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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

(Smart Manufacturing & Automation)

PROGRAMME SCHEME & SYLLABI

B.Tech. Mechanical Engineering – 2024-25

SEMESTER - I

Sr. No.	Course Type	Course Code	Course Title	Hours/ week		Credits	Maximum marks				ESE Duration (Hrs)
				L	P		Continuous 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	24ES04TH0101	Mechanical Marvels	1	0	1	50	-	-	50	-
6.	ESC	24ES04TH0102	Engineering Mechanics	3	0	3	50	-	50	100	3
7.	ESC	24ES04TH0103	Engineering Graphics	2		2	50		50	100	3
8.	ESC	24ES04PR0103	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	24ES04TH0104	Programming for Problem Solving	1		1	50		50	100	2
12.	ESC	24ES04PR0104	Programming for Problem Solving Lab		2	1		50		50	
13.	VEC / HSS	24HS02TH0104	Foundational Course in Universal Human Values	1	0	1	50	-	-	50	-

	M										
			TOTAL	**16**	**10**	**21**	**400**	**250**	**300**	**950**	**15**

Semester II

Sr. No.	Course Type	Course Code	Course Title	Hours/ week		Credits	Maximum marks				ESE Duration (Hrs)
				L	P		Continuous Evaluation		End Sem Exam	Total	
							Th.	Pr.			
1.	BSC	24HS03TH0214	Linear Algebra and Integral Calculus	3	0	3	50	-	50	100	3
2.	ESC	24ES04TH0201	Artificial Intelligence	3	0	3	50	-	50	100	3
3.	ESC	24ES04TH0202	Theory of Mechanisms & Elasticity	3	0	3	50	-	50	100	3
4.	ESC	24ES04TH0203	Data Structure and Algorithms	2		2	50		50	100	2
5.	ESC	24ES04PR0203	Data Structure and Algorithms Lab		2	1		50		50	
6.	ESC	24ES04TH0204	Digital Logic Design	2		2	50		50	100	2
7.	ESC	24ES04PR0204	Digital Logic Design Lab		2	1		50		100	
8.	AEC/ HSSM	24HS02TH0201	English for Professional Communication	2		2	50		50	50	2
9.	AEC/ HSSM	24HS02PR0201	English for Professional Communication Lab		2	1		50		50	
10.	VSEC	24ES04TH0205	Fabrication Practices	1		1	50		-	50	-
11.	VSEC	24ES04PR0205	Fabrication Practices Lab		2	1		50			
12.	CCA	24HS02PR0206-	Liberal/Performing Arts Lab	0	2	1		50		50	

		1-16									
13.	CCA	24HS04PR0201	Sports-Yoga-Recreation	0	2	1		50		50	
			TOTAL	**16**	**12**	**22**	**350**	**300**	**250**	**900**	**15**

Semester III

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	BSC	24HS03TH0303	Probability & Statistics	3	0	3	50	-	50	100	3	1
2	PCC	24ES04TH0302	Thermodynamics	3	0	3	50	-	50	100	3	2
3	PCC	24ES04TH0303	Manufacturing Engineering	2	0	2	50	-	50	100	2	3
4	PCC	24ES04PR0303	Manufacturing Engineering Lab	0	2	1	-	50	-	50	-	4
5	PCC	24HS01TH0302	Materials Science & Testing	2	0	2	50	-	50	100	2	5
6	PCC	24HS01PR0303	Materials Science & Testing Lab	0	2	1	-	50	-	50	-	6
7	PCC	24ES04TH0305	Introduction to Python	2	0	2	50	-	-	50	-	7
8	PCC	24ES04PR0305	Introduction to Python Lab	0	2	1	-	50	-	50	-	8
9	PCC	24ES04TH0301	Machine Drawing and CAD	1	0	1	50	-	-	50	3	9
10	PCC	24ES04PR0301	Machine Drawing and CAD Lab	0	2	1	-	50	-	50	-	10
11	OE	24ESOEC04TH0306	Open Elective-I/ MOOC	2	0	2	50	-	50	100	2	11
12	MDM	24ES04TH0307	MDM-I	3	0	3	50	-	50	100	3	12
13	AEC	24ES04TH0304	Design Thinking	0	2	1	-	50	-	50	-	13
			TOTAL	**18**	**10**	**23**	**400**	**250**	**300**	**950**	**18**	

Open Elective - I

SN	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	24ES04TH0401	Mechanics of Solids	3	0	3	50	-	50	100	3	1
2	PCC	24ES04TH0402	Kinematics and Dynamics of Machinery	3	0	3	50	-	50	100	3	2
3	PCC	24ES04PR0402	Kinematics and Dynamics of Machinery Lab	0	2	1	-	50	-	50	-	3
4	PCC	24ES04TH0403	Fluid Mechanics and Hydraulic Machines	3	0	3	50	-	50	100	3	4
5	PCC	24ES04PR0403	Fluid Mechanics and Hydraulic Machines Lab	0	2	1	-	50	-	50	-	5
6	PCC	24ES04TH0404	Manufacturing Technology	3	0	3	50	-	50	100	3	6
7	PCC	24ES04PR0404	Manufacturing Technology Lab	0	2	1	-	50	-	50	-	7
8	CEP/FP	24ES04PR0405	Project-1 (Mini project)	0	2	1	-	50	-	50	-	8
9	OE	24ESOEC04TH0406	Open Elective-II/ MOOC	2	0	2	50	-	50	100	2	9
10	MDM	24ES04TH0407	MDM-II	3	0	3	50	-	50	100	3	10
11	AEC	CDPC	Basic Competitive Coding	0	2	1	-	50	-	50	-	11
12	VEC	24HS01TH0401	Environmental Science	1	0	1	50	-	-	50	-	12
13	VEC	24HS01PR0401	Environmental Science Lab	0	2	1	-	50	-	50	-	13

			TOTAL	18	12	24	350	300	300	950	17	

Open Elective - II	
SN	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	T	P		Continuous	End Sem Exam	Total	
1	III	24ES03HT0301	Field & Service Robot	3	0	0	3	50	50	100	3
2	IV	24ES03HT0401	Advanced sensors & Actuators	3	0	0	3	50	50	100	3
3	V	24ES03HT0501	Mobile and Micro Robotics	4	0	0	4	50	50	100	3
4	VI	24ES03HT0601	Multi-Robot Systems and Swarm Intelligence	4	0	0	4	50	50	100	3
5	VII	24ES03HP0701	Project	0	0	8	4	50	50	100	3
			TOTAL	14	0	8	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	T	P		Continuous Evaluation	End Sem	Total	

									Exam		
1	III	24ES04HT0301	Geometric Dimensioning and Tolerances	3	0	0	3	50	50	100	3
2	IV	24ES04HT0401	Advanced Solid Modelling & Assembly	3	0	0	3	50	50	100	3
3	V	24ES04HT0501	Additive Manufacturing Techniques	4	0	0	4	50	50	100	3
4	VI	24ES04HT0601	Design for Manufacturing	4	0	0	4	50	50	100	3
5	VII	24ES04HP0701	Project	0	0	8	4	50	50	100	3
			TOTAL	14	0	8	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	T	P		Continuous Evaluation	End Sem Exam	Total	
1	III	24ES03MT0301	Introduction to Robotics	3	0	0	3	50	50	100	3
2	IV	24ES03MT0401	Mechatronics and Automation	3	0	0	3	50	50	100	3
3	V	24ES03MT0501	Modelling and Simulation of Robotic Systems	4	0	0	4	50	50	100	3
4	VI	24ES03MT0601	Robot safety and maintenance	4	0	0	4	50	50	100	3
5	VII	24ES03MP0701	Project	0	0	8	4	50	50	100	3
			TOTAL	14	0	8	18				

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

Sr.				Hours/week			Credit	Maximum marks			ESE

No.	Sem	Course Code	Course Title	L	T	P		Continuous Evaluation	End Sem Exam	Total	Duration (Hrs)
1	III	24ES04MT0301	Basics of Mechanical Engineering	3	0	0	3	50	50	100	3
2	IV	24ES04MT0401	Energy system and technologies	3	0	0	3	50	50	100	3
3	V	24ES04MT0501	Product Design & Digital Manufacturing	4	0	0	4	50	50	100	3
4	VI	24ES04MT0601	Automotive Technology	4	0	0	4	50	50	100	3
5	VII	24ES04MP0701	Project	0	0	8	4	50	50	100	3
			TOTAL	14	0	8	18				

MDM: Track-I:

Sr. No.	Sem	Course Code	Course Title	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	III	24ES03TH0307	Defence 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-defence & Protection system	3	0	0	3	50	50	100	3
			TOTAL	12	0	0	12				

Defense Technology

Semester 4	**Mechanical Engineering and Smart Manufacturing**	**Mechanical and Automation Engineering**	**Mechanical Engineering (Design Thinking)**	**Mechanical Engineering (Electric Vehicle Technology)**	**Logistics and Supply Chain Management**
Semester 5	**Lean and Intelligent Manufacturing**	**Material handling and MES**	**Product Design and Development**	**Electric Vehicle Technology**	**Productivity Improvement Technique**

Program Electives:

Semester 6	**Additive Manufacturing and Reverse Engineering**	**Industrial Automation**	**Human Factors in Design**	**Battery Management systems**	**Transportation, Distribution and Warehouse Management**
Semester 7	**Machine Learning for Smart Manufacturing**	**PLC and SCADA**	**Design for Manufacturability**	**Vehicle Dynamics**	**Supply Chain Analytics**
Semester 7	**Smart Factory Design**	**Automation system & Control**	**Design Thinking for Innovation**	**Electric Vehicle Charging Infrastructure**	**Enterprise Resource Planning**
Semester 7	**Stress Analysis**	**Product lifecycle Management**	**System Design**	**Drone Technology**	**Multi-criteria Decision making**

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

Physics Lab Manual written by the Teaching Faculty of Physics Department, RCOEM.

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: 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, 11thReprint, 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: Introduction to 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 offurnaces.

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 and preparation 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 ofBharatnatayam).

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

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 knowledgesystem. 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 examof 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, GhanteKi 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)

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 YourPhotos 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

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)

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 Handbook for the Actor* (1st ed.). Vinatge Books New York.

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 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 France, the culture and similarities/differences between Indiaand 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

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

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

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

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 thussubsequently 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 thecourse 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 tigerreserve, 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

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**

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.

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**

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 activitiesfor 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 conditioningof 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 Associationdrive 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)

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

Syllabus of Semester III B. Tech. in Robotics and AI

Course Code: **Course: Field & Service Robot**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 03**

Course Objective: To introduce the world of field and service robots.

Course Outcome:

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

CO1: Learn basic terminology and application of industrial robots.

CO2: Understand and apply the application of Underwater, Aerial and Space Robots

CO3: Understand and apply the application of Agriculture, Construction and Mining Robots

CO4: Understand and apply the application of Domestic and Medical Robotics

CO5: Understand and apply the application Humanoids and Intelligent Vehicles

Unit 1: Industrial robotics

History and evolution of robotics, laws of robotics, robots, robot subsystems, robot configurations, classification of robots, Typical applications- welding, assembly, painting, automated material transfer, machining, human-robot cooperation for handling tasks.

Introduction to parallel manipulators, structure classification of parallel manipulators, applications.

Unit 2: Underwater, Aerial and Space Robotics

Introduction to underwater robotics, historical background, sensor systems, actuating systems, applications.

Introduction to aerial robotics, historical background, unmanned aerial vehicles, quadrotors, components of autonomous flight, applications and challenges of aerial robotics.

Introduction to space robotics, historical background, orbital robotics systems, surface robotic systems, applications and examples.

Unit 3: Agriculture, Construction and Mining Robotics

Introduction to agricultural robotics, overview of the agricultural robots, typical applications, challenges of the field.

Introduction to robotics in construction, system overview, basic types of construction robots, economic aspects, applications.

Introduction to robotics in mining, historical background, applications in mining process.

Unit 4: Domestic and Medical Robotics

Introduction to home automation, domestic robotics, cleaning robots, lawn moving robots, challenges and applications.

Introduction to medical robotics, historical background, surgical robots, rehabilitation robots, exoskeletons, issues related to safety and ethics, applications and challenges in medical robotics.

Unit 5: Humanoids and Intelligent Vehicles

Introduction to humanoids, historical background, locomotion and manipulation of humanoids, whole body activities, teaching methodologies, applications.

Concept of intelligence, need and necessity of intelligent vehicles, driver assistance systems, driver monitoring systems, road scene interpretation, automated vehicles, applications and challenges.

Reference Books:

1. Industrial Robotics: Technology, Programming and Applications, by Groover M.P., Tata McGraw Hill Publication Ltd.
2. Parallel Robots: Mechanics and Control, by Taghirad H.D., CRC Press.
3. Underwater Robotics: Science, Design & Fabrication, by Moore S.W.,Bohm H., and ,Jensen V., Marine Advanced Technology Education (MATE) Center, 2010.
4. Aerial Robots: Aerodynamics, Control and Application, by Mejia O.D.M., Gomez J.A.E., (eds.), InTech Open Publications.
5. Robot Oriented Design: Design and Management Tools for the Deployment of Automation and Robotics in Construction, by Bock T., Linner T., Cmbridge University Press,
6. Robotics and Mechatronics for Agriculture, by Zhang D., Wei B., (eds.), CRC Press.
7. Medical Robotics, by Schweikard A., Ernst F., Springer Publications.
8. Household Service Robotics, by Xu Y., Qian H., and Wu X., Zhejiang University Press.
9. Springer Handbook of Robotics, by Khatib O., (ed.), Springer Publications.
10. Humanoid Robotics: A Reference, Vadakkepat P., Goswami A.,Springer Netherlands, 2017.
11. On Road Intelligent Vehicles, by Kala R., Elsevier Publications, 2017.

Syllabus of Semester IV B. Tech. in Robotics and AI

Advanced Sensors and Actuators

Course Code: (To be assigned)
Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: Basic Electronics, Control Systems, Physics of Sensors
Course Type: Elective / Advanced Application

Course Objectives:

- To understand the principles, design, and application of modern and smart sensors and actuators.
- To analyze sensing mechanisms and interface technologies in automation and robotics.
- To explore MEMS/NEMS-based sensor systems and intelligent actuators.
- To integrate sensors and actuators in cyber-physical systems and smart devices.

Course Outcomes:

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

1. Classify and explain advanced sensor technologies based on transduction principles.
2. Interface and calibrate advanced sensors for dynamic measurements.
3. Select and apply intelligent actuators for robotic, automotive, and biomedical systems.
4. Analyze sensor performance in harsh and embedded environments.
5. Integrate sensor-actuator pairs into real-time intelligent control systems.

Syllabus Content:

Unit 1: Introduction to Advanced Sensors

- Overview: Role of sensors in modern systems
- Classification: Physical, Chemical, Biological Sensors
- Smart Sensor Characteristics: Self-diagnostics, Signal Conditioning, Digital Output
- Performance Metrics: Sensitivity, Resolution, Drift, Range, Accuracy
- Sensor Interface Standards (I2C, SPI, CAN, Modbus)

Unit 2: Physical and Environmental Sensors

- **Position & Displacement:** Capacitive, Inductive, Optical Encoders, LVDTs
- **Force, Pressure, Strain:** Piezoresistive, Piezoelectric, MEMS-based
- **Temperature & Humidity:** RTDs, Thermocouples, Thermistors, Hygrometers
- **Vibration & Acceleration:** Accelerometers, Gyroscopes, IMUs
- Applications in automotive, aerospace, and wearable tech

Unit 3: Chemical, Biosensors and Optical Sensors

- Chemical Sensors: Gas sensors (MQ-series), pH, Ion-selective
- Biosensors: Glucose sensors, Enzyme-based sensors
- Optical Sensors: Photodiodes, Fiber Optic Sensors, Spectroscopic Sensors
- Application Areas: Environmental monitoring, Healthcare, Food safety

Unit 4: Advanced Actuators

- Classification: Electrical, Hydraulic, Pneumatic, Smart Material-based
- **Electrical Actuators:** Stepper Motors, Servo Motors, Voice Coil Actuators
- **Smart Actuators:** Shape Memory Alloys (SMA), Piezoelectric Actuators, Magnetostrictive Actuators
- Control and Drive Circuits for Actuators
- Feedback and Closed-Loop Operation in Precision Systems

Unit 5: Integration and Emerging Technologies

- Sensor Fusion and Embedded Processing (Kalman Filter, AI-based Sensor Fusion)
- Cyber-Physical Systems and IoT Sensor Integration
- Wireless Sensor Networks and Edge Sensing
- Safety, Reliability, and Calibration of Sensors and Actuators
- Trends: Bioinspired Sensors, Energy Harvesting Sensors, AI-Enabled Sensing Systems

Textbooks:

1. **“Sensors and Actuators: Engineering System Instrumentation”** – Clarence W. de Silva
2. **“Smart Sensors and MEMS”** – S. Middelhoek & S.A. Audet
3. **“Measurement Systems: Application and Design”** – Ernest O. Doebelin

Reference Resources:

- IEEE Sensors Journal, Elsevier’s *Sensors and Actuators A & B*
- NPTEL: “Sensors and Actuators” and “Smart Materials”
- Sensor/Actuator Datasheets (STMicroelectronics, Bosch, Honeywell)

Syllabus of Semester V B. Tech. in Robotics and AI

Mobile and Micro Robotics – Syllabus

Credits: 3 (L: 3, T: 0, P: 0)

Course Objectives:

- To introduce fundamentals of mobile and micro robotic systems.
- To study locomotion, sensing, and control systems in mobile robots.
- To expose learners to MEMS technology for micro-robotics.
- To understand the design, integration, and application of mobile and micro robots in real-world scenarios.

Unit 1: Introduction to Mobile Robotics

- Basics of mobile robotics: Definition, history, and applications.
- Types of mobile robots: Wheeled, legged, aerial, underwater, and hybrid robots.
- Components of mobile robots: Sensors, actuators, controllers, and power systems.
- Kinematic models of mobile robots.

Unit 2: Locomotion and Navigation

- Locomotion mechanisms: Wheels, tracks, legs.
- Locomotion kinematics: Differential drive, synchro drive, omnidirectional.
- Path planning: Grid-based, graph-based, potential field methods.
- Navigation techniques: GPS, SLAM (Simultaneous Localization and Mapping), odometry.

Unit 3: Control of Mobile Robots

- Feedback control basics: PID controllers for robot motion.
- Trajectory tracking and motion control.
- Obstacle avoidance techniques.
- Sensor fusion for localization.

Unit 4: Micro Robotics and MEMS

- Introduction to micro robotics and its applications (medical, military, industrial).
- MEMS: Basics, materials, fabrication techniques.
- Microactuators and microsensors.
- Energy and power systems for micro robots.

Unit 5: Design and Integration

- Hardware-software integration in mobile/micro robots.
- Communication systems (wired/wireless, Bluetooth, Zigbee, Wi-Fi).
- Real-time operating systems (RTOS) and embedded platforms (Arduino, Raspberry Pi, MSP430).
- Case Studies: Swarm robotics, bio-inspired robots, microbot surgery tools.

Textbooks:

1. **Siegwart, R., Nourbakhsh, I., Scaramuzza, D.** – *Introduction to Autonomous Mobile Robots*, MIT Press.
2. **Asada, H., Slotine, J. J. E.** – *Robot Analysis and Control*, Wiley.
3. **Marc Madou** – *Fundamentals of Microfabrication: The Science of Miniaturization*, CRC Press.

Reference Books:

- Dudek, G., & Jenkin, M. – *Computational Principles of Mobile Robotics*.
- Ghosh, P. K. – *Microprocessors and Microcontrollers*.
- Khoshnevisan, B. – *MEMS and Nanotechnology-Based Sensors and Devices for Smart Systems*.

Syllabus of Semester VI B. Tech. in Robotics and AI

Course Title: Multi-Robot Systems and Swarm Intelligence

Course Code: (To be assigned)
Credits: 3 (L: 3, T: 0, P: 0)

Prerequisites: Basics of Robotics, Control Systems, Artificial Intelligence
Course Type: Elective / Advanced

Course Objectives:

- To introduce students to the foundations of multi-robot coordination and swarm intelligence.
- To study decentralized control, communication, and collaboration strategies in robotic teams.
- To explore algorithmic approaches for task allocation, coverage, formation, and flocking.
- To understand biologically inspired behaviors and emergent phenomena in robotic swarms.
- To apply concepts to real-world problems such as search and rescue, surveillance, and mapping.

Course Outcomes:

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

1. Understand and model the behavior of multi-robot and swarm systems.
2. Analyze communication, localization, and control strategies for robotic teams.
3. Implement coordination and cooperation algorithms in multi-agent systems.
4. Apply swarm intelligence techniques like PSO, ACO, and behavior-based control.
5. Design and simulate multi-robot tasks using open-source tools or hardware platforms.

Syllabus Content:

Unit 1: Introduction to Multi-Robot Systems (MRS)

- Motivation and Applications
- Homogeneous vs. Heterogeneous Teams
- Centralized vs. Decentralized Architectures
- Communication Models: Broadcast, Peer-to-Peer, Indirect (Stigmergy)

- Challenges: Scalability, Robustness, Interference

Unit 2: Multi-Robot Coordination and Control

- Task Allocation Strategies (Market-Based, Consensus-Based)
- Motion Coordination: Formation Control, Leader-Follower, Flocking
- Coverage and Exploration Algorithms
- Path Planning and Collision Avoidance in Teams
- Localization and Mapping in Multi-Robot Contexts (Cooperative SLAM)

Unit 3: Swarm Robotics Fundamentals

- Principles of Swarm Intelligence
- Behavior-Based Control and Finite State Machines
- Emergent Behavior and Collective Intelligence
- Bio-Inspired Algorithms: Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Bee Algorithms
- Real-world Swarm Robotics Applications

Unit 4: Simulation and Implementation Tools

- Software Frameworks: ROS (Robot Operating System), Stage, Webots, V-REP, Gazebo
- Multi-Robot Simulations using ARGoS, CoppeliaSim
- Integration with AI and Machine Learning Models
- Hardware Platforms: Kilobots, e-pucks, TurtleBots
- Case Studies in Search & Rescue, Environmental Monitoring, Surveillance

Unit 5: Advanced Topics and Trends

- Multi-Agent Reinforcement Learning (MARL)
- Human-Swarm Interaction
- Swarm Robotics in Unstructured Environments
- Distributed Task Planning and Fault Tolerance
- Research Challenges and Future Directions in Swarm and MRS

Textbooks:

1. **"Swarm Robotics: From Biology to Robotics"** – Sahin and Spears (Springer)
2. **"Multi-Robot Systems: From Swarms to Intelligent Automata"** – Parker, Schneider, Schultz (Kluwer Academic)
3. **"Distributed Autonomous Robotic Systems"** – Hajime Asama et al.

Reference Books & Resources:

1. **Research Papers from journals:** IEEE Transactions on Robotics, Autonomous Robots, Swarm Intelligence
2. NPTEL/EdX/MOOC: Swarm Robotics, AI for Robotics
3. ROS Tutorials and GitHub Repositories for Multi-Robot Projects

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

Geometric Dimensioning and Tolerancing (GD&T)

Semester: III (3rd Semester, B. Tech. Mechanical Engineering)
Credits: 3 (L:3, T:0, P:0)
Evaluation Scheme: 50 Marks Continuous Evaluation + 50 Marks End Semester Exam = 100 Marks
End Semester Exam Duration: 3 Hours

Course Objectives

- Understand GD&T principles and their application in design and manufacturing.
- Interpret technical drawings and identify tolerancing requirements.
- Apply form, orientation, and position tolerances.
- Use GD&T for improved functionality and manufacturability.

Course Outcomes

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

1. Define and apply GD&T as per ASME Y14.5 standard.
2. Interpret and annotate drawings using correct GD&T symbols.
3. Use GD&T for defining form, orientation, location, and runout tolerances.
4. Explain the role of datums and material condition modifiers.
5. Evaluate manufacturability and inspect ability using GD&T.

Detailed Syllabus

1. **Introduction to GD&T**
    - Need, importance and scope of GD&T
    - Coordinate vs. geometric tolerancing

2. **Drawing Standards and Feature Control Frames**
    - ASME Y14.5 symbols
    - Feature control frames, datum reference frame
3. **Form Tolerances**
    - Straightness, flatness, circularity, cylindricity
4. **Orientation Tolerances**
    - Parallelism, perpendicularity, angularity
5. **Location Tolerances**
    - Position tolerance, concentricity, symmetry
6. **Runout Tolerances**
    - Circular and total runout
7. **Modifiers & Material Conditions**
    - MMC, LMC, RFS, bonus tolerance
8. **Measurement and Inspection**
    - CMM, surface plates, functional gauges
    - GD&T in inspection reports and manufacturing drawings

Textbooks

1. Krulikowski, A., *Fundamentals of Geometric Dimensioning and Tolerancing*, Cengage Learning.
2. Parkinson, A. C., *Principles of Engineering Drawing*, Longman.

Reference Books

1. James D. Meadows, *Geometric Dimensioning and Tolerancing: Applications, Analysis & Measurement*, CRC Press.
2. Madsen, D. A., & Madsen, D. P., *Engineering Drawing and Design*, Cengage Learning.

Online Resources

- Engineers Edge GD&T Guide
- NPTEL GD&T Course
- GD&T Basics - YouTube Channel
- ASME Y14.5 Info

Advanced Solid Modelling & Assembly

Semester: 3rd
Program: B.Tech Mechanical Engineering
Credits: 3 (L3-T0-P0)
Evaluation:
Continuous Evaluation (CE): 50 Marks
End Semester Exam (ESE): 50 Marks
Total Marks: 100
Exam Duration: 3 Hours

Course Objectives:

1. To master advanced 3D modeling techniques using CAD software (e.g., SolidWorks, CATIA, Autodesk Inventor).
2. To understand assembly design, constraints, and motion simulation.
3. To apply GD&T (Geometric Dimensioning & Tolerancing) principles in modeling.
4. To develop skills in surface modeling, parametric design, and finite element analysis (FEA) integration.
5. To prepare for real-world mechanical design challenges through project-based learning.

Syllabus

Module 1: Advanced 3D Modeling Techniques

- Parametric vs. Direct Modeling
- Sketching constraints and best practices
- Complex features: Lofts, Sweeps, Ribs, Shells

Module 2: Surface Modeling

- Introduction to surface modeling
- Creating complex surfaces (Blends, Patches)
- Conversion between solid and surface models

Module 3: Assembly Design

- Bottom-up vs. Top-down assembly approaches
- Mating conditions (Coincident, Concentric, Gear, Cam)
- Exploded views and Bill of Materials (BOM)

Module 4: Motion Simulation & Analysis

- Kinematic and dynamic simulations

- Interference detection and collision analysis
- Force, torque, and friction applications

Module 5: GD&T in CAD

- ASME Y14.5 standards
- Applying tolerances to 3D models
- Datum references and feature control frames

Module 6: Integration with FEA & Prototyping

- Exporting models for Finite Element Analysis (FEA)
- 3D printing considerations (Supports, Overhangs)
- Case studies in automotive/aerospace components

Textbooks

1. **SolidWorks 2023: Advanced Techniques** – *Paul Tran* (SDC Publications)
2. **CATIA V5: From Beginner to Advanced** – *Stefan Berisha* (CreateSpace)
3. **Engineering Design with SolidWorks** – *David Planchard* (McGraw-Hill)

Reference Books

1. **Parametric Modeling with Autodesk Inventor** – *Randy Shih* (SDC Publications)
2. **Geometric Dimensioning and Tolerancing** – *James D. Meadows* (CRC Press)
3. **Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD** – *Nikola Vukašinović* (Springer)

Online Resources

1. **LinkedIn Learning:**
    - SolidWorks Advanced Assembly Techniques
    - CATIA Surface Modeling
2. **YouTube:**
    - **SolidWorks Tutorials** (by GoEngineer)
    - **GD&T Explained** (by The Efficient Engineer)
3. **Official Software Tutorials:**
    - SolidWorks Tutorials
    - Autodesk Inventor Learning
4. **Coursera:** CAD and Digital Manufacturing

Additive Manufacturing Techniques

Credits: 3 (L: 3, T: 0, P: 0)

Course Objectives:

- To understand the fundamental principles and classification of additive manufacturing (AM) processes.
- To study materials, design considerations, and applications of AM.
- To explore post-processing, quality control, and recent trends in AM.
- To enable students to apply AM techniques for prototyping and production.

Unit 1: Introduction to Additive Manufacturing (AM)

- Definition, history, and evolution of AM.
- Comparison with subtractive and formative manufacturing.
- Classification of AM processes (ASTM F42): Vat photopolymerization, material extrusion, powder bed fusion, binder jetting, etc.
- Advantages, limitations, and applications of AM.

Unit 2: Additive Manufacturing Processes

- **Vat Photopolymerization (SLA, DLP)** – Process, materials, applications.
- **Material Extrusion (FDM/FFF)** – Process, equipment, filament materials.
- **Powder Bed Fusion (SLS, SLM, EBM)** – Mechanisms, lasers/electron beams, materials.
- **Binder Jetting and Material Jetting** – Working principles and applications.
- **Sheet Lamination & Directed Energy Deposition (DED)**.

Unit 3: Materials for Additive Manufacturing

- Polymers: Thermoplastics (PLA, ABS, Nylon), thermosets.
- Metals: Titanium, Aluminum, Stainless steel, Inconel.
- Ceramics and composites in AM.
- Material behavior, process-material compatibility, mechanical properties.

Unit 4: Design for Additive Manufacturing (DfAM)

- Principles of DfAM.
- Topology optimization and lattice structures.
- Support structures and build orientation.
- CAD tools and file formats (STL, AMF).
- Design rules and constraints in AM.

Unit 5: Post-Processing and Applications

- Post-processing techniques: Heat treatment, surface finishing, machining, infiltration.
- Inspection, testing, and quality assurance.
- Applications: Aerospace, biomedical, automotive, architecture, tooling.
- Sustainability and economic aspects of AM.

Textbooks:

1. **Ian Gibson, David Rosen, Brent Stucker** – *Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*, Springer.
2. **Andreas Gebhardt** – *Understanding Additive Manufacturing*, Hanser Publishers.

Reference Books:

- Chua C.K., Leong K.F. – *3D Printing and Additive Manufacturing: Principles and Applications*.
- ASTM/ISO Standards for AM (e.g., ISO/ASTM 52900, ISO/ASTM 52901).
- Kalpakjian, S., Schmid, S. – *Manufacturing Engineering and Technology* (relevant chapters).

Design for Manufacturing (DFM)

Credits: 3 (L: 3, T: 0, P: 0)

Course Objectives:

- To understand the integration of product design with manufacturing processes.
- To impart knowledge of DFM principles for different materials and manufacturing methods.
- To enhance decision-making in selection of processes, materials, and tolerances.
- To enable students to design cost-effective, manufacturable, and high-quality products.

Unit 1: Introduction to DFM

- Importance and scope of Design for Manufacturing.
- Product life cycle and concurrent engineering.
- General principles of DFM and DFA (Design for Assembly).
- Cost estimation and value engineering in product design.
- Case studies of successful DFM applications.

Unit 2: Tolerances and Fits

- Dimensional and geometric tolerances.
- Impact of tolerances on manufacturability and cost.
- Selective assembly and statistical tolerancing.
- Design considerations for interchangeable parts.
- Use of GD&T (Geometric Dimensioning and Tolerancing).

Unit 3: DFM for Machining Processes

- Design recommendations for turning, milling, drilling, and grinding.
- Influence of design on tool life, surface finish, and machining time.
- Design features to avoid machining problems (undercuts, sharp corners, etc.).
- Material selection and machinability considerations.

Unit 4: DFM for Casting, Forging, and Welding

- Design guidelines for cast components: wall thickness, draft angles, risers.
- Design considerations for forgings: grain flow, flash, die parting line.
- Welding design: joint types, distortions, residual stresses, accessibility.
- Defect minimization through better design.

Unit 5: DFM for Sheet Metal and Plastic Parts

- Design principles for shearing, bending, deep drawing.
- Design for press working tools.
- Design for injection molding, blow molding, and extrusion.
- Minimizing defects like warping, shrinkage, sink marks.
- Assembly considerations for plastic parts (snap fits, welding, adhesives).

Textbooks:

1. **James G. Bralla** – *Design for Manufacturability Handbook*, McGraw Hill.
2. **Geoffrey Boothroyd, Peter Dewhurst** – *Product Design for Manufacture and Assembly*.

Reference Books:

- Dieter G.E., Schmidt L.C. – *Engineering Design*, McGraw-Hill.
- Karl T. Ulrich, Steven D. Eppinger – *Product Design and Development*.
- Spotts M.F. – *Dimensioning and Tolerancing for Engineering Drawings*.

Design for Manufacturing

🎯 Course Objectives:

1. To familiarize students with the principles of designing for manufacturability.
2. To enable cost-effective, reliable, and high-quality product design considering process limitations.
3. To integrate tolerance, material selection, and manufacturing process capabilities into design decisions.

4. To promote critical thinking for optimizing product function and ease of fabrication/assembly.

Course Outcomes (COs):

After completing this course, students will be able to:

- CO1: Apply DFM principles to optimize component design for manufacturing processes.
- CO2: Select appropriate materials and processes for manufacturability and cost-efficiency.
- CO3: Integrate geometric tolerances and dimensional controls into engineering design.
- CO4: Evaluate the impact of design features on manufacturability across casting, machining, forming, and joining.
- CO5: Redesign mechanical components for improved manufacturability and assembly.

Course Content:

Unit 1: Introduction to DFM and Product Design Considerations

- Role of DFM in product development
- Concurrent engineering and early design decisions
- Cost–quality–time trade-offs
- Design simplification and modularity
- Case studies: Good and bad DFM practices

Unit 2: Tolerances, Fits, and Dimensional Control

- Fundamentals of dimensional and geometric tolerancing (GD&T)
- Limits, fits, and tolerance stack-up
- Statistical tolerance analysis
- Effect of tight tolerances on manufacturing cost
- Selective assembly vs interchangeable parts

Unit 3: Design for Machining and Metal Removal

- General guidelines for turning, milling, drilling, grinding
- Design for tool accessibility and chip removal
- Minimizing machining time, tool wear, and set-up
- Surface finish considerations
- Design rules for high-speed CNC machining

Unit 4: Design for Casting, Forging, and Welding

- Design for Casting: Draft, fillets, parting lines, shrinkage
- Design for Forging: Flash formation, grain flow, symmetry
- Design for Welding: Weld symbols, distortion control, access
- Welding joints vs. mechanical fasteners: cost and strength considerations
- Common defects and design remedies

Unit 5: Design for Sheet Metal and Plastics Manufacturing

- Sheet Metal Design: Bending, blanking, forming, relief features
- Minimizing burrs, springback, and distortion
- Design for Injection Molding: Parting lines, ribs, bosses, undercuts
- Material behavior and wall thickness variation
- Assembly techniques: snap fits, ultrasonic welding, adhesives

Textbooks:

1. **James G. Bralla** – *Design for Manufacturability Handbook*, McGraw Hill.

2. **Boothroyd, Dewhurst, and Knight** – *Product Design for Manufacture and Assembly*, CRC Press.

📚 Reference Books:

- G.E. Dieter and L.C. Schmidt – *Engineering Design*.
- Kevin Otto & Kristin Wood – *Product Design*.
- Spotts M.F. – *Dimensioning and Tolerancing for Engineering Drawings*.

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

B. Tech Second year (Robotics and AI)

Semester III

Course Code: Course Name: Introduction to Robotics

L: 3Hrs. T: 0 Hrs. P: 0 Hrs. Per week Total Credits:3

Course Objective

To introduce students to the fundamental principles of robotics including robot classification, industrial applications, the role of sensors and actuators, and the mathematical foundations of spatial transformations and robot kinematics, enabling them to analyse and design basic robotic systems.

Course Outcomes (COs)

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

1. **CO1:** Describe the evolution, structure, and classification of robotic systems along with their basic components.
2. **CO2:** Identify and analyze various types of industrial robots and their applications in manufacturing and automation.
3. **CO3:** Explain the working principles and selection criteria of sensors and actuators used in robotic systems.
4. **CO4:** Apply transformation techniques such as rotation matrices and homogeneous transformations to model robot motion.
5. **CO5:** Analyze the kinematic structure of serial manipulators using Denavit–Hartenberg parameters for forward kinematic analysis.

Unit 1: Introduction to Robotics

- Definition and classification of robots
- Historical development and evolution of robots
- Anatomy of a robot: Links, joints, DOF, workspace
- Types of robots (serial, parallel, mobile)
- Robot characteristics and performance parameters
- Basic components: Controller, manipulator, end effector, sensors

Unit 2: Industrial Robots and Their Applications

- Types of industrial robots: Cartesian, SCARA, Articulated, Delta
- Selection criteria for industrial robots

- Programming methods: Teach pendant, offline programming
- Applications:
    - Material handling and machine loading/unloading
    - Welding, painting, and assembly operations
    - Pick-and-place and palletizing
    - Inspection and quality control
- Case studies from automotive, electronics, and manufacturing industries

Unit 3: Sensors and Actuators in Robotics

Sensors:

- Internal vs external sensors
- Position sensors: Potentiometers, encoders, resolvers
- Velocity and acceleration sensors
- Proximity and tactile sensors
- Force/torque sensors
- Vision and ultrasonic sensors

Actuators:

- Electric actuators: DC, stepper, and servo motors
- Hydraulic and pneumatic actuators
- Comparisons and selection criteria
- Drive systems: Direct drive, gearboxes, belts

Unit 4: Transformation and Robot Kinematics

- Introduction to coordinate frames
- Homogeneous transformation matrices
- Rotation matrices and Euler angles

- Denavit–Hartenberg (D-H) parameters
- Forward kinematics for serial manipulators
- Basic introduction to inverse kinematics
- Robot configuration and singularity

Textbooks / Reference Books

1. **Introduction to Robotics: Mechanics and Control** – John J. Craig
2. **Robotics: Control, Sensing, Vision, and Intelligence** – K.S. Fu, R.C. Gonzalez, C.S.G. Lee
3. **Robotics: Modelling, Planning and Control** – B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo
4. **Robot Modeling and Control** – Mark W. Spong, Seth Hutchinson, M. Vidyasagar

Mechatronics and Automation

🎯 Course Objectives:

1. To provide an interdisciplinary understanding of mechanical, electrical, and computer systems.
2. To introduce sensors, actuators, controllers, and microprocessors for automated systems.
3. To understand the architecture and applications of mechatronic systems in modern automation.
4. To design and analyze real-time embedded control systems using PLCs and microcontrollers.

✔ Course Outcomes (COs):

- **CO1:** Understand the fundamentals of mechatronic systems and components.
- **CO2:** Analyze the operation of sensors, actuators, and interfacing elements.

- **CO3:** Develop logic for automated systems using PLCs and microcontrollers.
- **CO4:** Apply control principles for real-time systems.
- **CO5:** Design simple mechatronic systems for industrial and domestic applications.

Course Content:

Unit 1: Introduction to Mechatronics

- Definition, scope, and applications
- Elements of mechatronics system: sensors, actuators, control systems
- Mechatronic system design approach
- Case studies: Home appliances, robotics, automotive systems

Unit 2: Sensors and Transducers

- Types of sensors: Displacement, temperature, pressure, proximity, flow, force, level
- Signal conditioning and data acquisition
- Analog and digital sensors, resolution, accuracy
- Interfacing sensors with controllers

Unit 3: Actuators and Drives

- Electrical actuators: DC/AC motors, stepper motors, servo motors
- Pneumatic and hydraulic actuators: valves, cylinders
- Motor characteristics and control
- Drive circuits and interfacing techniques

Unit 4: Microcontrollers and PLCs in Mechatronics

- Architecture of 8051 / Arduino / PIC microcontrollers
- Basics of programming and interfacing: I/O, timers, ADC, PWM
- Introduction to PLC: Architecture, ladder logic, programming instructions
- PLC interfacing with sensors and actuators
- Simple applications: Traffic light, conveyor, elevator system

Unit 5: Industrial Automation and Control

- Introduction to automation and its levels
- Feedback and open-loop control systems
- PID control: Theory, tuning, implementation
- SCADA and HMI basics
- Integration of systems: Communication protocols (RS232, CAN, Modbus)

Suggested Laboratory Experiments / Mini Projects:

- Interfacing IR sensor and DC motor with Arduino
- Speed control of stepper motor using microcontroller
- Ladder logic program for elevator / bottle filling system using PLC
- Real-time temperature monitoring and control
- Industrial automation project using Arduino + relay + sensors

Textbooks:

1. **W. Bolton** – *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, Pearson.
2. **Devdas Shetty & Richard Kolk** – *Mechatronics System Design*, Cengage Learning.

📚 Reference Books:

- R.K. Rajput – *Mechatronics*
- Sabri Cetinkunt – *Mechatronics with Experiments*
- J. Stenerson & J. Currie – *Industrial Automation and Process Control*

Modeling and Simulation of Robotic Systems

🎯 Course Objectives:

1. To introduce the mathematical foundations for modeling robotic systems.
2. To develop dynamic models and simulate robotic motion and control.
3. To understand kinematics, dynamics, and trajectory planning for manipulators and mobile robots.
4. To apply simulation tools (like MATLAB/Simulink, ROS) for robotic system analysis.

✅ Course Outcomes (COs):

- **CO1:** Understand and model the kinematics of robotic systems.
- **CO2:** Analyze and simulate the dynamics of robotic manipulators.
- **CO3:** Design and simulate trajectory planning algorithms.
- **CO4:** Implement control strategies for robotic systems using simulation tools.
- **CO5:** Apply modeling and simulation for mobile and industrial robotic applications.

 Course Content:

Unit 1: Introduction to Robotics and Modeling

- Overview of robotic systems and components
- Types of robots: Serial, parallel, mobile
- Coordinate frames, DH parameters
- Homogeneous transformation matrices
- Robot modeling concepts: analytical, numerical, graphical

Unit 2: Kinematic Modeling

- Forward and inverse kinematics of robotic manipulators
- Geometric and analytical approaches
- Velocity kinematics: Jacobian matrix, singularities
- Workspace analysis
- Case studies using 2R and 3R manipulators

Unit 3: Dynamic Modeling of Robots

- Newton-Euler and Lagrangian methods
- Equations of motion for manipulators
- Dynamic model of 2-DOF and 3-DOF robots
- Inertia matrix, Coriolis and centrifugal terms, gravity terms
- Simulating dynamic equations using MATLAB/Simulink

Unit 4: Trajectory Planning and Control

- Joint space and Cartesian space trajectory generation

- Linear, cubic, quintic polynomial trajectories
- Velocity and acceleration profiles
- PID and feedforward control for manipulators
- Motion control simulation using MATLAB/Simulink or ROS-Gazebo

Unit 5: Modeling and Simulation of Mobile Robots

- Kinematics of wheeled mobile robots: differential drive, omnidirectional
- Dynamic modeling of mobile robots
- Path planning and obstacle avoidance
- SLAM basics and simulation
- Simulation platforms: ROS, Gazebo, V-REP/CoppeliaSim

Laboratory / Practical (Optional, 1 credit recommended):

- Modeling of 2R/3R manipulators in MATLAB/Simulink
- Simulation of forward and inverse kinematics
- Trajectory tracking using PID controller
- Mobile robot path simulation in Gazebo/ROS
- Modeling using Simscape Multibody or V-REP

Textbooks:

1. **Craig, J. J.** – *Introduction to Robotics: Mechanics and Control*, Pearson.
2. **Spong, M. W., Hutchinson, S., Vidyasagar, M.** – *Robot Modeling and Control*, Wiley.

📚 Reference Books:

- Siciliano, B., Khatib, O. – *Springer Handbook of Robotics*
- Kelly, R. et al. – *Control of Robot Manipulators in Joint Space*
- Corke, P. – *Robotics, Vision and Control* (Toolbox-based)

Here is a comprehensive and academic syllabus for the course titled **"Robot Safety and Maintenance"**, ideal for **undergraduate/postgraduate engineering programs** in **Robotics, Mechatronics, Mechanical, or Automation Engineering**.

Robot Safety and Maintenance

🎯 Course Objectives:

1. To impart knowledge of safety practices in robotic systems and work environments.
2. To understand the causes of robotic failures and design preventive maintenance strategies.
3. To familiarize students with safety standards and risk assessment protocols.
4. To develop troubleshooting skills and maintenance planning for robotic systems.

✅ Course Outcomes (COs):

- **CO1:** Identify potential safety hazards associated with industrial and mobile robots.
- **CO2:** Interpret and apply international robot safety standards (e.g., ISO, ANSI, OSHA).
- **CO3:** Analyze failure modes and implement condition-based or preventive maintenance.
- **CO4:** Plan and schedule systematic maintenance procedures.

- **CO5:** Recommend and apply safety and emergency protocols in robotic environments.

Course Content:

Unit 1: Introduction to Robot Safety

- Definition and importance of robot safety
- Types of hazards: mechanical, electrical, environmental, software
- Accident case studies in industrial robotics
- Safety system components: sensors, interlocks, emergency stops
- Safety in collaborative robot environments (cobots)

Unit 2: Safety Standards and Regulations

- Overview of international safety standards:
  - ISO 10218-1 & 2: Safety for industrial robots
  - ANSI/RIA R15.06, OSHA 1910
  - ISO/TS 15066: Collaborative robots
- Risk assessment and mitigation: hazard identification, severity, probability
- Safe design practices and safeguarding methods
- Human-robot interaction (HRI) safety aspects

Unit 3: Robot Maintenance Principles

- Types of maintenance: preventive, predictive, reactive, condition-based
- Maintenance objectives: uptime, reliability, MTBF, MTTR
- Maintenance tools and diagnostic software
- Lubrication, calibration, alignment, cleaning practices

Unit 4: Troubleshooting and Fault Diagnosis

- Root cause analysis techniques (Fishbone diagram, FMEA)
- Electrical, mechanical, hydraulic, pneumatic fault diagnostics
- Sensor and actuator failure analysis
- Use of diagnostic interfaces in robots (HMI, SCADA)

Unit 5: Maintenance Planning and Management

- Maintenance scheduling and documentation
- Computerized Maintenance Management Systems (CMMS)
- Spare parts inventory management
- Maintenance safety procedures and PPE
- Case studies on robot maintenance in manufacturing industries

Suggested Laboratory / Project Work (Optional 1 Credit):

- Prepare a risk assessment sheet for a robotic cell
- Develop a preventive maintenance checklist for a 6-axis industrial robot
- Fault simulation and troubleshooting using a virtual robot system
- Design a safety layout with interlock and emergency stops
- Use of digital twins for predictive maintenance (simulation-based)

Textbooks:

1. **Mikell P. Groover** – *Industrial Robotics: Technology, Programming, and Applications*, McGraw-Hill.
2. **Deborah S. Ray, Michael A. Ray** – *Industrial Robotics: Fundamentals of Robot Applications*, Cengage Learning.

📚 Reference Books & Standards:

- **RIA/ANSI/ISO Safety Standards** (ISO 10218-1/2, ISO 15066, OSHA 1910)
- F. Mondada et al. – *Autonomous Mobile Robotics: Safety and Applications*
- Maintenance manuals from manufacturers like ABB, KUKA, FANUC

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

Basics of Mechanical Engineering

Course Code: (To be assigned)
Credits: 3 (L: 3, T: 0, P: 0)

Prerequisites: None
Course Type: Foundation / Core (First Year)

Course Objectives:

- To introduce students to fundamental concepts of mechanical engineering.
- To provide basic knowledge of thermodynamics, IC engines, power plants, and refrigeration.
- To explain manufacturing processes and engineering materials.
- To provide exposure to basic mechanical systems like power transmission and mechanisms.
- To develop an understanding of applications in multidisciplinary engineering.

Course Outcomes:

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

1. Understand and apply basic laws of thermodynamics and heat engines.
2. Explain working principles of IC engines and power generation systems.
3. Identify and understand commonly used engineering materials and their properties.
4. Comprehend basic manufacturing processes.
5. Understand mechanical elements used in machines and power transmission.

Syllabus Content:

Unit 1: Thermodynamics and Heat Engines

- Basic Concepts: System, Boundary, Properties, State, Process, Cycle
- Zeroth, First and Second Laws of Thermodynamics

- Types of Heat Engines and Efficiencies
- Concept of Entropy (Introductory)
- Working of Carnot and Rankine Cycles

Unit 2: Internal Combustion (IC) Engines and Power Plants

- IC Engines: Classification, Components, Working of 2-Stroke and 4-Stroke Petrol and Diesel Engines
- Performance Parameters
- Overview of Power Plants: Thermal, Hydro, Nuclear, and Solar
- Introduction to Renewable Energy Sources

Unit 3: Refrigeration and Air Conditioning

- Basic Concepts of Refrigeration
- Working Principle of Vapour Compression and Vapour Absorption Systems
- Air Conditioning: Summer and Winter AC Systems
- Applications in Domestic and Industrial Sectors

Unit 4: Engineering Materials and Manufacturing Processes

- Classification of Materials: Metals, Polymers, Ceramics, Composites
- Properties: Mechanical, Thermal, Electrical
- Manufacturing Processes: Casting, Forging, Welding, Machining, 3D Printing
- Introduction to CNC and Automation in Manufacturing

Unit 5: Mechanical Systems and Power Transmission

- Mechanisms: Slider Crank, Four-Bar, Cam-Follower (Basic Types)
- Power Transmission: Belts, Chains, Gears, Couplings
- Basic Concepts of Bearings and Clutches
- Introduction to Pumps and Compressors

Textbooks:

1. **"Basic Mechanical Engineering"** – Pravin Kumar, Pearson
2. **"Elements of Mechanical Engineering"** – R.K. Rajput, Laxmi Publications
3. **"Basic Mechanical Engineering"** – D.S. Kumar, S.K. Kataria & Sons

Reference Books:

1. **"Fundamentals of Mechanical Engineering"** – Saeed Moaveni
2. **"Basic Mechanical Engineering"** – P. K. Nag (McGraw Hill)
3. **Online Resources:** NPTEL Lectures, MOOC platforms (SWAYAM, Coursera)

Energy Systems and Technologies

Course Code: (To be assigned)
Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: Thermodynamics, Fluid Mechanics, Basics of Electrical Engineering
Course Type: Core / Elective

Course Objectives:

- To introduce students to various conventional and non-conventional energy systems.
- To study energy conversion technologies and their environmental impacts.
- To develop an understanding of design, performance, and integration of modern energy systems.
- To evaluate energy policies, efficiency strategies, and system economics.

Course Outcomes:

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

1. Understand and classify different energy systems and technologies.
2. Analyze the working and efficiency of thermal, electrical, and renewable energy systems.
3. Design and assess hybrid and integrated energy systems.
4. Evaluate the economic and environmental aspects of energy technologies.
5. Apply principles of energy system integration for sustainable development.

Syllabus Content:

Unit 1: Introduction to Energy Systems

- Global and Indian Energy Scenario
- Classification of Energy Sources
- Characteristics of Conventional and Non-Conventional Energy
- Energy Chain: Source → Conversion → Transmission → Utilization
- Energy Conversion Principles and Efficiencies

Unit 2: Conventional Energy Systems

- **Fossil Fuel-Based Systems:** Thermal Power Plants, Combustion Systems, Efficiency Improvement
- **Nuclear Energy Systems:** Reactor Types, Fuel Cycles, Safety Aspects
- **Hydropower Systems:** Types, Site Selection, Components, Environmental Impact
- Emissions and Carbon Footprint of Conventional Systems

Unit 3: Renewable Energy Technologies

- **Solar Energy Systems:** Thermal Collectors, PV Systems, Storage
- **Wind Energy Systems:** Aerodynamics, Turbines, Siting, Hybrid Integration
- **Biomass and Bioenergy:** Biogas, Gasifiers, Biofuels
- **Geothermal and Ocean Energy Systems:** Tidal, Wave, OTEC
- Comparison and Suitability of Renewable Systems

Unit 4: Integrated and Emerging Energy Systems

- **Hybrid Energy Systems:** Solar-Wind-Diesel, Smart Grids, Microgrids
- **Energy Storage Technologies:** Thermal, Electrochemical, Mechanical
- **Cogeneration and Trigeneration Systems**
- Fuel Cells and Hydrogen-Based Systems
- Smart Energy Networks and Demand Response

Unit 5: Energy System Management and Policy

- Energy Efficiency in Systems and Devices
- Economic Evaluation: Costing, LCOE, Payback, NPV
- Life Cycle Analysis and Environmental Impact Assessment
- Government Policies and Incentives (MNRE, BEE, International Energy Agencies)
- Case Studies: Integrated Energy Planning for Urban and Rural Areas

Textbooks:

1. **"Energy Systems Engineering: Evaluation and Implementation"** – Francis Vanek & Louis Albright
2. **"Non-Conventional Energy Resources"** – B.H. Khan
3. **"Renewable Energy: Power for a Sustainable Future"** – Godfrey Boyle

Reference Books & Resources:

- NPTEL: "Energy Resources and Technology", "Energy Systems"
- Reports from MNRE, BEE, IEA, TERI, IRENA
- RETScreen, HOMER Pro, PVsyst (Simulation Tools)

Product Design and Digital Manufacturing

🎯 Course Objectives:

1. To introduce the fundamentals of product design, innovation, and development.
2. To expose students to tools and technologies in digital design and manufacturing.
3. To integrate CAD, CAM, CAE, and Industry 4.0 tools for product lifecycle.
4. To understand the role of digital twins, additive manufacturing, and automation in modern manufacturing.

✔ Course Outcomes (COs):

- **CO1:** Apply structured methods for concept generation, design thinking, and product development.
- **CO2:** Utilize CAD/CAE tools for product modeling and validation.
- **CO3:** Understand and apply principles of digital manufacturing and Industry 4.0.
- **CO4:** Implement additive and subtractive manufacturing strategies for rapid prototyping.
- **CO5:** Integrate digital technologies for smart and sustainable product development.

? Course Content:

Unit 1: Fundamentals of Product Design

- Product development process and lifecycle

- Design thinking and innovation frameworks
- User-centered design, ergonomics, aesthetics
- Concurrent engineering and DFX principles
- Case studies of successful product designs

Unit 2: CAD and CAE in Product Design

- Solid and surface modeling (parametric and direct modeling)
- Assembly modeling and tolerance analysis
- Finite Element Analysis (FEA) for design validation
- Topology optimization and generative design
- Digital mock-ups and design iterations

Unit 3: Digital Manufacturing Fundamentals

- Definition and components of digital manufacturing
- Cyber-Physical Systems and Smart Factories
- Role of CAD/CAM/CAE/PDM/PLM
- Digital threads and digital twins
- Real-time data monitoring and decision-making

Unit 4: Additive and Subtractive Manufacturing

- Additive Manufacturing (AM) processes and integration
- Design for Additive Manufacturing (DfAM)
- CNC-based subtractive manufacturing techniques
- Toolpath generation and simulation
- Hybrid manufacturing approaches

Unit 5: Industry 4.0 and Intelligent Manufacturing

- IoT in manufacturing: sensors, data acquisition
- Cloud manufacturing and digital supply chains
- Automation, robotics, and smart assembly systems
- Sustainability and green manufacturing
- Case studies: Digital manufacturing in automotive, aerospace, healthcare

Suggested Laboratory / Project Work (Optional 1 Credit Recommended):

- Design a product in CAD and validate it using CAE tools
- 3D print a prototype and evaluate its fit/form/function
- Develop a digital twin model of a manufacturing process
- Simulate a manufacturing line with digital manufacturing software (e.g., Siemens Tecnomatix, FlexSim, Arena)
- Create a bill of materials and process plan using PLM tools

Textbooks:

1. **Ulrich, K.T. & Eppinger, S.D.** – *Product Design and Development*, McGraw-Hill
2. **Gibson, I., Rosen, D.W., Stucker, B.** – *Additive Manufacturing Technologies*, Springer
3. **Michael McClellan** – *Collaborative Manufacturing: Using Real-Time Information to Support the Supply Chain*, CRC Press

Reference Books:

- **Chitale & Gupta** – *Product Design and Manufacturing*
- **Madhusudan Reddy** – *Digital Manufacturing and Automation*
- **Kalpakjian & Schmid** – *Manufacturing Engineering and Technology*

Automotive Technology

🎯 Course Objectives:

1. To introduce the layout, structure, and key components of modern automobiles.
2. To study internal combustion engine systems, transmission, suspension, and vehicle control systems.
3. To explore modern technologies like electric vehicles, hybrid systems, and ADAS.
4. To understand safety, emission, and diagnostic technologies in vehicles.

✔ Course Outcomes (COs):

- **CO1:** Describe the construction and working of automotive powertrains and sub-systems.
- **CO2:** Analyze the performance of engines, transmission, suspension, and braking systems.
- **CO3:** Understand vehicle electronics and control systems including sensors, ECUs, and CAN.
- **CO4:** Evaluate emerging automotive technologies including EVs and hybrid vehicles.
- **CO5:** Apply diagnostic tools and standards for vehicle safety and emission control.

⍰ Course Content:

Unit 1: Vehicle Layout and Powertrain Systems

- Classification and layout of vehicles (FWD, RWD, AWD)
- Chassis and body types
- IC engine types, construction and working (SI and CI engines)
- Engine components, valve timing, engine balancing
- Power transmission system: clutch, gearbox (manual and automatic), differential, propeller shaft

Unit 2: Suspension, Steering, and Braking Systems

- Suspension types: rigid axle, independent suspension
- Springs: leaf spring, coil spring, torsion bar
- Hydraulic shock absorbers, active suspension
- Steering systems: rack and pinion, power steering, steering geometry
- Braking systems: disc, drum, ABS, EBD, regenerative braking

Unit 3: Automotive Electronics and Control

- Sensors: throttle position, MAP, oxygen, speed, temperature
- ECUs and their functions (engine, transmission, ABS, airbag)
- Communication protocols: CAN, LIN, FlexRay
- Vehicle diagnostics: OBD-I and OBD-II standards
- Instrument clusters and electronic dashboard systems

Unit 4: Advanced Vehicle Technologies

- Introduction to Hybrid Electric Vehicles (HEV) and Electric Vehicles (EV)
- Types of hybrid configurations: series, parallel, power-split
- Battery technologies (Li-ion, NiMH), BMS and thermal management
- Power electronics in EVs: inverters, converters, controllers
- Introduction to Fuel Cell Vehicles (FCV)

Unit 5: Safety, Emissions and Diagnostics

- Passive and active safety systems: airbags, crumple zones, ESC
- ADAS: cruise control, lane assist, parking assist

- Emission norms: BS-VI, Euro VI
- Catalytic converters, DPF, SCR technologies
- Diagnostic Trouble Codes (DTCs) and scan tools

? Suggested Practical / Laboratory Work (Optional - 1 credit):

- Dismantling and assembly of a 4-stroke IC engine
- Simulation of vehicle dynamics using software (e.g., ADAMS, AVL Cruise)
- CAN bus communication experiment
- Diagnostic scanning using OBD-II scanner
- Visit to EV/Automotive manufacturing unit and report submission

Textbooks:

1. **Kirpal Singh** – *Automobile Engineering Vol I & II*, Standard Publishers
2. **William H. Crouse, Donald L. Anglin** – *Automotive Mechanics*, McGraw-Hill
3. **Bosch Automotive Handbook**, Bosch GmbH

Reference Books:

- R. B. Gupta – *Automobile Engineering*
- Jack Erjavec – *Automotive Technology: A Systems Approach*
- Iqbal Husain – *Electric and Hybrid Vehicles: Design Fundamentals*

MDM scheme for School of Engineering Sciences (B. Tech Programs)

Track-I: Defense Technology

Course Code: 24ES03TH0307			Course: Defence Platforms
L: 3	T: 0	P: 0	Total Credits: 3
Semester: III			Total Marks: 100 (50 CE + 50 ESE)

Course Objectives:

1. To introduce students to the structural, functional, and technological aspects of land, naval, and aerial defense platforms.
2. To develop awareness about emerging technologies, indigenous capabilities, and strategic applications in defense systems.

Course Outcomes:

CO1: Identify and classify various defense platforms used in land, sea, and air operations.
CO2: Explain the basic design principles behind mobility, protection, and firepower in defense vehicles.
CO3: Demonstrate an understanding of the structure and functions of naval and aerial defense systems.
CO4: Analyze the role of emerging technologies such as AI, robotics, and unmanned systems in modern defense applications.
CO5: Evaluate India's indigenous defense capabilities and compare them with global defense technologies.

Syllabus

Unit 1: Introduction to Defense Systems and Platforms
Overview of national defense and security framework, Classification of defense platforms: Land, Air, Naval, Cyber, and Space, Basic technology: weapon systems, support systems, communication and control, Role of mechanical engineers in defense

Unit 2: Land-Based Platforms
Tracked vehicles: Tanks, ARVs, Light Tanks, Infantry Combat Vehicles (ICVs), Armoured Personnel Carriers (APCs), Artillery systems: Towed, SPG, ATAGS, Design principles: mobility, armour, firepower, Logistics and maintenance systems

Unit 3: Naval Platforms
Design, structure and classification of vessels, Warships: Destroyers, Frigates, Corvettes, Submarines, Propulsion systems: Diesel-electric, nuclear, Weaponry and stealth in naval platforms, Vehicle robotics and underwater drones

Unit 4: Aerial Platforms
Fighter aircraft types (Tejas, Sukhoi-30 MKI), UAV/drones: Nishant, Rustom, Heron, Helicopters: LCH, Dhruv, Apache, Aerodynamics, propulsion, stealth and avionics, Future aerial combat systems

Unit 5: Emerging Technologies in Defense
Network centric warfare and systems, Artificial Intelligence and decision making, Directed Energy Weapons, Unmanned systems: hypersonics, swarm drones, directed-energy weapons, indigenous technology development

Books:

Understanding Modern Warfare – David Jordan et al.
Introduction to Defense Acquisition Management – Defense Acquisition University
Weapons: An International Encyclopedia – Diagram Group
Military Vehicle Technology – David McLellan
Jane's Armour and Artillery – Jane's Information Group

Evaluation Scheme

Component	Marks	Description
Mid Term Test	20+20	Subjective Test
Teacher's Assignment	10	Assignment, MCQ,Viva
End Semester Examination	50	Descriptive 3-hour written exam

Course Code: 24ES03TH0407			Course: Warfare Systems
L: 3	T: 0	P: 0	Total Credits: 3
Semester: IV			Total Marks: 100 (50 CE + 50 ESE)

Course Objectives:

1. To provide insights into historical and modern warfare systems and their technological evolution.
2. To understand the structure, components, and working principles of various warfare systems.
3. To explore mechanical engineering contributions in designing and maintaining warfare technologies.

Course Outcomes:

CO1: Define and classify different types of warfare and identify their historical evolution.
CO2: Analyze the mechanical engineering aspects of conventional weapon systems including tanks, firearms, and artillery.
CO3: Explain the design and functioning of naval and submarine warfare systems including propulsion and stealth.
CO4: Evaluate air and space warfare capabilities including aircraft design, missile systems, and satellite surveillance.
CO5: Assess modern cyber and electronic warfare technologies and their impact on mechanical system vulnerabilities.

Syllabus

Unit 1: Fundamentals of Warfare Systems
Definition and evolution of warfare, Classifications: Conventional, Asymmetric, Cyber, Electronic, Nuclear, Mechanics and dynamics of military engagements, Mechanical engineering relevance in warfare design

Unit 2: Conventional Weapon Systems
Ballistics and projectile dynamics, Firearms, artillery, and their mechanical subsystems, Tanks and armored systems – mobility and firing mechanisms, Personal protective equipment and soldier systems

Unit 3: Naval and Submarine Warfare
Structure and propulsion of naval ships and submarines, Torpedoes, anti-ship missiles, and sonar systems, Stealth technologies and undersea warfare strategies, Role of materials and mechanics in naval platforms

Unit 4: Air and Space Warfare
Combat aircraft and missile systems – design and aerodynamics, Air defense systems – RADAR, AWACS, SAMs, Space-based warfare capabilities – satellites and surveillance, Anti-satellite weapons and hypersonic threats

Unit 5: Cyber and Electronic Warfare
Electronic warfare systems – jammers, decoys, ECM and ECCM, Cyber-attacks and defenses – mechanical system vulnerabilities, Role of AI, IoT and robotics in future warfare, Hybrid warfare and information warfare trends

Textbook

1. *Introduction to Modern Warfare Systems* – DRDO Publication
2. *Warfare and Military Technology* – Martin van Creveld

Reference Books

- *Art of War* – Sun Tzu
- *Modern Weapons and Warfare* – Chris Bishop
- *Future Warfare* – Col. John Antal
- *Understanding Cyber Warfare* – Christopher Whyte
- DRDO, HAL, and Ministry of Defence technical papers and publications

Online Resources

- https://drdo.gov.in – DRDO Official Site
- https://mod.gov.in – Ministry of Defence, India
- https://nptel.ac.in – NPTEL Modules
- YouTube Channels: Indian Army, Indian Navy, DRDO, HAL
- Coursera/edX: AI in Defense, Cybersecurity Fundamentals, Military Technology Courses

Evaluation Scheme

Component	Marks	Description
Mid Term Test	20+20	Subjective Test
Teacher's Assignment	10	Assignment, MCQ,Viva
End Semester Examination	50	Descriptive 3-hour written exam

Course Code: 24ES03TH0507			Course: Weapon Systems
L: 3	T: 0	P: 0	Total Credits: 3
Semester: V			Total Marks: 100 (50 CE + 50 ESE)

Course Objectives:

1. To understand the fundamental principles, classifications, and operation of modern weapon systems.
2. To explore the mechanical engineering aspects involved in the design, dynamics, and deployment of various weapon systems.
3. To study the integration of fire control, propulsion, guidance, and stabilization technologies in weapon design.

Course Outcomes:

CO1: Classify and describe the various types of weapon systems used in defense applications.
CO2: Explain the working principles of internal ballistics, external ballistics, and terminal effects.
CO3: Analyze the structural and mechanical components of firearms, cannons, and missile systems.
CO4: Understand the integration of guidance, propulsion, and control in modern smart weapons.
CO5: Evaluate the technological challenges and recent advancements in indigenous weapon development.

Syllabus

Unit 1: Introduction to Weapon Systems
Definition and classification of weapon systems, Evolution of weapon systems from ancient to modern era, Components: launcher, projectile, guidance, fire control, Role of mechanical engineering in weapon design

Unit 2: Ballistics and Firing Mechanisms
Internal ballistics – combustion, chamber pressure, recoil, External ballistics – trajectory, drag, wind effects, Terminal ballistics – impact mechanics, penetration, Firing mechanisms in rifles, machine guns, artillery

Unit 3: Missile and Rocket Systems
Basic structure and classification of missiles and rockets, Propulsion systems – solid, liquid, hybrid, Aerodynamics and heat shielding, Guidance and control mechanisms

Unit 4: Fire Control and Launch Systems
Fire control systems – analog/digital, RADAR integration, Launch platforms – mobile, static, naval and aerial-based, Stabilization and recoil mechanisms in launchers

Unit 5: Advanced and Smart Weapons
Precision-guided munitions (PGMs), loitering munitions, Drone-based delivery systems, Electromagnetic railguns and laser-based weapons, Indigenous technologies – BrahMos, Pinaka, NAG, AKASH, Future trends: hypersonics, AI-guided weapons

Textbook

1. *Principles of Guided Missile Design* – Dr. M. N. Sinha
2. *Weapon Systems and Ballistics* – R.K. Arora

Reference Books

- *Modern Weapons and Warfare* – Chris Bishop
- *Fundamentals of Naval Weapons Systems* – CDR Craig M. Payne (US Navy)
- *Missile Guidance and Control Systems* – George M. Siouris
- *Indian Defence Technology Series* – DRDO Publications
- *Military Ballistics: A Basic Manual* – Malcolm J. D. Powell

Online Resources

- https://drdo.gov.in – DRDO Official Site
- https://nptel.ac.in – NPTEL Defense Modules
- YouTube Channels: DRDO, Bharat Forge, Indian Army Tech, MBDA Missiles
- Coursera/edX: Missiles and Rockets, Fundamentals of Ballistics, Weapon Design

- YouTube Channels: Indian Army, Indian Navy, DRDO, HAL
- Coursera/edX: AI in Defense, Cybersecurity Fundamentals, Military Technology Courses

Evaluation Scheme

Component	Marks	Description
Mid Term Test	20+20	Subjective Test
Teacher's Assignment	10	Assignment, MCQ,Viva
End Semester Examination	50	Descriptive 3-hour written exam

Course Code: 24ES03TH0607			Course: Self-defense & Protection systems
L: 3	T: 0	P: 0	Total Credits: 3
Semester: VI			Total Marks: 100 (50 CE + 50 ESE)

Course Objectives:

1. To introduce students to the fundamentals and technologies behind personal, vehicular, and infrastructure protection systems.
2. To study the application of mechanical and material engineering in designing armor, shelters, and anti-threat mechanisms.
3. To develop an understanding of modern self-defense technologies and threat mitigation strategies in civil and military domains.

Course Outcomes:

CO1: Classify and explain different types of self-defense and protection systems used by individuals and defense forces.
CO2: Understand the design and materials used in bulletproof vests, helmets, and riot gear.
CO3: Analyze vehicle protection technologies including mine-resistant and ambush-protected (MRAP) designs.
CO4: Evaluate technologies used in anti-intrusion, perimeter security, and blast mitigation.
CO5: Assess new-age protection technologies such as exoskeletons, active armor, and AI-based threat response.

Syllabus

Unit 1: Introduction to Self-Defense & Protection Systems
Threat landscape: Civilian and military, Classification: Personal, vehicle, infrastructure protection, Principles of threat assessment and risk analysis, Historical evolution of armor and protective technologies

Unit 2: Personal Protective Equipment (PPE)
Ballistic vests, helmets, shields – materials and manufacturing, Stab and blast resistant clothing, Riot gear and tactical suits, Standards: NIJ, STANAG, IS codes

Unit 3: Vehicle Protection Systems
Armoring of military and VIP vehicles, Design of MRAPs, blast seats, and underbody protection, Transparent armor: bulletproof glass and visors, Add-on and reactive armor systems

Unit 4: Infrastructure and Perimeter Protection
Blast-proof bunkers and shelters – structural design, Perimeter security: fences, intrusion sensors, drones, Access control, surveillance systems, and automated countermeasures

Unit 5: Advanced & Smart Protection Technologies
Exoskeletons and wearable robotics, Active protection systems (APS): Trophy, Iron Fist, Drone detection and counter-UAV systems, AI-based threat detection and emergency response systems

Textbook

1. *Personal Protective Equipment: Design, Material and Technologies* – Joseph R. Davis
2. *Armor and Protection Systems* – R.K. Arora

Reference Books

- *Modern Ballistic Armor* – L. J. Arnold
- *Protective Relaying and Infrastructure Defense* – J. Lewis Blackburn
- *Blast Protection of Civil Infrastructures and Vehicles* – A. G. Malvar
- DRDO Publications and DRTC Lecture Notes on Protective Systems
- IS/NIJ/STANAG specifications and defense procurement guidelines

Online Resources

- https://drdo.gov.in – DRDO Official Site
- https://bis.gov.in – Bureau of Indian Standards
- NPTEL modules on material science, structural protection, smart systems
- YouTube: DRDO labs, Military Tech, PPE testing videos
- Coursera/edX: Courses on smart wearables, armor design, structural protection

Evaluation Scheme

Component	Marks	Description
Mid Term Test	20+20	Subjective Test
Teacher's Assignment	10	Assignment, MCQ,Viva
End Semester Examination	50	Descriptive 3-hour written exam