves - Conic sections, Cycloid and Involute etc.

UNIT 2: Orthographic Projections: Theory of Projections, Concept of Projection, and First & Third angle projection methods. Conversion of given 3-dimensional view to 2-dimensional representation.

UNIT 3: Projections of Lines and Planes: Projections of lines (line inclined to both planes), Projections of planes (inclined to both the planes), Concept of auxiliary plane method for projections of the plane.

UNIT 4: Sections of Solids and Development of Surfaces: Theory of sectioning, sections of prism, pyramid, cylinder and cone, Development of lateral surfaces of solids, Real-world applications of surface development.

UNIT 5: Isometric Projections: Principles of Isometric projection - Isometric Scale, Isometric View, and Conversion of Orthographic views to Isometric Views / Projection.

Text Books:

1. Agarwal B & Agarwal C.M. Engineering Graphics, Tata McGraw Hill Publications.
2. Engineering Drawing by N.D. Bhatt, Charotar Publishing House Pvt. Ltd.
3. Engineering Drawing with an Introduction to AutoCAD" by D. A. Jolhe Tata McGraw Hill Publications
4. Engineering Drawing by R.K. Dhawan, S. Chand Publications
5. Engineering Drawing by K.L. Narayana & P. Kannaiah, SciTech Publication

Reference Books:

1. AutoCAD 14 for Engineering Drawing by P. Nageshwara Rao, Tata McGraw Hill Publications.
2. A text book of Engineering Drawing by P.S. Gill, S.K. Kataria& sons, Delhi.
3. Engineering Drawing and Computer Graphics by M. B. Shah & B.C. Rana, Pearson Education.

Semester I

Course Code: 24ES03PR0103			**Course: Engineering Graphics Lab**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course Outcomes:

Students are prepared for actual work situations through practical training in a new state of the art computer designed CAD laboratory using engineering software. The student shall be able to:

CO1. Draw and interpret technical drawings.
CO2. Convert 2-D to 3-D drawing and vice versa
CO3. Represent the various positions of planes and solids in different orientations.
CO4. Develop the solid surface for sheet metal working
CO5. Use & demonstrate drafting package.

Introduction to Computer Aided Drawing:

Introduction, Drawing Instruments and their uses, relevant BIS conventions and standards. Lettering, line conventions, dimensioning, material conventions and free hand practicing.

Computer screen, layout of the software, standard tool bar / menu and description of most commonly used tool bars, and navigational tools.

Co-ordinate system and reference planes HP, VP, RPP & LPP of 2D/3D environment. Selection of drawing sheet size and scale.

Commands and creation of lines, coordinate points, axes, poly-lines, square, rectangle, Polygon, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz., tangency, parallelism, inclination and perpendicularity.

Practical's to be performed from the list as below

SN	List of sheets
1	Engineering Curves
2	Orthographic Projection
3	Projection of Straight Lines and Planes
4	Section of solids and Development of surfaces
5	Isometric projection

Suggested Text/ Reference Books:

1. Agarwal B & Agarwal C.M. Engineering Graphics, Tata McGraw Hill Publications
2. Bhatt N.D. Panchal V.M. & Ingle P.R., Engineering drawing, CharotarPublishing house.
3. Jolhe D.A., Engineering drawing with an Introduction to Auto CAD", Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
4. Shah M.B. & Rana B.C., Engineering drawing and Computer Graphic, Pearson Education.
5. Narayana K.L & P Kannaiah, Text Book on Engineering Drawing, Scitech Publishers.
6. (Corresponding set of) CAD Software Theory and USER Manuals.

Semester I

Course Code: 24EE07TP0106			Course: Basics of Electrical Engineering
L: 2	T: 0	P: 0	Total Credits: 2

Course Objectives

The objective of this course is to provide mechanical engineering students with a comprehensive understanding of electrical and electronics principles and their application in electromechanical systems.
Additionally, the course will explore various case studies to demonstrate the real-world applications of these concepts in industries such as automation, electric vehicles, and medical devices.

Course Outcomes:

After the completion of the course, students will be able to:

CO1. Explain the basics of Electrical systems and various components.
CO2. Identify the various components in Electro-mechanical systems.
CO3. Classify the types of power converters as per the applications.
CO4. Select the battery for specific application.

1. Introduction to Electrical System:

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's current and voltage laws, analysis of simple circuits with DC excitation.
AC Circuits: Representation of sinusoidal wave forms, peak and RMS values. Concept of Impedance, Power, Energy. Introduction to 3-phase systems-

2. Introduction to power converters:

Basic schematic introduction to power converters, Types of Power converter, AC-DC, DC-DC, DC-AC converters, applications

3. Electrical Machines:

Introduction to DC motors

Single Phase Transformer: Construction, principle of operation, EMF Equation. Regulation and Efficiency of a Transformer.

Three Phase Induction Motor: Construction and Principle of Operation, Slip and Torque, Speed Characteristics.

Stepper motor: Construction, working principle and modes of operation

4. Electromechanical Systems:

Introduction to electromechanical systems: Basics of electric motors, actuators, and sensors, Design considerations for integrating electrical and mechanical components, Applications of power electronics in mechanical systems. Selection and sizing of motors for mechanical systems, Motor control techniques and applications.

Text Books:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. Electrical Technology: B. L. Thereja, S. Chand Publications.
3. Electrical & Electronic Instruments & Measurement by A. K. Sawhney, Dhanpat Rai and Co. 19th Edition, 2015.
4. Mechatronics: Principles, Concepts and Applications, Mahalik N. P., Tata McGraw Hill

Reference Books:

1. D. C. Kulshreshtha, "Basic Electrical Engineering", McGrawHill,2009.
2. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
3. Basic Electrical Engineering: S.B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.
4. Electronic Instrumentation & Measurement Technique by W. D. Cooper & A. D. Helfrick, Prentice Hall, 3rd revised Edition, 1985.

Semester I

Course Code: 24EE07PR0106			**Course: Basics of Electrical Engineering Lab**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course Outcomes:

After the completion of the course, students will be able to:

CO1. Perform experiments on basis DC and AC circuits and make valid conclusions from observed results.

CO2. Study the operation of DC-DC converters.
CO3. To reverse the direction of rotation of a dc shunt motor and control it's speed by different methods.
CO4. Calculate the energy bill and verify the same with that provided by the utility for a specific installation and specific period.
CO5. Write effective reports based on observations and conclusions.

List of Experiments:

1. To verify Kirchhoff's laws of DC circuits.
2. To verify Kirchhoff's laws for RLC series circuits.
3. To verify Kirchhoff's laws for RLC parallel circuits.
4. To study DC – DC Buck converter.
5. To study DC – DC Boost converter.
6. To study battery charging.
7. Study of actuators and sensors for electro-mechanical systems.
8. To calculation and verification of energy bill of a house.
9. To reverse the direction of rotation of a dc shunt motor and control it's speed by different methods.
10. To measure power in DC circuit using shunt and voltage divider circuit.
11. To study the charging/ discharging characteristics of super capacitor.
12. Open-ended experiments.

Semester I

Course Code: 24ES03TP0104			**Course: Programming for Problem Solving**
L: 1	**T: 0**	**P: 0**	**Total Credits: 1**

Course Objective

Develop foundational programming skills to design, implement, and analyse simple algorithms and data structures, using the C programming language, with a focus on solving real-world problems

Course Outcomes

CO1. Understand the components of a computer system and develop algorithms using flowcharts and pseudo-code.
CO2. Demonstrate proficiency in C programming, including the use of data types, operators, control statements, loops, and functions.
CO3. Utilize arrays, implement basic sorting algorithms, and understand the concept of algorithm complexity through example programs.
CO4. Apply pointers and structures in programming, and perform file handling operations including file input/output in C.

Unit - I: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)Idea of Algorithm: Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart /Pseudo code with examples. Arithmetic expressions and precedence

Unit - II: C Programming Language

Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements, Pre-processor Directives, Decision Control Statement-if, if-else, nested if-else statement, switch case, Loops and Writing and evaluation of conditionals and consequent branching.

Unit - III: Arrays and Basic Algorithms

Arrays: 1-D, 2-D, Character arrays and Strings. Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Unit - IV: Functions and Recursion

User defined and Library Functions, Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference. Recursion: As a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit - V: Pointers and Structures

Structures, Defining structures, Array of Structures, Introduction to pointers, Defining pointers, Pointer arithmetic, pointer operators, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit - VI: File handling

Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading and writing the file, closing the files etc.

Text Books

1. Programming in ANSI C: E. Balguruswami McGraw Hill

2. Mastering C: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill

Reference Books

1. Programming with C: Byron Gottfried, Schaums Outline Series.

2. Let Us C: YashwantKanetkar, BPB Publication

Semester I

Course Code: 24ES03PR0104			Course: Programming for Problem Solving Lab
L: 0	T: 0	P: 2	Total Credits: 1

10 to 12 Practical based on the above contents

Semester I

Course Code: 24HS02TH0104			Course: Foundational Course in Universal Human Values
L: 1	T: 0	P: 0	Total Credits: 1

Course Objectives:

- To help the student see the need for developing a holistic perspective of life
- To sensitize the student about the scope of life – individual, family (inter-personal relationship), society and nature/existence.
- To strengthen self-reflection.
- To develop more confidence and commitment to understand, learn and act accordingly.

Course outcome:

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

CO1. Develop a holistic perspective of life
CO2. Better understanding of inter-personal relationships and relationship with society and nature.
CO3. An ability to strengthen self-reflection

Syllabus

Unit 1:- Aspirations and concerns

Need for Value Education: Guidelines and content of value education. Exploring our aspirations and concerns: Knowing yourself, Basic human aspirations Need for a holistic perspective, Role of UHV; Self-Management: harmony in human being

Unit 2:- Health

Harmony of the self and Body, Mental and physical health; Health for family, friends and society.

Unit 3:- Relationships and Society

Harmony in relationships, Foundational values: Trust, Respect, Reverence for excellence, Gratitude and love; harmony in society; harmony with nature.

Text book:

R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 10030, ISBN 978-8-174- 46781-2

Reference books:

1. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, and Universe Books.

6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, Jeevan VidyaekParichay, Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

Semester II

Course Code: 24HS03TH0214			Course: Linear Algebra and Integral Calculus
L: 3	T: 0	P: 0	Total Credits: 3

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in
Calculus and multivariate analysis. It aims to equip the studentswithstandard concepts and tools at an intermediate to advanced level that will serve them welltowards tackling more advanced level of mathematics and applications that they wouldfind useful in their disciplines.

Course Outcomes

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

CO1. Interpret the solutions of system of linear equations and use the concepts of Eigen values, Eigen vectors to find diagonalization of matrices, reduction of quadratic form to canonical form.
CO2. Evaluate definite and improper integrals using Beta, Gamma functions. Also trace Cartesian curves.
CO3. Solve multiple integration by change of order, change of variable methods and apply it to findarea, volume, mass and centerof gravity.
CO4. Understand geometric meaning of gradient, curl, divergence
CO5. Perform line, surface and volume integrals of vector-valued functions

Syllabus

Module 1: LinearAlgebra:(8hours)
Rank-nullity theorem; System of linearequations; Symmetric, skew-symmetric and orthogonal matrices; Eigenvaluesand eigenvectors; Diagonalization of matrices; Orthogonaltransformation and quadratic to canonical forms, Introduction to n-dimensional space, Sinular value decomposition and its application in reducing the dimensionality of images and data .

Module 2: Integral *Calculus:* (8hours)
Evaluation of definite and improper integrals; Beta and Gammafunctions and their properties; Tracing of curves (Cartesian form)
65

Module 3: ***Multiple Integrals*** (10 hours)
Multiple Integration: Double and triple integrals (Cartesian and polar), change of order ofintegration in double integrals, Change of variables (Cartesian to polar), Applications: area, massand volume by double integration, Center of mass and Gravity (basic concepts).

Module 4: Vector Calculus (Differentiation) (7 hours)
Scalar point function, Vector point function, vector differentiation, gradient, divergence and curl, directional derivatives with their physical interpretations, solenoidal and irrotational motions, Scalarpotential function.

Module 5: Vector Calculus (Integration) (7 hours)
Vector integration: Line integrals, work done, conservative fields, surface integrals and volume integrals, Stoke's theorem, Gauss divergence theorem, Green's theorem and their simple applications.

Topics for self-learning

Rolle's theorem, Mean value theorems, Indeterminate forms, Applications of definite integrals to evaluate perimeter, area, surface areas and volumes of revolutions.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. P. N. Wartikar and J. N. Wartikar, A text book of Applied Mathematics Volume I & II, Pune VidhyarthiGrihaPrakashan, Pune-411030 (India).
6. Biomedical Statistics –Shantikumar Yadav , Sompal Singh, Ruchika Gupta
7. Theory and Problems of Probability and Statistics - M.R. Spiegal (Mc Graw Hill) Schaum Series

Semester II

Course Code: 24ES03TH0201			Course: Artificial Intelligence
L: 3	T: 0	P: 0	Total Credits: 3

Course Objectives:

- To introduce classical AI and rational intelligent agents.
- To introduce techniques for problem solving by search and adversarial games.
- To introduce constraints, logic, and inference techniques
- To introduce planning, acting, and multi-agent systems.
- To introduce knowledge-representation and reasoning.

Course Outcomes

After completing this course, students will be able to

CO1. Analyse different elements of an AI system.
CO2. Apply elementary principles of AI for problem solving and search
CO3. Apply constraints and logic for intelligent systems
CO4. Apply knowledge representation and reasoning for defining intelligent systems

Unit 1

History and Foundations of AI, Rational Intelligent Agents, Agents and Environments, Nature of Environments, Structure of Agents.

Unit 2

Problem Solving by Search: Uninformed and Informed Search Strategies, Heuristic Functions; Adversarial Search:
Games, Optimal Decisions in Games, Alpha-Beta Pruning

Unit 3
Constraint Satisfaction Problems, Inference in CSPs, Backtracking Search; Knowledge-Based Agents, Propositional and First-Order Logic, Resolution Theorem Proving, Unification Forward and Backward Chaining

Unit 4
Classical Planning: Algorithms for Planning, Planning Graphs, Hierarchical Planning, Planning and Acting in Nondeterministic Domain, Multi-Agent Planning; Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Reasoning with Default Information.

Textbooks/ References:
Russell, Stuart Jonathan, Norvig, Peter, Davis, Ernest. Artificial Intelligence: A Modern Approach. United Kingdom: Pearson, 2010.
Deepak Khemani. A First Course in Artificial Intelligence. McGraw Hill Education (India), 2013.
Denis Rothman. Artificial Intelligence by Example, Packt, 2018.

Semester II

Course Code: 24ES03TH0202			**Course: Theory of Mechanisms & Elasticity**
L: 3	**T: 0**	**P: 0**	**Total Credits: 3**

Course Objective: To impart the basic knowledge the machines and mechanisms as well as mechanics of material.

Course Outcome:

CO1. Describe the functioning of a machine, the relationship between the number of links and joints and to determine its mobility.
CO2. Explain the inversions of mechanism and their applications.
CO3. Classify and synthesize the cams for different follower motions.
CO4. Understand basic concept of stress, strain and their relations based on linear elasticity, material behaviour due to different types of loading.
CO5. Learnanalyticalandgraphicalanalysisofcompoundstressesandanalysisofstrainenergy.
CO6. Develop shear force – bending moment diagram of beams under different loading conditions & support conditions and analyse bending & shear stresses in beams.

Unit-I: Basics of Mechanisms and Machines
Basics of Mechanisms and Machines: Basic concept of mechanism, link, kinematics pairs, kinematics chain,

mechanism, machine, simple & compound chain, Degree of freedom, Kutzbach's theory, Grubber's criterion. Harding's notations, Class-I& Class-II mechanisms **(8)**

Unit-II: Applications of Inversion of Mechanisms
Inversions and applications of a four bar chain, single slider crank chain and double slider chain. Limiting positions, Mechanical advantage, Transmission angle, various types of mechanism such as Geneva wheel, Pawl and ratchet mechanism, and mechanism used in various toys, Introduction to Belt drive, Chain drive and gear drives **(7)**

Unit-III: Cams and Followers
Classification of cams and followers-Terminology and definitions- Displacement diagrams-uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions, and pressure angle and its significance, radial follower and offset followers **(7)**

Unit IV: Concept of simple stresses and strains
Concept of Elasticity, types of stresses, Hooke's law, stress and strain diagram; statically indeterminate systems, elastic constants and their relations; Factor of safety Thermal stresses and strain.

Unit-V: Compound stresses and strain
Normal and shear stress on inclined plane, principal stresses and principal planes, maximum shear stresses, Mohr's circle
Strain energy: Strain energy stored in a body subjected to axial loading, & impact loading.

Unit–VI: Shear force and bending moment
Relation between load, shear force and bending moment, Shear force and bending moment diagrams for different types of beams subjected to different types of loads.

Text Books

1. Theory of Machines: S.S. Rattan, Tata McGraw Hill Publishers, 3rd edition onwards
2. Strength of Materials by S.S. Rattan, McGraw-Hills Education (India) Publication, India.
3. Strength of Materials by S.S. Bhavikatti, Vikas Publishing house, Noida, India.

Reference Books

1. Kinematics & Dynamics of Machinery: R.L. Norton Tata McGraw Hill Publishers
2. Mechanism and Machine Theory: J.S. Rao & Rao V. Dukkipati, New Age International
3. Strength of Materials by F.L. Singer, Harper and row Publication.
4. Engineering Mechanics of Solid by Egor P. Popov, Prentice Hall of India Publication.

Semester II

Course Code: 24ES03TP0201			Course: Data Structure and Algorithms
L: 2	T: 0	P: 0	Total Credits: 2

Course Objective

Equip students with the knowledge and skills to design, implement, and analyse fundamental data structures and algorithms, enabling them to efficiently solve complex problems and optimize performance in computational applications.

Course Outcomes

On successful completion, of course student will able to:

CO1. Identify different ADTs, their operations and specify their complexities.
CO2. Apply linear data structures to address practical challenges and analyse their complexity.
CO3. Implement different sorting, searching, and hashing methods and analyse their time and space requirements.
CO4. Analyse non-linear data structures to develop solutions for real-world applications.

UNIT I: Data Structures and Algorithms Basics

Introduction: Basic terminologies, elementary data organizations, data structure operations; abstract data types (ADT) and their characteristics.

Algorithms: Definition, characteristics, analysis of an algorithm, asymptotic notations, and time and space trade-offs.

Array ADT: Definition, operations and representations – row-major and column- major.

UNIT II: Sorting, Searching and Hashing

Sorting: Different approaches to sorting, properties of different sorting algorithms (insertion, Shell, quick, merge, heap, counting), performance analysis and comparison.

Searching: Necessity of a robust search mechanism, searching linear lists (linear search, binary search) and complexity analysis of search methods.

Hashing: Hash functions and hash tables, closed and open hashing, randomization methods (division method, mid-square method, folding), collision resolution techniques.

UNIT III: Stacks and Queues

Stack ADT: Allowable operations, algorithms and their complexity analysis, applications of stacks–expression conversion and evaluation (algorithmic analysis), multiple stacks.

Queue ADT: Allowable operations, algorithms and their complexity analysis for simple queue and circular queue, introduction to double-ended queues and priority queues.

UNIT IV: Linked Lists

Singly Linked Lists: Representation in memory, algorithms of several operations: traversing, searching, insertion, deletion, reversal, ordering, etc. Doubly and Circular Linked Lists: Operations and algorithmic analysis. Linked representation of stacks and queues.

UNIT V: Trees and Graphs

Trees: Basic tree terminologies, binary tree and operations, binary search tree (BST) and operations with time analysis of algorithms, threaded binary trees. Self-balancing Search Trees: Tree rotations, AVL tree and operations, Graphs: Basic terminologies, representation of graphs, traversals (DFS, BFS) with complexity analysis, path finding (Dijkstra's SSSP, Floyd's APSP), and spanning tree (Prim's and Kruskal's algorithms).

Text Books

1. G.A.V. Pai, Data Structures and Algorithms: Concepts, Techniques and Application, First Edition, McGraw Hill, 2017.

2. Ellis Horowitz, SartajSahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.

3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Third Edition, Pearson Education, 2007.

4. Thomas H Cormen, Algorithms Unlocked, MIT Press, 2013

Reference Books

1. Reema Thareja, Data Structures using C, Third Edition, Oxford University Press, 2023

2. Narasimha Karumanchi, Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles Fifth Edition, Career Monk Publications, 2016.

3. Aditya Bhargava, Grokking Algorithms: An Illustrated Guide for Programmers and Other Curious People, First Edition, Manning Publications, 2016.

4. K. R. Venugopal and Sudeep R. Prasad, Mastering C, Second Edition, McGraw Hill,2015.

5. A. K. Sharma, Data Structures using C, Second Edition, Pearson Education, 2013.

Semester II

Course Code: 24ES03PR0203			Course: Data Structure and Algorithms Lab
L: 0	T: 0	P: 2	Total Credits: 1

10 to 12 Practical based on the above contents

Semester II

Course Code: 24EE01TP0206			Course: Digital Logic Design
L: 2	T: 0	P: 0	Total Credits: 2

Course Outcomes

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

CO1. Apply various optimization techniques to minimize digital circuits.
CO2. Design combinational logic circuits.
CO3. Analyze and design asynchronous and synchronous sequential circuits.
CO4. Discuss x 86 architecture

Syllabus

Module 1

Basics of Digital Electronics: Motivation for digital systems: Number Systems and arithmetic's, Logic and Boolean algebra, logic gates & truth tables, SOP, POS, Minimization of combinational circuits using Karnaugh- maps.

Module 2

Combinational Circuit Design: Multiplexers, De-multiplexers, Encoders, Decoders, Code Converters, Adders, Subtractor (Half, Full), BCD Adder/ Subtractor, ripple and carry look-ahead addition, Unsigned Multiplier.

Module 3

Sequential circuit Design-I: Storage elements, Flip-flops and latches: D, T, J/K, S/R flip-flops: level triggered, edge triggered, Master Slave flip-flop, flip flop conversion, timing analysis.

Module 4

Sequential circuit Design-II: Design of asynchronous and synchronous counters, Registers & Shift registers, Application of shift register: ring counter, Johnson counter, sequence generator and detector, serial adder; Linear feedback shift register (LFSR)

Module 5

Design of synchronous sequential circuit using Mealy model and Moore model: state transition diagram, algorithm state machine (ASM) chart

Text Books

1. Donald P. Leach, Albert P. Malvino and GoutamSaha, “Digital Principles & Applications 8e”, McGraw Hill

2. Douglas V. Hall “Microprocessors and Interfacing” Tata McGraw Hill Education Private Limited, 2005

Reference Books

1. Thomas L Floyd, “Digital Fundamentals 9e”, Pearson

2. M. Morris Mano and Michael D. Ciletti, “Digital Design 5e”, Pearson

3. Taub and Shilling, “Digital Integrated Electronics”, McGraw Hill

4. A. Anand Kumar, “Fundamentals of Digital Circuits” Fourth Edition, PHI

5. Kip R. Irvine, “Assembly Language for x86 Processors” Seventh Edition, Pearson Education

Semester II

Course Code: 24ES03PR0204			**Course: Digital Logic Design Lab**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

List of Experiments

1. To verify truth table of different logic gates.

2. Design basic logic gates using universal gate and verify its truth table.

3. To verify following Boolean expressions using gates and Multisim software.

a) A+AB+AB

b) AB(C+AC)

4. To implement the following arithmetic circuits using (a) logic gates IC’s and (b) using Multisim software.

a) Full adder

b) Half subtractor

5. Implement the function F = Σm (1,3,5,7,8,9,11,13,15) using 16:1 and 8:1 multiplexer.

6. Verify the truth table of SR, JK, JKMS, T and D flip flop.

7. To study the following functions of Shift register using IC 7495

a) SIPO

b) PIPO

c) PISO

d) SISO

8. Design and verify 2-bit synchronous down counter using S-R flip-flop.

9. Design and verify the functionality of a sequence detector to detect the sequence 1101 using Melay and Moore model and use J-K flop-flop to implement the design.

Semester II

Course Code: 24HS02TP0201			**Course: English for Professional Communication**
L: 2	**T: 0**	**P: 0**	**Total Credits: 2**

Course Objectives
The main objective of this course is to enhance the employability skills of students as well as prepare them for effective work place communication.

Course outcomes:
On successful completion of the course the students will be able to achieve the following:

CO1. Demonstrate effective use of word power in written as well as oral communication.
CO2. Understand the techniques of listening and apply the techniques of reading comprehension used in professional communication.
CO3. Apply the principles of functional grammar in everyday as well as professional communication.
CO4. Effectively implement the comprehensive principles of written communication by applying various writing styles.
CO5. Create precise and accurate written communication products.

Unit-1: Vocabulary Building
1.1 Importance of using appropriate vocabulary.
1.2 Techniques of vocabulary development.
1.3 Commonly used power verbs, power adjectives and power adverbs.
1.4 Synonyms, antonyms, phrases & idioms, one-word substitutions and standard abbreviations.

Unit -2: Listening and Reading Comprehension
2.1 Listening Comprehension: active listening, reasons for poor listening, traits of a good listener, and barriers to effective listening.
2.2 Reading Comprehension: types and strategies.

Unit -3: Functional Grammar and Usage
3.1 Identifying Common Errors in use of: articles, prepositions, modifiers, modal auxiliaries, redundancies, and clichés.

3.2 Tenses
3.3 Subject-verb agreement, noun-pronoun agreement
3.4 Voice

Unit-4: Writing Skills
4.1 Sentence Structures
4.2 Sentence Types
4.3 Paragraph Writing: Principles, Techniques, and Styles

Unit-5: Writing Practices
5.1 Art of Condensation: Précis, Summary, and Note Making
5.2 Correspondence writing techniques and etiquettes – academic writing
5.3 Essay Writing

Books

1. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 10031.
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Semester II

Course Code: 24HS02PR0201			**Course: English for Professional Communication Lab**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course Objective
To enhance competency of communication in English among learners

Course Outcomes
On completion of English Lab course, students will be able to achieve the following:

CO1. Apply effective listening and speaking skills in professional and everyday conversations.
CO2. Demonstrate the techniques of effective Presentation Skills
CO3. Evaluate and apply the effective strategies for Group Discussions
CO4. Analyze and apply the effective strategies for Personal Interviews
CO5. Implement essential language skills- listening, speaking, reading, and writing

List of Practical

1. Computer Assisted + Activity Based Language Learning
Practical 1: Everyday Situations: Conversations and Dialogues – Speaking Skills
Practical 2: Pronunciation, Intonation, Stress, and Rhythm
Practical 3: Everyday Situations: Conversations and Dialogues – Listening Skills

2. Activity Based Language Learning
Practical 4: Presentation Skills: Orientation & Mock Session
Practical 5: Presentation Skills: Practice
Practical 6: Group Discussions: Orientation & Mock Session
Practical 7: Group Discussions: Practice
Practical 8: Personal Interviews: Orientation & Mock Session
Practical 9: Personal Interviews: Practice

Semester II

Course Code: 24ES03TP0202			**Course: Fabrication Practices**
L: 1	**T: 0**	**P: 0**	**Total Credits: 1**

Course Objectives:
The Objective of the course is:

1. Identify the different manufacturing process for various workshop trades including fitting, carpentry, smithy/foundry and welding, etc.
2. To get acquainted with the knowledge of various machine tools and equipments.

Course Outcomes:
The expected learning outcome is that the students will be able to:

CO1. Understand casting technique for the production of casted components.

CO2. Identify an appropriate molding pattern and various carpentry joints.

CO3. Understand the machining parameters and cutting tool for various machining operations.

CO4. Distinguish with hot and cold working method for the manufacturing of metal components.

CO5. Understand various fitting joints and sheet metal operations.

CO6. Apply the knowledge of suitable joining processes to carry out fabrication work. Introduction to foundries, metal casting, types of sand, introduction to moulding tools & different castingprocess.

Syllabus

Unit - I:
Introduction to foundries, metal casting, types of sand, introduction to moulding tools & different casting process.

Unit - II:
Introduction to pattern making for metal casting, different types of carpentry tools, holding devices,different

types of carpentry joints.

Unit - III:

Fundamentals of metal cutting, Lathe machine specification and operations, metal cutting parameters, single point cutting tool.

Unit - IV

Smithy and forging, hot working and cold working of metals, forging tools like chisels, hammers, types of furnaces.

Unit - V:

Fitting operations and associated measuring and marking tools, sheet metal operations.

Unit - VI:

Metal joining Process, types of welding, mechanics of welding, soldering and brazing.

Text Books

1. Workshop Technology, Volume - I & II - By Hajra Choudhary, Media Promoters & Publishers Pvt. Ltd.
2. Manufacturing Technology, Volume - I & II - P.N. Rao, Tata McGraw Hill Pub. Company, New Delhi.
3. Manufacturing Science - A. Ghosh & A. K. Malik - East West Press Pvt. Ltd. New Delhi.

Semester II

Course Code: 24ES03PR0205			**Course: Fabrication Practices Lab**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course Objectives:

The Objective of the course is:

1. To familiarize with major manufacturing process and required Machine Tools.
2. To get acquainted with and hands on experience on machine tools and equipments.

Course Outcomes:

The expected learning outcome is that the students will be able to:

CO1. Prepare a sand mould for casting and perform pattern making.

CO2. Perform different machining operations on lathe machine and parts fitting job.

CO3. Apply the knowledge of joining processes to carry out fabrication work.

List of Experiments:

Introduction of tools, equipments, material & process along with demonstration andpreparation of simple job using various workshop trades such as:

1) Metal casting and molding practice

2) Pattern making practice
3) Machining practices
4) Smithy and forging practice
5) Fitting job practice
6) Welding practice

*Case study: To prepare simple model/ project using various workshop facility (Group Activity)

Text Books

1. Workshop Technology, Volume - I & II - By Hajra Choudhary, Media Promoters &Publishers Pvt. Ltd.
2. Manufacturing Technology, Volume - I & II - P.N. Rao, Tata McGraw Hill Pub. Company, New Delhi.
3. Manufacturing Science - A. Ghosh & A. K. Malik - East West Press Pvt. Ltd. New Delhi.

Reference Books

1. Kalpak Jain and Schimd, Manufacturing processes for engineering materials, 5th Edition - Pearson India, 10034.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and System.
3. Production Engineering - P. C. Sharma, S. Chand and Company Ltd., New Delhi.

Semester II

Liberal/Performing Art Courses

Course Code: 24HS02PR0106-01			**Course: Bharatnatayam**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course objective

The course aims to introduce the students to Bharatnatayam, an important element of Indian traditional knowledge system. The course will not only provide the learning and skill to perform this art but would also enhance many mental and physical aspects of the students such as strength, flexibility, discipline, self-confidence, creativity, focus, coordination, etc.

Course Outcomes

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

CO1. Understand the importance of dance and Bharatnataym as an Indian dance form.
CO2. Develop skillsto perform the dance form at its basic level.

CO3. Evaluate their strengths and interest to take bridge course to give *Pratham* (1st level formal exam of Bharatnatayam).

Syllabus

Practical -1: Orientation in Bharatnatayam

Practical-2: Tattu Adavu till 8, Naatta Adavu 4 Steps, Pakka Adavu 1 step, Metta Adavu 1 Step, KudittaMetta Adavu 4 Steps,

Practical -3: Practice sessions

Practical-4: Tatta Kuditta Adavu (Metta), Tatta Kuditta Adavu (Metta) 2 Steps, Tirmanam Adavu 3 Steps, Kattu Adav - 3 Steps, Kattu Adav - 3 Steps

Practical-5: Practice sessions

Practical-6: Tiramanam (front) 3 Steps, Repeat of Tiramanam (Overhead) 3 Steps,

Practical-7: Practice sessions

Practical - 8: final practice sessions and performances.

Recommended reading

1. Introduction to Bharata's Natyasastra, Adya Rangacharya, 2011
2. The Natyasastra and the Body in Performance: Essays on the Ancient Text, edited by Sreenath Nair,2015
3. Bharatanatyam How to ...: A Step-by-step Approach to Learn the Classical Form, Eshwar Jayalakshmi,2011

Semester II

Course Code: 24HS02PR0106-02			**Course: Kathak**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course objective

The course aims to introduce the students to Kathak, an important element of Indian traditional knowledge system. The course will not only provide the learning and skill to perform this art but would also enhance many mental and physical aspects of the students such as strength, flexibility, discipline, self-confidence, creativity, focus, coordination, etc.

Course Outcomes

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

CO1: Understand the importance of dance and Kathak as an Indian dance form

CO2: Develop skills to perform the dance form at its basic level.

CO3: Evaluate their strengths and interest to take bridge course to give *Prarambhik* (1st level formal exam of

Kathak).

Syllabus
Practical -1: Orientation in Kathak. Correct posture of kathak, Basic Movements and exercise Stepping, Chakkar of 5 counts (Bhramari),

Practical -2: practice sessions of practical 1

Practical -3: Hastaks, Hastaks and Steppings, Reciting asamyukta Mudra shloka, Hastak and steppings

Practical -4: practice sessions of practical 3

Practical -5: Todas and Asamyukta hasta mudra shlok, Vandana of Shlok, 2 Todas and Vandana, Ghante Ki Tihai,

Practical -6: practice sessions of practical 5

Practical -7: 2 1 Chakkardar Toda and Ginnti Ki Tihai, 2 Todas and 1 Chakkardar Toda, practice sessions

Practical -8: Final performances.

Recommended reading
1. Kathak Volume1 A "Theoretical & Practical Guide" (Kathak Dance Book), Marami Medhi & Debasish Talukdar, 2022, Anshika Publication (13 September 2022)

Semester II

Course Code: 24HS02PR0106-03			**Course: Introduction to Digital Photography**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course objective

The course aims to develop basic skills of students in digital photography to lay a foundation for them as a hobby/ or as profession.

Course outcome:

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

Develop an understanding of the technical aspects and aesthetics of Photography.
Apply therules of digital photography for creating photographs.
Develop skills to enhance photographs through post processing.
Create a portfolio of their photographs in selected genre.

Syllabus

Practical 1: **Orientation in digital photography:** Genres, camera handling and settings

Practical 2: **Rules of Composition**

Practical 3: **Rules of Composition**: Practice sessions

Practical 4: **Understanding Exposure and Art of Pre-Visualization**

Practical 5: **Rules of Composition and Art of Pre-Visualization:** Practice sessions

Practical 6: **Post Processing Photographs and Portfolio creation**

Practical 7: **Post Processing Photographs:** Practice sessions

Practical 8: **Portfolio finalization and presentation in selected genre.**

Reference material

1. Scott Kelby (2020) *The Digital Photography Book: The Step-by-Step Secrets for how to Make Your Photos Look Like the Pros*, Rocky Nook, USA
2. Larry Hall (2014) *Digital Photography Guide: From Beginner to Intermediate: A Compilation of Important Information in Digital Photography*, Speedy Publishing LLC, Newark
3. J Miotke (2010) *Better Photo Basics: The Absolute Beginner's Guide to Taking Photos Like a Pro*, AMPHOTO Books, Crown Publishing Group, USA

Semester II

Course Code: 24HS02PR0106-04			**Course: Introduction to Basic Japanese Language**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course objective

The course aims to develop basic communication skills in Japanese Language and help develop a basic understanding of Japanese culture in cross-cultural communication.

Course outcome

CO1. Gain a brief understanding about Japan as a country and Japanese culture.
CO2. Develop ability to use vocabulary required for basic level communication in Japanese language.
CO3. Able to write and read the first script in Japanese language.
CO4. Able to frame simple sentences in Japanese in order to handle everyday conversations
CO5. Able towrite in basic Japanese about the topics closely related to the learner.

Syllabus

Practical-1: Orientation about Japan, its language, and its culture

Practical-2: Communication Skills 1: Vocabulary for basic Japanese language

Practical -3: Practice sessions

Practical-4: Writing Skills 1: Reading and writing first script in Japanese

Practical-5: Practice sessions

Practical- 6: Communication Skills 2: framing sentences

Practical- 7: Practice sessions

Practical- 8: Writing Skills 2: Write basic Japanese and practice

Recommended Reading

1. Marugoto Starter (A1) Rikai - Course Book for Communicative Language Competences, by the Japan Foundation, Goyal Publishers & Distributors Pvt. Ltd (ISBN: 9788183078047)
2. Japanese Kana Script Practice Book – Vol. 1 Hiragana, by Ameya Patki, Daiichi Japanese Language Solutions (ISBN: 9788194562900)

Semester II

Course Code: 24HS02PR0106-05			**Course: Art of Theatre**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course objectives:

The course aims to develop in the students, an actor's craft through physical and mental training.

Course Outcomes:

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

CO1. Understand and synthesize the working of the prominent genres of theatre across the world.
CO2. Apply the skill of voice and speech in theatre and public speaking
CO3. Apply the art of acting and also develop generic skills such as confidence, communication skills, self-responsibility, motivation, commitment, interpersonal skills, problem solving, and self-discipline.
CO4. Apply skills acquired related to technical/production aspects of theatre and also develop problem solving and interpersonal skills.

Syllabus:

Practical 1: **Orientation in theatre**

Practical 2: **Voice and Speech training**

Practical 3: **Voice and Speech training: practice sessions**

Practical 4: **Art of acting**

Practical 5: **Art of acting: practice sessions Practical 6: Art of script writing**

Practical 7: **Art of script writing: practice sessions Practical 8: Final performances**

Reference books:

1. Boleslavsky, R. (2022). *Acting: The First Six Lessons* (1st ed., pp. 1-92). Delhi Open Books.
2. Shakthi, C. (2017). *No Drama Just Theatre* (1st ed., pp. 1-171). Partridge.
3. Bruder, M., Cohn, L. M., Olnek, M., Pollack, N., Previto, R., & Zigler, S. (1986). *A Practical Handbookfor the Actor* (1st ed.). Vinatge Books New York.

Semester II

Course Code: 24HS02PR0106-06			Course: Introduction to French Language
L: 0	T: 0	P: 2	Total Credits: 1

Course objective:

To help build a foundation and interest in French language so that the students can pursue the proficiencylevels of the language in higher semesters.

Course outcomes:

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

CO1. Demonstrate basic knowledge about France, the culture and similarities/differences between India and France.
CO2. Learn to use simple language structures in everyday communication.
CO3. Develop ability to write in basic French about themselves and others.
CO4. Develop ability to understand beginner level texts in French

Syllabus

List of Practicals:

Practical-1: Orientation about France, the language, and culture

Practical-2: Communication Skills 1: Vocabulary building for everyday conversations

Practical -3: Practice sessions

Practical-4: Reading and writing Skills : Reading and writing simple text in French

Practical-5: Practice sessions

Practical-6: Communication Skills 2: listening comprehension

Practical-7: Practice sessions

Practical-8: Writing Skills: Write basic French and practice

Recommended reading

1. 15-minute French by Caroline Lemoine
2. Cours de Langue et de Civilisation Françaises by G. Mauger Vol. 1.1
3. Cosmopolite I by Natalie Hirschsprung, Tony Tricot

Semester II

Course Code: 24HS02PR0106-07			Course: Introduction to Spanish Language
L: 0	T: 0	P: 2	Total Credits: 1

Course objective:

To help build a foundation and interest in Spanish language so that the students can pursue the proficiency levels of the language in higher semesters.

Course outcomes:

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

CO1. Demonstrate basic knowledge about Spain, the culture and similarities/differences between India and France
CO2. Learn to use simple language structures in everyday communication.
CO3. Develop ability to write in basic Spanish about themselves and others.
CO4. Develop ability to read and understand beginner level texts in Spanish

Syllabus

List of Practicals

Practical-1: Orientation about Spain, the language, and culture

Practical-2: Communication Skills 1: Vocabulary building for everyday conversations

Practical -3: Practice sessions

Practical-4: Reading and writing Skills: Reading and writing simple text in Spanish

Practical-5: Practice sessions

Practical-6: Communication Skills 2: listening comprehension

Practical-7: Practice sessions

Practical-8: Writing Skills: Write basic Spanish and practice

Recommended reading

1. 15-Minute Spanish by Ana Bremon
2. Aula Internacional 1 by Jaime Corpas ,Eva Garcia, Agustin Garmendia.
3. Chicos Chicas Libro del Alumno by María Ángeles Palomino

Semester II

Course Code: 24HS02PR0106-08			Course: Art of Painting
L: 0	T: 0	P: 2	Total Credits: 1

Course objective

Painting is fundamentally about learning to see, and to transport that vision onto paper through a varietyof mark making techniques. This course aims to develop basic skills of students in painting to lay a foundation for them as a hobby and/or a profession.

Course outcome:

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

CO1. Become familiar with the basic methods, techniques & tools of painting.
CO2. Train the eye and hand to develop sense of balance, proportion and rhythm.
CO3. Develop theability to observe and render simple natural forms.
CO4. Enjoy the challenging and nuanced process of painting.

Syllabus

Practical 1: Orientation in Painting tools & basics of lines, shapes, light, shadows and textures
Practical 2: The art of observation how to see shapes in drawing
Practical 3: Introduction Water color how to handle water paints
Practical 4: Introduction to acrylic colors how to handle acrylic paints
Practical 5: Explore layering paint and capturing the quality of light with paint.
Practical 6: Create landscape painting
Practical 7: Create Abstract painting
Practical 8: Paint on Canvas (try to recreate any famous painting)

Reference material

1. Drawing made easy by Navneet Gala; 2015th edition
2. Alla Prima II Everything I Know about Painting--And More by Richard Schmid with Katie Swatland
3. Daily Painting: Paint Small and Often To Become a More Creative, Productive, and Successful Artist by Carol Marine

Semester II

Course Code: 24HS02PR0106-09			Course: Art of Drawing
L: 0	T: 0	P: 2	Total Credits: 1

Course objective

Drawing is fundamentally about learning to see, and to transport that vision onto paper through a varietyof mark making techniques. This course aims to develop basic skills of students in drawing to lay a foundation for them as a hobby and/or a profession.

Course outcome:

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

CO1. Become familiar with the basic methods, techniques & tools of drawing.
CO2. Train the eye and hand to develop sense of balance, proportion and rhythm.
CO3. Develop theability to observe and render simple natural forms.
CO4. Enjoy the challenging and nuanced process of drawing.

Syllabus

Practical 1: **Orientation in Drawing tools & basics of lines, shapes, light, shadows and textures**

Practical2: **The art of observation** how to see shapes in drawing

Practical 3: **One/two-point basic linear perspective**

Practical 4: **Nature drawing and landscapes**

Practical 5: **Gestalt principles of visual composition**

Practical 6: **Figure drawing**: structure and proportions of human body

Practical 7: **Gesture drawing:** expression and compositions of human figures

Practical 8: **Memory drawing:** an exercise to combine the techniques learnt

Reference material

1. Drawing made easy by Navneet Gala; 2015th edition
2. Perspective Made Easy (Dover Art Instruction) by Ernest R. Norling

Semester II

Course Code: 24HS02PR0106-10			**Course: Nature Camp**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course Objective: To create an opportunity for the students to develop affinity with nature and thus subsequently impact their ability to contribute towards sustainability of nature.

Course outcome:

After the completion of the course the students will be able to do the following:

CO1. Develop an affinity with nature by observing and understanding it marvels with guidance fromexperts
CO2. Develop an understanding of the challenges and solutions associated with nature and itsconservation.

Course content

In collaboration with the Forest Department and/or a local NGO working in the field of environment conservation, this course would be conducted in 24 hours. Students will be taken to a tiger reserve in Vidrabha region or Forest fringe villages or work with an NGO from Vidarbha region working on natural resource management. The camps (for 2 days) will cover any one of the following topics as decided by the course coordinator:

1. Awareness about each element of biodiversity (camps on moths, butterflies, birds, other wildlife etc.)

2. Environment management (water, forest, wildlife) – practices of Forest Department in managing a tiger reserve, and other aspects of water and forest conservation.
3. Sustainable natural resource management - initiatives by rural communities and local NGOs
4. Man- animal conflict and solutions (socio-economic and technical) – role of local communities and Forest Department
5. Traditional practices in environment conservation – role of local communities and local NGOs

Semester II

Course Code: 24HS02PR0106-11			**Course: Developing Self-awareness**
L: 0	**T: 0**	**P: 2**	**Total Credits: 1**

Course objectives:

The course aims to develop students in their personal as well as professional life by means of graphotherapy, NLP, and Neurobics

Course Outcomes:

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

CO1. Gain foundational understanding of graphology and through self-analysis will achieve greater about their strengths and weaknesses & areas for personal growth
CO2. Students will be equipped with tools and techniques for continuous self- improvement, using signature analysis and graphotherapy as part of their personal development journey
CO3. Understand how to use Neuro Linguistic Programming (NLP) strategies to set and achieve goals effectively, overcoming mental blocks and limiting beliefs.
CO4. Enhance ability to absorb, retain, and recall information, which can benefit academic and professional performance.

Syllabus:

Practical 1: **The Power of Handwriting (Handwriting is Brainwriting)**

Practical 2: **Know yourself through handwriting**

Practical 3: **The Role of Signature in your life**

Practical 4: **Graphotherapy to enhance yourself in all ways**

Practical 5: **Neurolinguistic Programming , S.M.A.R.T Goal**

Practical 6: **Effective Communication Model, Rapport Building and Anchor**

Practical 7: **Brain Directives & Linguistic Presuppositions**

Practical 8: **Neurobics**

Semester II

Course Code: 24HS02PR0106-12			Course: Art of Poetry
L: 0	T: 0	P: 2	Total Credits: 1

Course Outcomes:

To familiarize the students with the art of poetry and develop a sense of appreciationfor the art

At the end of the course the student will be able to achieve the following:

CO1. Understand the origin and development of poetry
CO2. Appreciate the art of poetry in life
CO3. Develop aesthetic sense
CO4. Develop holistic perspective to their personality

Syllabus

Practical 1. Art of poetry – orientation
Practical 2. Forms of poetry – orientation
Practical 3. Forms of poetry – recitation
Practical 4. Application of poetry – orientation
Practical 5. Application of poetry – practical session
Practical 6. Poetry and aesthetics
Practical 7. Writing poetry – orientation
Practical 8. Writing poetry – writing sessions

Reading Material

I. The Art of Poetry

1. Fry, S. (2005). The ode less travelled: Unlocking the poetic mind. HarperCollins.
2. Addonizio, K., & Laux, D. (1997). The poet's companion: A guide to the pleasures of writing poetry. W.W. Norton & Company.
3. Lucy, J. (Ed.). (2001). The art of poetry. Penguin Books.

II. Understanding and Interpretation of Poetry

1. Hirsch, E. (1999). How to read a poem: And fall in love with poetry. Harcourt Brace & Company.
2. Pinsky, R. (1998). The sounds of poetry: A brief history. Farrar, Straus and Giroux.
3. Meyer, M. (2005). Poetry: An introduction. Bedford/St. Martin's.

III. Writing Poetry

1. Hugo, R. (1979). The triggering town: Lectures and essays on poetry and writing. W.W. Norton & Company.
2. Bradbury, R. (1990). Zen in the art of writing: Releasing the creative genius within you. Bantam Books.

Semester II

Course Code: 24HS02PR0106-13			Course: Creative and content writing
L: 0	T: 0	P: 2	Total Credits: 1

Course objective:

The objective of the course is to equip students with comprehensive skills in creative and content writing through experiential learning and real-world applications.

Course outcomes:

On completion of the course, student will be able to achieve the following:

CO1. Understand and apply fundamental concepts and techniques of creative writing.
CO2. Apply storytelling techniques to create engaging narratives.
CO3. Develop and implement effective SEO and digital content strategies
CO4. Create and refine content using various tools and applying diverse writing styles and formats.
CO5. Utilize digital tools to craft multimedia narratives and create a professional portfolio.

Syllabus

Creative Writing

Practical 1: **Introduction to Creative and Content Writing**

Practical 2: **Character and Story Development**

Practical 3: **Crafting Compelling Narratives**

Content Writing

Practical 4: **SEO and Digital Content Strategies**

Practical 5: **Writing for Media**

Practical 6: **Tools**

Content Creation

Practical 7: **Digital Storytelling**

Practical 8**: Creative Portfolio Launch**

Semester II

Course Code: 24HS02PR0106-14			Course: Science of life through Bhagwad Gita
L: 0	T: 0	P: 2	Total Credits: 1

Course Objective

The objective of the course is to seek directions from the Bhagwad Gita to garner life skills for a successful and happy life

Course Outcome

CO1. To understand the methodology to correctly interpret and analysis the scripture
CO2. To understand the application of various teaching of the Bhagwad Gita
CO3. Use meditation and breathing techniques for healthy mind and body.

Syllabus

Practical 1: **Introduction to Bhagwad Gita - methodology**

Practical 2: **Real life application of chapter 1-3**

Practical 3: **Real life application of chapter 4-6**

Practical 4: **Real life application of chapter 7-9**

Practical 5: **Real life application of chapter 10-12**

Practical 6: **Real life application of chapter 13-15**

Practical 7: **Real life application of chapter 16-18**

Practical 8: **Meditation and breathing techniques**

Semester II

Course Code: 24HS04PR0201			Course: Sports-Yoga-Recreation
L: 0	T: 0	P: 2	Total Credits: 1

Aim of the Course

The course aims at creating awareness about the fundamentals of Physical Education, Sports, Yoga, Recreation and its effectiveness to promote Health and wellness through Healthy Lifestyle.

Objectives of the Course

CO1. To impart the students with basic concepts of Sports, Yoga and Recreational activities for health and wellness.
CO2. To familiarize the students with health-related Exercise and evaluate their Health-related Fitness.
CO3. To make Overall growth & development with team spirit, social values and leadership qualities among students through various sports, games and Yogic activities.
CO4. To create Environment for better interaction and recreation among students as neutralizer for stress through various minor and recreational games.

Course Outcomes:

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

1. Understand fundamental skills, basic principle and practices of sports and Yoga.
2. Practically learn the principles of implementing general and specific conditioning of physical exercises and yoga.
3. Develop Health-related fitness and Body-mind co-ordination through various fitness activities, sports, recreational games and yoga.
4. Practice Healthy & active living with reducing Sedentary Life style.

Course Content:

Unit 1: - Theory: Introduction

- Meaning, Definition and Importance of Health & Wellness
- Dimensions of Health and Wellness
- Factors influencing Health and Wellness
- Physical Fitness, Nutrition, Habits, Age, Gender, Lifestyle, Body Types
- Health & Wellness through Physical Activities, Sports, Games, Yoga and Recreation activities
- Causes of Stress & Stress relief through Exercise and Yoga
- Safety in Sports

Unit 2: - Practical- Exercises for Health and Wellness

- Warm-Up and Cool Down - General & Specific Exercises
- Physical Fitness Activities
- Stretching Exercises
- General & Specific Exercises for Strength, Speed, Agility, Flexibility, coordinative abilities
- Cardiovascular Exercises
- Assessment of BMI
- Relaxation techniques
- Physical Efficiency Tests

Unit 3: - Yoga

- Shukshma Vyayam
- Suryanamaskar
- Basic Set of Yogasanas – Sitting, standing, supine and prone position

- Basic Set of Pranayama & Meditation

References:

1. Russell, R.P. (1994). Health and Fitness Through Physical Education. USA: Human Kinetics.
2. Uppal, A.K. (1992). Physical Fitness. New Delhi: FriendsPublication.
3. AAPHERD "Health related Physical Fitness Test Manual."1980 Published by Association drive Reston Virginia
4. Kumar, Ajith. (1984) Yoga Pravesha. Bengaluru: Rashtrothanna Prakashana. Dr. Devinder K. Kansal, A Textbook of Test Evaluation, Accreditation, Measurementsand Standards (TEAMS 'Science)

Semester III

Course Code: 24HS03TH0303			**Course: Probability & Statistics**
L: 3	**P: 0**	**S: 1**	**Total Credits: 3**

Course Objective:

The objective of this course is to expose student to understand the basic importance fundamental principles of probability, including probability distributions, random variables, basic statistical methods used for data analysis, inferential statistics, hypothesis testing, confidence intervals, and regression analysis in computer science and Information technology.

Course Outcomes: On successful completion of the course, student shall be able to

1. Grasp the meaning of discrete and continuous random variables, probability distribution. Interpret the meaning of probabilities derived from distributions. This involves understanding what the calculated probabilities represent in practical terms and drawing conclusions from the results.
2. To analyze and interpret stochastic models, including calculating probabilities, transition probabilities, and steady-state probabilities within stochastic systems.
3. Understand null hypothesis (H0) and alternative hypothesis (H1), significance levels, p-values, and the basic logic behind hypothesis testing.
4. To apply MLE to various statistical models, such as linear regression, exponential distribution, etc. They should understand how to formulate likelihood functions and derive estimators for unknown parameters.

Syllabus

Module 1: Measure of central tendency, quartile, inter quartile range and outliers, Probability spaces, conditional probability, independence, Discrete and continuous random variables, expectation and variance of random variable, Binomial distribution, Poisson distribution, Normal distribution and their applications.

Module 2: Joint probability function, Introduction to stochastic process, random walk, stationary and auto regressive process, transition probability Matrix, Discrete time Markov chain and its applications in queueing problems.

Module 3: Small and large sampling, Sampling Distributions, Point and Interval Estimations, Testing of Hypothesis for single mean and proportion for both small and large sample size, testing the means of paired observation.

Module 4: Testing of Hypothesis for difference of mean and proportion, Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes, maximum likelihood estimation

Text Books:

1. M R. Spiegal , Theory and Problems of probability and statistics :,2nded :,Schaum series
2. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Reference Books:

1. Maurtis Kaptein, Statistics for data science, An introduction to probability, statistics and Data Analysis, Springer 2022.Jay L Devore, Probability and Statistics for Engineering and sciences, 8th edition, Cenage learning.

Semester III

Course Code: 24ES03TH0301			**Course: Fundamentals of Robotics**
L: 3	**P: 0**	**S: 1**	**Total Credits: 3**

Unit I- Introduction

Definition of Robot & Robotics, History of Robots, Law of Robotics, Types of Robot, Robot Anatomy, Co-ordinate System, Work Envelope, Classification of Robots, Robots Parts and their Functions, Specifications of Robot, Benefits of Robots, Need for Robots, Manufacturing applications of Robots, Nonmanufacturing Applications of Robots, Future of Robots.

Unit II- End Effectors

Definition and role in robotics, Overview of robotic manipulators and their components, Classification of end effectors, Introduction to Grippers and Tools, Classification of grippers: Mechanical, Magnetic, Vacuum, adhesive, Hooks and Scoops, Expandable bladder type, drive system for grippers, Selection and Design Consideration of Grippers.

Unit III- Drive systems, Sensors and Robotic vision system

Drive system- hydraulic, pneumatic and electric systems; Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Force sensor, Light sensors, Pressure sensors; Robotic vision system - Low level & High level vision Sensing & Digitizing, Image processing & analysis, Segmentation, Edge detection, Object description & recognition, Interpretation, Applications.

Unit IV- Robot Programming

Introduction, Methods or robot programming, Lead-through programming, Textual or computer like programming, Off-line programming, defining a robot program, Method of defining position in space, Motion interpolation, Basic programming commands in work cell control (wait, signal and delay commands), Branching, Robot programming languages/textual programming, First generation languages, Second generation languages, Future generation languages, Structure of robot language, VAL programming.

Text Books:

[1] Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.

[2] Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999.
[3] R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.

Reference Books:

[1] S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
[2] Richard D. Klafter, Thomas.A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning., 2009.
[3] Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
[4] P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd., 1995.
[5] Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.
[6] Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987.
[7] Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985.
[8] B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

Semester III

Course Code: 24ES03TH0302			**Course: Design of Manipulator and end-effectors**
L: 2	**P: 0**	**S: 0**	**Total Credits: 2**

Course Objective:

Course Outcome:

Unit 1: Fundamentals of Structural Design in Robotics

Introduction to structural requirements of manipulators, Design criteria: stiffness, strength, mass, natural frequency, and payload, Overview of static and dynamic loading in robotic arms, Structural design versus kinematic design. Geometric and structural considerations in link design, Beam theory and application to link design, Mass distribution and centre of gravity effects, Deformation and deflection analysis, Case study: lightweight link design for industrial robots

Unit 2: Material Selection and Manufacturing Considerations

Selection of materials based on mechanical properties, cost, and weight, Composites, lightweight alloys, and additive manufacturing for robot arms, Design for manufacturability and assembly, Thermal and vibration effects on structure

Unit 3: Kinematics of power transmission elements

Role of transmission in robotic motion, Types: rotary–rotary & rotary–linear, kinematics of various gearing system, kinematics of belt & chain drives, Screw drives- Lead and ball screws, Motion conversion and linear velocity equations, Cable/Tendon-Driven Mechanisms, Linkage Kinematics- Four-bar and slider-crank mechanisms and its applications in grippers and joint actuation.

Unit 4: Design and mechanisms of End Effectors

Force transmission and gripping forces, Structural requirements for gripper arms and fingers, Design of frames and holding mechanisms, Materials and topology selection for different end effectors, Case studies: vacuum grippers, magnetic grippers, parallel jaw gripper

Textbooks & References:

1. **Robot Manipulator Structures** – Vladimir S. Arakelian
2. **Design of Machine Elements** – V. B. Bhandari
3. **Structural Analysis** – R. C. Hibbeler

4. Fundamentals of Mechanics of Robotic Manipulation" by Marco Ceccarelli

Semester III

Course Code: 24ES03PR0302			Course: Design of Manipulator and end-effectors Lab
L: 0	P:2	S: 0	Total Credits: 1

Lab consist of:

1. Modelling (Mechanisms) and simulation of manipulator and End-effectors by RoboAnalyser and ADAMS software
2. Structural Analysis of links by ANSYS and ABAQUS software

Semester III

Course Code: 24ES03TH0303			Course: Microcontroller and Interfacing
L: 3	P:0	S: 1	Total Credits: 3

Course Objective

To introduce the architecture, programming, and interfacing techniques of microprocessors, with an emphasis on 8086 and ARM architectures, and to develop hands-on skills through Python programming on Raspberry Pi boards for real-world embedded applications.

Course Outcomes (COs)

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

CO1: Describe the architecture and operational features of 8086 microprocessor and ARM-based processors.
CO2: Write and debug assembly language programs for 8086 microprocessors.
CO3: Design and implement interfacing of memory and I/O devices with microprocessors.
CO4: Explain the instruction set architecture and development environment of ARM processors.
CO5: Develop and execute Python programs for basic hardware interfacing tasks on Raspberry Pi platforms.

Course Syllabus

Unit 1: 8086 Microprocessor Architecture

- Overview of microprocessor evolution
- Internal architecture of 8086
- Memory segmentation and addressing modes
- Instruction formats and execution cycle
- Minimum and maximum mode operation
- Bus interface and timing diagrams

Unit 2: 8086 Assembly Language Programming

- Instruction set: data transfer, arithmetic, logical, control flow
- Procedures, macros, and assembler directives
- Stack, subroutines, and interrupt handling
- Simple assembly programs using emulators or kits
- Debugging tools and simulation techniques

Unit 3: Interfacing Techniques

- I/O mapped and memory-mapped I/O
- Interfacing of LEDs, switches, seven-segment displays
- ADC/DAC interfacing
- Keyboard and LCD interfacing
- Interrupt-driven and DMA-based data transfer
- Stepper motor and DC motor interfacing

Unit 4: ARM Processor Architecture and Programming

- Overview of ARM architecture: ARM7, Cortex-M series
- Register organization, instruction types
- Pipelining and performance aspects
- Embedded system development with ARM cores
- Embedded C basics for ARM development

Unit 5: Python Programming Lab on Raspberry Pi

- Introduction to Raspberry Pi hardware and setup
- GPIO programming using Python
- Interfacing LEDs, buttons, sensors, and motors
- Serial and I2C communication
- Mini project: real-world embedded application using Raspberry Pi

Textbooks and References

1. **Microprocessors and Interfacing** – Douglas V. Hall
2. **The 8051 and ARM Microcontrollers** – Muhammad Ali Mazidi
3. **Embedded Systems with ARM Cortex-M Microcontrollers** – Jonathan Valvano
4. **Learning Python with Raspberry Pi** – Wolfram Donat
5. ARM documentation, Raspberry Pi Foundation tutorials, Python.org

Semester III

Course Code: 24ES03PR0303			**Course: Microcontroller and Interfacing Lab**
L: 0	**P:2**	**S: 0**	**Total Credits: 1**

The Practical based on above syllabus

Semester III

Course Code: 24ES03TH0304			**Course: Introduction to Python**
L: 2	**P:0**	**S: 1**	**Total Credits: 2**

Course Objectives:

1. To provide students with a solid foundation in the Python programming language which makes them to understand and apply fundamental programming concepts

2. To develop students' ability to implement control flow constructs, modular programming through the use of functions

Course Outcomes: Students will be able to

CO1. Apply fundamental programming concepts such as data types, control structures, functions, and file handling to develop basic Python applications.

CO2. Design and implement modular Python programs using appropriate data structures like lists, tuples, dictionaries, and sets to solve real-world computational problems.

CO3. Demonstrate the ability to write, test, document, and manage Python code effectively using exception handling, unit testing, and basic version control tools like Git.

Course Outline:

Unit 1: Python Basics and Fundamentals

This unit introduces students to the Python programming environment, including installation of Python and the use of integrated development environments (IDEs) such as IDLE or Visual Studio Code. Students will learn about the basic syntax of Python, keywords, identifiers, and how to write simple Python programs. The unit also covers variables, data types, type casting, input and output functions, and the use of basic arithmetic and logical operators.

Unit 2: Control Structures

This unit focuses on the fundamental control flow mechanisms in Python. Students will learn how to use conditional statements such as if, elif, and else to make decisions within programs. Additionally, the unit introduces loop structures including for and while loops, loop control statements like break, continue, and pass, and how these constructs are used to implement iteration and repetitive tasks.

Unit 3: Functions and Modular Programming

In this unit, students will understand the concept of modular programming using functions. They will learn how to define and call functions, use parameters and return values, and understand variable scope (local and global variables). The unit emphasizes the importance of writing reusable and organized code through the creation of user-defined functions.

Unit 4: Data Structures – Strings, Lists, Tuples, Dictionaries, and Sets

This unit covers the built-in data structures in Python, including strings and their manipulation using built-in methods, as well as lists, tuples, dictionaries, and sets. Students will learn how to create, access, modify, and iterate through these data structures. Emphasis is placed on using appropriate data types for solving computational problems efficiently.

Unit 5: File Handling and Exception Management

Students will be introduced to file operations in Python, including reading from and writing to text files, and working with structured data in formats like CSV. The unit also explores exception handling techniques using try, except, finally, and raise, helping students write more robust and error-resilient programs.

Unit 6: Libraries, Data Handling, and Project Development

In the final unit, students are introduced to the use of Python libraries such as math, random, and datetime, followed by a basic introduction to numpy and pandas for simple data handling tasks. The unit concludes with

the development of mini projects where students apply the knowledge and skills gained from previous units to design, implement, and demonstrate complete Python applications.

Semester III

Course Code: 24ES03PR0304			Course: Introduction to Python Lab
L: 0	P:2	S: 0	Total Credits: 1

List of Experiments to Be conducted

1. Write a Python program to demonstrate input/output operations and use of variables and data types.
2. Write a Python program to perform arithmetic operations and apply logical and comparison operators.
3. Write a Python program that uses `if-else` conditions to determine whether a number is even or odd, or find the largest of three numbers.
4. Write a Python program to implement loops: print multiplication tables, factorial, and Fibonacci series using `for` and `while` loops.
5. Write user-defined functions to calculate the area of geometric shapes and demonstrate parameter passing and return values.
6. Write a Python program to manipulate strings using slicing, formatting, and string methods such as `find`, `replace`, and `split`.
7. Write a Python program to demonstrate list and tuple operations: creation, indexing, slicing, appending, and iteration.
8. Write a Python program using dictionaries and sets to store and process key-value pairs, and perform set operations.
9. Write a Python program to read from and write to a text file, and count the number of words or lines in the file.
10. Write a Python program that handles exceptions using `try`, `except`, and `finally` blocks to manage runtime errors.
11. Write a Python program that uses built-in libraries such as `math`, `random`, or `datetime` to solve basic computational problems.
12. Develop a mini project such as a contact book, quiz game, or file organizer using all concepts learned in the course.

Semester III

Course Code: 24ES03TH0305			Course: Design Thinking
L: 1	P:0	S: 0	Total Credits: 1

Course Outcomes

1. Be familiar with processes and methods of creative problem solving:
2. Enhance their creative and innovative thinking skills
3. Practice thinking creatively and innovative design and development

UNIT1. Introduction: Making a case for creativity, Creative thinking as a skill, Valuing diversity in thinking: Thinking preferences, Creativity styles, Creativity in problem solving

UNIT2. Pattern Breaking: Thinking differently, Lateral thinking, Mind stimulation: games, brain-twisters and puzzles, Idea-collection processes, Brainstorming/Brain writing, The SCAMPER methods, Metaphoric thinking, Outrageous thinking, Mapping thoughts, other (new approaches)

UNIT3. Using Math and Science, Systematic logical thinking, Using math concepts, Eight- Dimensional (8D) Approach to Ideation: Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity, and Experimentation

UNIT4. Systematic Inventive Thinking: Systematic inventive thinking: The TRIZ methodology, Decision and Evaluation: Focused thinking framework, six thinking hats, and Ethical considerations.

UNIT 5. Design for Innovation: Introduction to design for interaction, nine lessons for innovation, difference in creativity and innovation, Building blocks for innovation

UNIT6.IntellectualProperty: Introduction to intellectual property: Patents, Trademarks

, Trade Secret, Unfair Competition.

Reference Books and TextBook

1. Creative Problem Solving for Managers-Tony Proctor-Routledge Taylor &Francis Group
2. 101Activities for Teaching creativity and Problem Solving-By Arthur B. Vangundy-Pfeiffer
3. H .S. Fogler and S .E. LeBlanc, Strategies for Creative Problem Solving ,Prentice Hall
4. E. Lumsdaine and M. Lumsdaine, Creative Problem Solving, McGraw Hill,

Semester III

Course Code: 24ES03PR0305			**Course: Design Thinking Lab**
L: 0	**P:2**	**S: 0**	**Total Credits: 1**

IV Semester

Course Code: 24ES03TH0401			**Course: Kinematics of Robot**
L: 3	**P:0**	**S: 02**	**Total Credits: 3**

Course Objectives

- To impart the basic knowledge of robot manipulators, robot anatomy, laws of robot and applications.
- To impart the concepts of serial and parallel robotic system, its components, forward and inverse kinematics related to robot manipulators.

Course Outcomes

At the end of the course, the student will be able to:
CO1: Describe the fundamentals of robotics, robot anatomy and components of robot.
CO2: Solve the forward and inverse kinematics problems of serial robot manipulators.
CO3: Compute Jacobian matrix and solve the singularity problems of serial robot manipulators.
CO4: Solve the forward and inverse kinematics problems of parallel robot manipulators.
CO5: Design and simulate the forward, inverse kinematics problem of serial and parallel robot manipulator.

Unit 1
Introduction to robots, Brief history, laws of robots, Definitions, Robot classifications, Robot anatomy, Components
of robots, robot sensing, actuators – Electric motors, servo motors, stepper motors, work envelope, End Effectors-
Grippers-Types: Pneumatic, Hydraulic, Magnetic, Vacuum Grippers; Selection and Design Considerations, resolution, accuracy and repeatability of robot, applications, robot teaching, specification.
Unit 2
Robot manipulator kinematics, Degrees of freedom, links, joints, Rotation matrix, Euler angles, Homogeneous transformation matrix, D-H parameters, Forward and inverse kinematic problems of 2-link and 3-link robot manipulator, work volume simulation, singularities, analysis of singularities, Robot Exoskeleton, Jacobian, Inverse
Jacobian.
Unit 3
Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loopclosure
equations, Direct kinematics problem, Inverse kinematics of parallel manipulators and mechanisms, Introduction to direct kinematics of Gough-Stewart platform.
Unit 4
Introduction to Robot Programming Languages, Joint and Cartesian Motion Planning, Offline and Online Simulation of Industrial Robots, Robotic applications such as pick-and-place, assembling, welding, painting, etc.
Text Books
Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009.
Craig J. J., Introduction to Robotics: Mechanics and Control, 3rd Edition, Addison-Wesley, Reading, MA, 2005.
Odrey, Mikell P. Groover& Nicholas G., Mitchel Weiss, Roger N. Nagel, and Ashish Dutta. "Industrial Robotics,
Technology programming and Applications.", McGraw Hill Education; 2nd edition (July 2017).
Reference Books
P. A. Janaki Raman, Robotics and Image Processing An Introduction, Tata MCGraw Hill Publishing company Ltd.,
1995.
Shames I. H., Engineering Mechanics- Statics and Dynamics" $/e Prentice-Hall of India Pvt. Ltd., 2005.

IV Semester

Course Code: 24ES03PR0401			**Course: Kinematics of Robot Lab**
L: 0	**P:2**	**S: 0**	**Total Credits: 3**

IV Semester

Course Code: 24EE07TH0402			Course: Control System for Robotics
L: 3	P:0	S: 2	Total Credits: 3

Course Objectives

- To develop foundational understanding of classical and modern control theory applied to robotic systems.
- To analyze dynamic models of robotic manipulators and apply control strategies.
- To design feedback controllers for ensuring stability, accuracy, and performance in robotic motion.
- To study time-domain and frequency-domain techniques for robot control.

Course Outcomes (COs)

By the end of this course, students will be able to:

CO1: Model dynamic systems relevant to robotic actuators and links using differential equations, transfer functions, and state-space representations.

CO2: Analyze time-domain responses of robotic systems and assess system performance based on transient and steady-state characteristics.

CO3: Design and tune PID controllers to achieve desired performance in robotic joint and actuator control applications.

CO4: Evaluate system stability and frequency response using Bode plots, Nyquist criteria, and root locus techniques to ensure robust robot control.

CO5: Apply state-space control techniques, including pole placement and observer design, for multi-variable control in robotic manipulators.

Syllabus

Unit 1: Introduction to Control Systems and Modeling for Robotics

Introduction to control systems in robotics: open-loop vs closed-loop control, Feedback and its importance in robotics, Transfer functions and block diagram reduction, Mathematical modeling of robotic joints and links (DC motors, gears, inertia), Modeling of dynamic systems: electrical, mechanical, and electromechanical systems

Unit 2: Time-Domain Analysis and Stability

Time response of first- and second-order systems, Transient and steady-state response specifications, Stability of linear systems: Routh-Hurwitz criterion, Error constants and steady-state errors in tracking, Application to robotic joint control and actuator dynamics

Unit 3: Root Locus and PID Control for Robots

Root locus concepts and construction rules, Effects of pole-zero placements on system behaviour, PID control design: tuning, implementation, and effect on robotic manipulators, Ziegler–Nichols and Cohen–Coon methods for tuning, Case study: PID control of a robotic arm joint

Unit 4: Frequency Response Analysis

Bode plots and gain/phase margin, Nyquist criterion and system stability, Use of frequency response in controller design, Robotics applications: disturbance rejection, robustness

Unit 5: State-Space and Modern Control in Robotics

State-space representation of robotic systems, Controllability and observability, Pole placement and state feedback control, Introduction to observers and Kalman filters in robot sensing and estimation, Multi-input multi-output (MIMO) control in robot manipulators

Textbooks and References

- Primary Textbook:
  Modern Control Engineering – Katsuhiko Ogata (5th Edition)
- Other References:
  - Feedback Control of Dynamic Systems – Franklin, Powell, Emami-Naeini
  - Introduction to Robotics: Mechanics and Control – John J. Craig (for robotic application examples)
  - Robotics, Vision and Control – Peter Corke (for MATLAB/simulation tools)

IV Semester

Course Code: 24EE07PR0402			**Course: Control System for Robotics Lab**
L: 0	**P:2**	**S: 0**	**Total Credits: 1**

IV Semester

Course Code: 24ES03TH0402			**Course: Machine Learning**
L: 3	**P:0**	**S: 2**	**Total Credits: 3**

Course Objectives:

1. To equip students with machine learning concepts and their applications in mechanical engineering.

2. To learn data preprocessing techniques, supervised and unsupervised learning models, and deep learning approaches for mechanical systems.

Course Outcomes: Students will be able to

CO1. To introduce students to the foundational principles of machine learning, including the key concepts, types of learning, and the structure of a typical machine learning workflow
CO2. To develop the ability to preprocess and prepare data for machine learning models, by teaching students how to clean, transform, scale, and encode data using Python tools such as NumPy, Pandas, and scikit-learn.
CO3. To equip students with the skills to apply unsupervised learning algorithms, such as clustering and dimensionality reduction techniques, for exploratory data analysis.
CO4. To familiarize students with advanced model optimization and ensemble methods, including cross-validation, hyperparameter tuning, bagging, boosting, and stacking, for building robust and high-performing predictive models.
CO4. To introduce the basic concepts of neural networks and deep learning, nd apply simple artificial neural networks and explore their use in image and text-based machine learning tasks.
CO5. To apply ML in real-world applications with ethical considerations, encouraging them to critically evaluate the use of ML systems in practice.

Course Outline:

Unit 1: **Foundations of Machine Learning and Data Preprocessing:** Introduction to machine learning, types of machine learning (supervised, unsupervised, reinforcement), machine learning workflow, data collection and cleaning, handling missing values, outlier detection, encoding categorical variables (label encoding, one-hot encoding), feature scaling (normalization, standardization), train-test split, K-fold cross-validation, introduction to numpy, pandas, and scikit-learn.

Unit 2: **Supervised Learning – Regression Techniques:** Simple linear regression, multiple linear regression, polynomial regression, assumptions of regression, overfitting and underfitting, ridge regression (L2), lasso regression (L1), elastic net, evaluation metrics (MAE, MSE, RMSE, R^2 score), regression with scikit-learn, regression model visualization using matplotlib and seaborn.

Unit 3: **Supervised Learning – Classification Techniques:** Logistic regression, k-nearest neighbors (k-NN), decision trees (Gini index, entropy), random forest classifier, support vector machines (SVM) with kernel trick, confusion matrix, accuracy, precision, recall, F1-score, ROC curve and AUC, stratified sampling, cross-validation in classification, classification using scikit-learn.

Unit 4: **Unsupervised Learning and Dimensionality Reduction:** k-means clustering, elbow method, silhouette score, hierarchical clustering, dendrograms, DBSCAN algorithm, principal component analysis (PCA), explained variance ratio, t-SNE for data visualization, comparison of clustering techniques, customer segmentation, anomaly detection.

Unit 5: **Ensemble Learning, Model Selection, and Optimization:** Ensemble learning concepts, bagging, boosting, stacking, random forest (bagging), AdaBoost, gradient boosting (GBM, intro to XGBoost), bias-variance trade-off, model selection, hyperparameter tuning with grid search and random search, K-fold and stratified cross-validation, feature importance, building pipelines in scikit-learn.

Unit 6: **Neural Networks and Applications of Machine Learning:** Introduction to neural networks, perceptron model, activation functions (sigmoid, tanh, ReLU), multilayer perceptron (MLP), forward and backward propagation (conceptual), gradient descent optimization, introduction to TensorFlow and Keras, image classification with MNIST, text classification with TF-IDF, real-world ML applications, ethical concerns in ML.

IV Semester

Course Code: 24ES03PR0402			**Course: Machine Learning Lab**
L: 0	**P:2**	**S: 0**	**Total Credits: 1**

List of Experiments (12 Lab Exercises)

1. Load and preprocess a real-world dataset using pandas, including handling missing values and encoding categorical features.
2. Perform data visualization and correlation analysis using seaborn and matplotlib.
3. Implement simple and multiple linear regression models using scikit-learn and evaluate them with MSE, RMSE, and R^2.
4. Apply logistic regression on a classification dataset and evaluate model performance using confusion matrix and ROC curve.
5. Implement k-Nearest Neighbors (k-NN) classification and tune the value of k using cross-validation.
6. Build decision tree and random forest classifiers, and compare their accuracy and feature importances.
7. Apply Support Vector Machines (SVM) with different kernels on a binary classification dataset.
8. Implement k-means clustering and visualize clusters using scatter plots; determine optimal k using the elbow method.
9. Perform PCA on a dataset and visualize the results in two dimensions; apply dimensionality reduction before classification.
10. Tune model hyperparameters using GridSearchCV and RandomizedSearchCV for a classifier of your choice.
11. Develop a basic ensemble model using Random Forest and AdaBoost on a benchmark dataset.
12. Complete a mini project: select a dataset, define the problem, preprocess data, apply and evaluate models, and present results.

IV Semester

Course Code: 24ES03TH0403			**Course: Mechatronics**
L: 2	**P:0**	**S: 0**	**Total Credits: 2**

Course Objectives

1. To introduce the fundamentals and interdisciplinary nature of Mechatronics.
2. To understand the working of sensors, actuators, and signal processing circuits in automation systems.
3. To enable students to use microcontrollers and PLCs for control and interfacing.
4. To develop competence in integrating mechanical and electronic components for automation.
5. To apply simulation and modeling tools for designing mechatronic systems.

Course Outcomes (COs)

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

CO1: Explain the basic concepts and structure of mechatronic systems.
CO2: Select and integrate appropriate sensors and actuators in a system.
CO3: Design signal conditioning circuits and perform A/D and D/A conversion.
CO4: Develop and implement control strategies using microcontrollers and PLCs.
CO5: Design and simulate complete mechatronic systems for real-world applications.

Course Syllabus –

Module 1: **Introduction to Mechatronics**: Definition and scope, Components and structure of mechatronic systems, Need and role of mechatronics in product and process automation, Case studies: Washing machine, ABS, pick-and-place robots.

Module 2**: Sensors and Actuators:** Types of sensors: displacement, force, pressure, temperature, proximity, speed, Sensor specifications and characteristics, Actuators: pneumatic, hydraulic, electrical, Motors: DC, servo, stepper motors, Solenoids and relay control.

Module 3: **Signal Conditioning and Data Conversion:** Analog and digital signals, Signal conditioning using op-amps, Filtering, amplification, noise reduction, Analog to Digital (A/D) and Digital to Analog (D/A) converters, Interfacing sensors and actuators with controllers.

Module 4: **Microcontrollers and Interfacing:** Architecture of microcontrollers (e.g., 8051, Arduino), Programming fundamentals, I/O interfacing: sensors, motors, display, Timers, interrupts, PWM, Communication protocols: UART, SPI, I2C.

Module 5: **Programmable Logic Controllers (PLC) and System Integration:** PLC architecture and working, Ladder logic diagrams: logic gates, timers, counters, PLC-based system control and applications, Introduction to system modeling and simulation (MATLAB/Simulink or Proteus), Mechatronic system design methodology

Recommended Textbooks and References

Textbooks:

1. Bolton, W. *Mechatronics*, Pearson Education.
2. Alciatore, D.G., and Histand, M.B. *Introduction to Mechatronics and Measurement Systems*, McGraw Hill.

References:

1. N.P. Mahalik, *Mechatronics: Principles, Concepts and Applications*, Tata McGraw-Hill.
2. F.D. Petruzella, *Programmable Logic Controllers*, McGraw-Hill.

3. Ghosh & Raj, *Fundamentals of Microprocessors and Microcontrollers*, S. Chand.

IV Semester

Course Code: 24ES03PR0403			Course: Mechatronics Lab
L: 0	P:2	S: 0	Total Credits: 1

Laboratory Experiments / Practicals

Exp. No.	Title of Practical
1	Identification and study of mechatronic system components
2	Interfacing basic sensors (temperature, IR, ultrasonic) with Arduino
3	Interfacing of stepper motor and servo motor with microcontroller
4	Signal conditioning using op-amps: amplifiers and filters
5	A/D and D/A conversion using Arduino
6	Microcontroller programming for real-time sensor data acquisition
7	PWM-based speed control of DC motor
8	Study and implementation of logic gates using PLC
9	Timer and counter applications in PLC (e.g., automatic gate control)
10	Mini-project: Design and demonstration of a simple mechatronic system (e.g., automatic hand sanitizer, line follower robot, smart door system)

IV Semester

Course Code: 24ES03PR0404			Course: Project 1
L: 0	P:2	S: 3	Total Credits: 1

IV Semester

Course Code: 24ES03PR0404			Course: Environmental Science
L: 1	P:0	S: 0	Total Credits: 1

Course Outcomes

After successful completion of this course, students will learn to;

CO1: Explain sustainable development, its goals, targets, challenges and global strategies for sustainable development

CO2: Analyze the utilization of green computing technology for environmental issues

Syllabus

Unit 1: Sustainability Engineering

Multidisciplinary nature of Environmental Science, air and water pollution; solid waste management; local and global environmental challenges; climate change; sustainable cities; sustainable sources of energy, Introduction to the idea of sustainability and its relevance; environment-related legislation; Green Chemistry

Unit 2: E-Waste and Green Computing

E-waste Management: Sources, Legislation, Prevention, Control, Recent developments.

Waste due to Nano-materials and Micro-Plastics.

Green Computing: Green Computing, Computing in Environment and Research, Green devices and Green data Servers.

Text Books:

1.Shikha Agrawal, Engineering Chemistry: Fundamentals and Applications, Cambridge University Press.

2. Dr. Rajshree Khare, A Textbook of Engineering Chemistry (AICTE), S.K. Kataria & amp; Sons.

3. S. S. Dara, A Textbook of Engineering Chemistry, S. Chand Publications.

4. M Afshar Alam, Sapna Jain, Hena Parveen, Green Computing Approach Towards Sustainable Development, Wiley Interscience Publications.

Reference Books:

1. E-waste recycling and management: present scenarios and environmental issues, Khan,

Anish, and Abdullah M. Asiri. 2019, Springer, Vol. 33. ISBN: 978-3-030-14186-8.

2. Hans-Eckhardt Schaefer, Nanoscience: The Science of the Small in Physics, Engineering,

Chemistry, Biology and Medicine, Springer-Verlag Berlin Heidelberg.

IV Semester

Course Code: 24ES03PR0404			Course: Environmental Science Lab
L: 0	P:2	S: 0	Total Credits: 1

Course Outcomes

After successful completion of this course, students will learn to;

CO1. Apply the fundamental principles of measurement and skills in preparation and handling of environmentally hazardous materials and interpret the statistical data related to measurements.

CO2. Use of the computational tools for searching, interpretation of results, etc. and preparation of case study regarding Environmental Issues.

List of Experiments:

Any Eight Experiments from the following:

[1] Demonstration of Handling of hazardous chemicals, MSDS (material safety data sheet), waste minimization strategies and chemical waste disposal.

[2] Preparation of different Solutions: Molar solution, Normal solution and percent solution and Determination of concentration in their various forms.

[3] Basic statistical analysis of results of neutralization of acid against the base and preparing graphs using software.

[4] Estimation of Copper ions from acid digested PCB solution.

[5] Estimation of Chromium ions from e-waste sample.

[6] Prediction of NMR spectra and analytical data of molecules using Computational Software and its analysis.

[7] Spectroscopic determination of wavelength of maximum absorption of chemical/biological compound in solution and plotting of calibration curves.

[8] Estimation of Fe (II) ions from e-waste spectrophotometrically / calorimetrically using 1,10-Phenanthroline method.

[9] Determination of Free CO_2 in the given beverage sample.

[10] Determination of dissolved oxygen (DO) in the given waste water sample.

[11] Estimation of amount of Chlorine present in the given water.

[12] Determination of rate of the reaction at room temperature and analysis of experimental data using Computational Software.

[13] Determination of Air Quality Index (AQI) of a region.

[14] Use of various open online search tools for Environmental Case Studies.

Suggested Books/Reference Books:

(1) S. S. Dara, A Textbook on Experiments and Calculations in Engineering Chemistry, S. Chand Publications.

(2) J. B. Yadav, Advanced Practical Physical Chemistry, Krishna's Prakashan Media (P) Limited.

(3) A. J. Elias, Collection of Interesting General Chemistry Experiments, Universities Press Publications.

(4) V. K. Ahluwalia, S. Dhingra and A. Gulati, College Practical Chemistry, Universities Press Publications.