SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR – 440013

An Institute with Empowered Autonomy status
Affiliated to Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur, and Maharashtra
(INDIA)

PROGRAMME SCHEME & SYLLABI

of First Year as per National Education Policy (NEP)
(With effect from Academic Year 2023-24)

B. Tech. (MECHANICAL ENGINEERING)
2023-24

Published By

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Principal

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ISO 9001: 10035 CERTIFIED ORGANISATION

Department Vision (Revision in progress)

Department of Mechanical Engineering aims to inculcate in students, a flair for excellence to become technological leader in industry and society.

Department Mission (Revision in progress)

1. To create the learning environment that stimulates students & faculty to enhance the knowledge in Mechanical Engineering.
2. To prepare the students to carry out research intended to cater the needs of the industry and society.
3. To march ahead with dedication, zeal and with a system responsive to the needs of all the stakeholders.

Program Educational Objectives (Revision in progress)

1. The graduates shall be capable to accept challenges in engineering industries.
2. The graduates shall demonstrate core competency to design, analyze and evaluate various engineering systems.
3. The graduates shall be able to apply computational and professional skills in corporate world.
4. The program shall prepare the graduates for higher studies, entrepreneurship and create awareness about lifelong learning.

Program Outcomes

Engineering Graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of Mathematics, Science, Engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, Formulate, Review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
4. **Conduct investigation of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select and apply appropriate techniques resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentations, make effective presentations, and give and receiveclear instructions.
11. **Project management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team to manage projects and in multidisciplinary environment.
12. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes (Revision in progress)

1. Graduates will stand for design, production and operations in core mechanical domain andmanagement of interdisciplinary applications.
2. Graduates will be capable of carrying out the analysis of mechanical and allied systems and provide numerical and computer based solution.

Scheme of Teaching & Examination of Bachelor of Technology
(Mechanical Engineering)
Semester - I

Sr. No.	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	BSC	PHT1005	Physics for Mechanical Engineering	2	1	0	3	50	50	100	3
2	BSC	PHP1005	Physics for Mechanical Engineering Lab	0	0	2	1	25+25	-	50	-
3	BSC	MAT1001	Applied Mathematics - I	2	1	0	3	50	50	100	3
4	BSC	MAP1001	Computational Mathematics Lab	0	0	2	1	25+25	-	50	-
5	ESC	MET1001	Mechanical Marvels	1	0	0	1	50	50	100	1*
6	ESC	MET1002	Engineering Mechanics	3	0	0	3	50	50	100	3
7	ESC	MET1003	Engineering Graphics	2	0	0	2	50	50	100	3
8	VSEC	MEP1003	Engineering Graphics Lab	0	0	4	2	50+50	-	100	-
9	AEC-1	HUT1002	English for Professional Communication	2	0	0	2	50	50	100	2
10	AEC-1	HUP1002	English for Professional Communication Lab	0	0	2	1	25+25	-	50	-
11	CCA	HUP0001-1 to 10/ PEP0001-21 to 22/ CHP0001-31 to 32	Liberal/Performing Art	0	0	2	1	25+25	-	50	-
12	VEC	HUT1004	Foundational Course in Universal Human Values	1	0	0	1	50	-	50	1*
			Total	**13**	**2**	**12**	**21**			**950**	

NOTE: Liberal/Performing Art - To be selected from the basket of Liberal/Performing Art.

Sr. No.	Course Code	Course Name	Department
1	HUP0001-1	Fundamentals of Indian Classical Dance: Bharatnatayam	Humanities
2	HUP0001-2	Fundamentals of Indian Classical Dance: Kathak	Humanities
3	HUP0001-3	Introduction to Digital Photography	Humanities
4	HUP0001-4	Introduction to Japanese Language and Culture	Humanities
5	HUP0001-5	Art of Theatre	Humanities
6	HUP0001-6	Introduction to French Language	Humanities
7	HUP0001-7	Introduction to Spanish Language	Humanities
8	HUP0001-8	Art of Painting	Humanities
9	HUP0001-9	Art of Drawing	Humanities
10	HUP0001-10	Nature camp	Humanities
11	PEP0001-21	Disaster Management through Adventure Sports	Physical Education
12	PEP0001-22	Self-defence Essentials and Basics Knowledge of Defence Forces	Physical Education
13	CHP0001-31	Art of Indian Traditional Cuisine	Chemistry
14	CHP0001-32	Introduction to Remedies by Ayurveda	Chemistry

Scheme of Teaching & Examination of Bachelor of Technology
(Mechanical Engineering)
Semester - II

Sr. No.	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	BSC	CHT2004	Chemistry for Mechanical Engineers	2	0	0	2	50	50	100	3
2	BSC	CHP2004	Chemistry Lab for Mechanical Engineers	0	0	2	1	25+25	-	50	-
3	BSC	MAT2001	Applied Mathematics - II	2	1	0	3	50	50	100	3
4	PCC	MET2001	Thermal and Fluid Sciences	3	0	0	3	50	50	100	3
5	PCC	MET2002	Theory of Mechanisms & Elasticity	3	0	0	3	50	50	100	3
6	ESC	EET2004	Basics of Electrical Systems	2	0	0	2	50	50	100	2
7	ESC	MET2003	Programming for Problem Solving	1	0	0	1	50	-	50	-
8	ESC	MEP2003	Programming for Problem Solving Lab	0	0	2	1	25+25	-	50	-
9	IKS	HUT2001	Foundational Literature of Indian Civilization	2	0	0	2	50	50	100	2
10	VSEC	MET2004	Fab Lab - I	1	0	0	1	50	50	100	1*
11	VSEC	MEP2004	Fab Lab - I	0	0	2	1	25+25	-	50	-
12	CCA	PET2001	Sports-Yoga-Recreation	1	0	0	1	25+25	-	50	-
13	CCA	PEP2001	Sports-Yoga-Recreation Lab	0	0	2	1	25+25	-	50	-
			Total	**17**	**1**	**8**	**22**			**1000**	

Exit option 1 : Finishing School Certificate for a UG certificate course on Industry 4.0 Technologies			
In association with TATA-Technologies Ltd (Additional 8 Credits)			
1		Certificate courses in association with TATA-Technologies Ltd on	Offline certification Course offered by RCOEM-TATA-CIIIT (RTC)
	RTC01	Basics of Solid Modeling	13 Hrs. -1 Credit each (any 8 to be selected)
	RTC02	3-D Printing	
	RTC03	Reverse Engineering	
	RTC04	Multi Body Dynamics (MBD)	
	RTC05	Internet of Things	
	RTC06	CNC Operations and Programming	
	RTC07	Finite Element Analysis	
	RTC08	Manufacturing Execution System	
	RTC09	Robotic Welding	
	RTC10	AutoCAD Drafting	
	RTC11	Profile engraving and Laser cutting (SIL)	
	RTC12	Electro Discharge Machining (P 20)	
	RTC13	Solar Technician	
	RTC14	Computer proficiency	
OR			
2	RTC15	One Month Internship at Industry	As prescribed by Industry
OR			
3	RTC16	Project Work (one month)	As prescribed by Industry/Institute

Scheme of Teaching & Examination of Bachelor of Technology
(Mechanical Engineering)
Semester III

Sr. No	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MDM	MAT3001	Statistics for Engineers	2	0	0	2	50	50	100	2
2	MDM	MAP3001	Statistics for Engineers	0	0	2	1	25+25	-	50	-
3	PCC	MET3001	Material Science and Testing	2	0	0	2	50	50	100	2
4	PCC	MEP3001	Material Science and Testing Lab	0	0	2	1	25+25	-	50	-
5	PCC	MEP3002	Machine Drawing and CAD Lab	0	0	4	2	25+25	-	50	-
6	PCC	MET3003	Manufacturing Engineering	3	0	0	3	50	50	100	3
7	VSEC	MEP3004	Fab Lab-II	0	0	4	2	25+25	-	50	-
8	OE	MET2980	Open Elective-I **OR** MOOC Course	2	0	0	2	50	50	100	2
9	MGT	HUT3005	Engineering Economics	2	0	0	2	50	50	100	2
10	FP	MEP3005	Field Project- Rural Technology	0	0	4	2	25+25	-	50	-
11	VEC	CHT3001	Environmental Science	2	0	0	2	50	50	100	-
			Total	**13**	**0**	**16**	**21**			**800**	

Open Elective - I	
Course Code	**Course Name**
MET2980-1	Facilities Planning
MET2980-2	Product Design and 3D Printing
MET2980-3	Mechanical Engineering in Daily Life

Scheme of Teaching & Examination of Bachelor of Technology (Mechanical Engineering)

Semester IV

Sr. No.	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MDM	MAT4001	Numerical Methods	2	0	0	2	50	50	100	2
2	MDM	MAP4001	Numerical Methods Lab	0	0	2	1	25+25	-	50	-
3	PCC	MET4001	Mechanics of Solids	3	0	0	3	50	50	100	3
4	PCC	MET4002	Kinematics & Dynamics of Machinery	3	0	0	3	50	50	100	3
5	PCC	MEP4002	Kinematics & Dynamics of Machinery Lab	0	0	2	1	25+25	-	50	-
6	PCC	MET4003	Fluid Dynamics and Hydraulic Machines	3	0	0	3	50	50	100	3
7	PCC	MEP4003	Fluid Dynamics and Hydraulic Machines Lab	0	0	2	1	25+25	-	50	-
8	PCC	MET4004	Heat Transfer	3	0	0	3	50	50	100	3
9	PCC	MEP4004	Heat Transfer Lab	0	0	2	1	25+25	-	50	-
10	OE	MET2990	Open Elective-II **OR** MOOC Course	3	0	0	3	50	50	100	3
			Total	**17**	**0**	**8**	**21**			**800**	

Open Elective - II	
Course Code	**Course Name**
MET2990-1	Total Quality Management
MET2990-2	Project Management
MET2990-3	CAD-CAM

Exit option 2: Finishing School for a UG Diploma course of Machining Supervisor			
In association with TATA-Technologies Ltd. (Additional 8 Credits)			
	1	A course for Certified Machining Supervisor	Offline certification Course
OR	2	Prescribed Courses for Machining Supervisor	Online certification Course
OR	3	One Month Internship at Industry	As prescribed by Industry

Scheme of Teaching & Examination of Bachelor of Technology (Mechanical Engineering)

Semester V

Sr. No.	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MDM	MET5001	Robotics and Mechatronics	3	0	0	3	50	50	100	3
2	MDM	MEP5001	Robotics and Mechatronics Lab	0	0	2	1	25+25	-	50	-
3	PCC	MET5002	Design of Machine Elements	3	0	0	3	50	50	100	3
4	PCC	MEP5002	Design of Machine Elements Lab	0	0	2	1	25+25	-	50	-
5	PCC	MET5003	Manufacturing Technology	3	0	0	3	50	50	100	3
6	PCC	MEP5003	Manufacturing Technology Lab	0	0	2	1	25+25	-	50	-
7	PCC	MET5004	Instrumentation and control	3	0	0	3	50	50	100	3
8	PCC	MEP5004	Instrumentation and control Lab	0	0	2	1	25+25	-	50	-
9	PSE	MET5005	Program Specific Elective-I (List Specified)	3	0	0	3	50	50	100	3
10	OE	MET3980	Open Elective-III OR MOOC Course	3	0	0	3	50	50	100	3
			Total	**18**	**0**	**8**	**22**	**500**	**300**	**800**	

Program Specific Elective – I			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET5005-1	Mechanical Electrical & Plumbing	MET5005-6	Digital Twins & Cyber Physical Systems
MET5005-2	Automotive Powertrains	MET5005-7	Machine Learning for Mechanical Engineering
MET5005-3	Advanced Materials & Composites	MET5005-8	Ancient Indian Machines
MET5005-4	Manufacturing Execution Systems	MET5005-9	Defense Platforms
MET5005-5	Data Visualization Tools		

Open Elective - III	
Course Code	**Course Name**
MET3980-1	Electric Vehicle Technology
MET3980-2	Robotics and Drone Technology
MET3980-3	Heating Ventilation & Air-Conditioning

Scheme of Teaching & Examination of Bachelor of Technology (Mechanical Engineering)

Semester VI

Sr. No.	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MDM	MET6001	Robotic Process Automation	2	0	0	2	50	50	100	2
2	PCC	MET6002	Computer Aided Engineering	3	0	0	3	50	50	100	3
3	PCC	MEP6002	Computer Aided Engineering Lab	0	0	2	1	25+25	-	50	-
4	PCC	MET6003	Applied Thermal Engineering	3	0	0	3	50	50	100	3
5	PCC	MEP6003	Applied Thermal Engineering Lab	0	0	2	1	25+25	-	50	-
6	PCC	MET6004	Product Innovation and Entrepreneurship OR Patent Filing/Appling linked to TBI	2	0	0	2	50	50	100	3
7	PSE	MET6005	Program Specific Elective-II (List specified)	3	0	0	3	50	50	100	3
8	PSE	MEP6005	Program Specific Elective-II Lab (List specified)	0	0	2	1	25+25	-	50	-
9	PSE	MET6006	Program Specific Elective-III (List specified)	3	0	0	3	50	50	100	3
9	PSE	MEP6006	Program Specific Elective-III Lab (List specified)	0	0	2	1	25+25	-	50	-
10	VSEC	MEP6007	Object oriented Programming (Skill Based Course) OR Industry based Mini Project (working Model) with Seminar	0	0	4	2	50	50	100	2
			Total	**19**	**0**	**6**	**22**			**850**	

Program Specific Elective – II with Lab			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET6005-1	3-D Printing & Additive Manufacturing	MEP6005-1	3-D Printing & Additive Manufacturing Lab
MET6005-2	Renewable Energy Systems	MEP6005-2	Renewable Energy Systems Lab
MET6005-3	Human Machine Interface	MEP6005-3	Human Machine Interface Lab
MET6005-4	Drone & Electric Vehicle Technology	MEP6005-4	Drone & Electric Vehicle Technology Lab
MET6005-5	Warfare system	MEP6005-5	Warfare system Lab

Program Specific Elective – III with Lab			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET6006-1	Synthesis of Mechanisms	MEP6006-1	Synthesis of Mechanisms Lab
MET6006-2	Automated System Integration	MEP6006-2	Automated System Integration Lab
MET6006-3	Industrial Internet of Things	MEP6006-3	Industrial Internet of Things Lab
MET6006-4	Hydraulics & Pneumatics	MEP6006-4	Hydraulics & Pneumatics
MET6006-5	Relational DBMS	MEP6006-5	Relational DBMS Lab
MET6006-6	Automotive Mechanics	MEP6006-6	Automotive Mechanics
MET6006-7	Human Factors in Engineering	MEP6006-7	Human Factors in Engineering Lab

Exit option 3 : Finishing school for B. Voc. Degree for a course on A Graduate/Trainee Mechanical Engineer			
In association with TATA-Technologies Ltd (Additional 8 Credits)			
	1	A course for B. Voc. Degree in Mechanical Engineering	Offline certification Course
OR	2	Prescribed Courses for B. Voc. Degree in Mechanical Engineering	Online certification Course
OR	3	One Month Internship at Industry	As prescribed by Industry

Scheme of Teaching & Examination of Bachelor of Technology (Mechanical Engineering)

Semester VII

Sr. No.	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	MDM	MET7001	PLC & Industrial Control System	2	0	0	2	50	50	100	2
2	MDM	MEP7001	PLC & Industrial Control System	0	0	2	1	25+25	-	50	-
3	PCC	MET7002	Applied Thermal Engineering	3	0	0	3	50	50	100	3
4	PCC	MEP7002	Applied Thermal Engineering Lab	0	0	2	1	25+25	-	50	-
5	PSE	MET7003	Program Specific Elective-IV (List specified)	3	0	0	3	50	50	100	3
6	PSE	MET7004	Program Specific Elective-V (List specified)	3	0	0	3	50	50	100	3
7	PSE	MEP7004	Program Specific Elective-V Lab (List specified)	0	0	2	1	25+25	-	50	-
8	PSE	MET7005	Program Specific Elective-VI (List specified)	3	0	0	3	50	50	100	3
9	PSE	MEP7005	Program Specific Elective-VI Lab (List specified)	0	0	2	1	25+25	-	50	-
10	PBL	MEP7006	**Project -II**	0	0	8	4	100	100	200	3
			Total	**15**	**0**	**14**	**22**			**900**	

Program Specific Elective-IV			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET7003-1	Artificial Intelligence	MET7003-7	Power Plant Engineering
MET7003-2	Micro Fluidics	MET7003-8	Six Sigma Management
MET7003-3	Micromachining	MET7003-9	Motion Control Systems
MET7003-4	Wealth Creation & Management	MET7003-10	Elements of Marine Engineering
MET7003-5	Armament Technology in Defence	MET7003-11	Space Technology
MET7003-6	Introduction to Corporate Law Practice	MET7003-12	Standards and Certification Processes

Program Specific Elective – V with Lab			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET7004-1	Augmented Reality & Virtual Reality	MEP7004-1	Augmented Reality & Virtual Reality Lab
MET7004-2	Computational Fluid Dynamics	MEP7004-2	Computational Fluid Dynamics Lab
MET7004-3	Supply Chain Management	MEP7004-3	Supply Chain Management Lab
MET7004-4	Industrial Robotics	MEP7004-4	Industrial Robotics Lab
MET7004-5	Operations Research & Optimization	MEP7004-5	Operations Research & Optimization Lab
MET7004-6	Unmanned Aerial Systems (UAS)	MEP7004-6	Unmanned Aerial Systems (UAS) Lab
MET7004-7	Enterprise Resource Planning	MEP7004-7	Enterprise Resource Planning Lab
MET7004-8	National Accreditation Board for Testing and Calibration Laboratories	MEP7004-8	National Accreditation Board for Testing and Calibration Laboratories Course Lab
MET7004-9	Non-Destructive Testing	MEP7004-9	Non-Destructive Testing Lab

Program Specific Elective - VI with Lab			
Course Code	**Course Name**	**Course Code**	**Course Name**
MET7005-1	Product Lifecycle Engineering	MEP7005-1	Product Life Cycle Engineering Lab
MET7005-2	Refrigeration & Air Conditioning	MEP7005-2	Refrigeration & Air Conditioning Lab
MET7005-3	Stress Analysis	MEP7005-3	Stress Analysis Lab
MET7005-4	Field and Service Robots	MEP7005-4	Field and Service Robots Lab
MET7005-5	Noise Vibration & Harshness	MEP7005-5	Noise Vibration & Harshness Lab
MET7005-6	Work System Design	MEP7005-6	Work System Design Lab

Scheme of Teaching & Examination of Bachelor of Technology
(Mechanical Engineering)
Semester VIII
Semester VIII Level 6.0 (B. Tech. in Mechanical Engineering with Multi-disciplinary Minor)

Sr. No.	Course Type	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	PSE	MET8001	Occupational Health & Safety OR MOOC courses	3	0	0	3	50	50	100	3
2	PSE	MET8002	Multi-criteria Decision Making OR MOOC Courses	3	0	0	3	50	50	100	3
3	PBL	MEP8003	**Project -III**	0	0	12	6	100	100	200	3
			Total	**6**	**0**	**12**	**12**			**400**	
			OR								
1	ELC	MET8004	Research Methodology **OR** Research Paper Publication in WoS/SCOPUS/SCI Journal	4	0	0	4	50	50	100	3
2	ELC	MEP8005	Full Semester Research Internship at the Institute	0	0	16	8	100	100	200	-
			Total	**4**	**0**	**16**	**12**			**300**	
			OR								
1	ELC	MEP8006	TBI Internship	0	0	24	12	100	100	200	-
			OR								
1	ELC	MEP8007	Full Semester Industry Internship	0	0	24	12	100	100	200	-
						24	**12**			**400**	

*** For Online MOOC Courses only the SWAYAM portal is allowed**

Semester VIII Level 6.0 (B. Tech. in Mechanical Engineering Honors with Multi-disciplinary Minor)

(The Student will take honor courses of additional 18 credits, over and above 160 minimum credits.)

Scheme of Teaching & Examination of Bachelor of Technology Honors Specialization (Mechanical Engineering) Honors Courses

Semester	Course Code	Name	L	T	P	Cr
III	METH3100	Geometric Dimensioning and Tolerance	2	0	2	3
IV	METH4100	Mechanical Estimation and Costing	2	0	2	3
V	METH5100	Integrated Advanced Manufacturing	3	1	0	4
VI	METH6100	Advanced Heat and Mass Transfer	3	1	0	4
VII	METH7100	Design of Mechanical Systems	3	0	2	4
		Total	**13**	**2**	**6**	**18**

Semester VIII Level 6.0 (B. Tech. in Mechanical Engineering Honors with Research & Multi-disciplinary minor)

(The Student will take research project in **semester VII & VIII of additional 18 credits**, over and above 160 minimum credits.)

Semester	Course Code	Name	L	T	P	Cr
VII	MEPR8001-1	Research Project Phase – I	0	0	12	6
VIII	MEPR8001-2	Research Project Phase – II	0	0	24	12
		Total	**0**	**0**	**36**	**18**

Semester VIII Level 6.0 (B. Tech. in Mechanical Engineering with double minor & multi-disciplinary minor)

(The student will take additional minor courses of 18 credits in another Engineering discipline**, over and above 160 minimum credits.)**

Scheme of Teaching & Examination of Bachelor of Technology Minors Specialization (Mechanical Engineering)

Semester	Course Code	Name of the course	L	T	P	Cr
III	METM3100	Elements of Mechanical Engineering	3	0	0	3
IV	METM4100	Additive Manufacturing	3	0	0	3
V	METM5100	CNC Programming & Operations	4	0	0	4
VI	METM6100	Energy Systems	4	0	0	4
VII	METM7100	Product Lifecycle Management (PLM)	4	0	0	4
		Total	**18**	**0**	**0**	**18**

Scheme of Teaching & Examination for Bachelor of Technology
List of Multi-Disciplinary Minors (MDM) - **Automation**
(Mechanical Engineering)

Semester	Code	Name of the course	L	T	P	Cr
III	MAT3001	Statistics for Mechanical Engineering	2	0	0	2
III	MAP3001	Statistics for Mechanical Engineering Lab	0	0	2	1
IV	MET4001	Numerical Methods	1	0	0	1
IV	MET4001	Numerical Methods Lab	0	0	2	1
V	MAT5001	Robotics and Mechatronics	2	0	0	2
V	MAP5001	Robotics and Mechatronics Lab	0	0	2	1
VI	MET6001	Robotic Process Automation	3	0	0	3
VII	MET7001	PLC & Industrial Control System	2	0	0	2
VII	MEP7001	PLC & Industrial Control System	0	0	2	1
		Total	**10**	**0**	**8**	**14**

Semester I

Department of Mechanical Engineering

Course Code: PHT1005 **Course: Physics for Mechanical Engineering**

L:2 Hrs.,T:1Hrs.,P:0Hrs.,Per week **Total Credits : 3**

Course Objectives

1. To train the student to work with oscillatory phenomenon and with optical devices such as lasers, optical fibers.
2. To introduce fundamental concepts of modern physics, nanotechnology, acoustics and ultrasonic.

Course Outcomes

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

1. Apply oscillatory phenomenon to various oscillating systems.
2. Apply laser light for various applications.
3. Implement theory of quantum physics to nanomaterial's, its characterization,to the theory of semiconductors and solar cell.
4. Explain the basic principles of architectural acoustics and ultrasonic.
5. Explain the working of aerodynamic objects placed in fluid stream.

Module1: Oscillations (6L)

Damped and forced harmonic oscillations: Differential equation for damped and forced oscillations, LCR circuit (qualitative), electrical resonance, Numerical problems.

Module2: Lasers (6L)

Lasers: Laser Characteristics, Spatial and Temporal Coherence, Einstein Coefficient and its significance, Population inversion, Two, three and four level pumping schemes, Threshold gain coefficient, Components of laser, Ruby laser, Gas Laser (CO_2, He-Ne), Nd-YAG, Fiber Laser and Dye laser and their engineering applications. Numerical problems.

Module 3: Quantum mechanics & Nanosize Effects (8L)

Matter waves, Group velocity and phase velocity, Heisenberg's Uncertainty principle and its application, one dimensional Time Independent Schrodinger's wave equation (TISWE). Its applications to Infinite potential well and Tunneling, Nano size effects. Applications of TISWE to characterization of nanomaterials.

Module 4: Semiconductors and Solar Cell (7L)

Band theory of solids, Valence band, Conduction band, intrinsic semiconductors, doping, extrinsic semiconductors, PN junction diode, Solar cell: IV characteristics, Conversion efficiency.

Module 5: Architectural Acoustics and Ultrasonics (8L)

Architectural Acoustics: Absorption, Reverberation and time of reverberation, Sabine's formula (Mention the expression), Factors affecting acoustics of a building and their remedies.

Ultrasonics: Introduction, Principle, Measurement of ultrasonic velocity in liquids and other applications.

Module 6: Aeronautics Physics (7L)

Real world applications: Smart Skies, Mobile Accelerometers, Parachutes, Helicopters, Numericals on Drag & Lift Forces, Parachute Design.

Text Book(s):

1. The Physics of vibrations and waves by H.J. Pain Sixth edition, John Wiley & Sons.
2. Engineering Physics by M.N. Avadhanulu and Kshirsagar S. Chand Publication

References:

1. Applied Physics by S. Jain, G. G. Sahasrabudhe and S. M. Pande, Universities Press 2013.
2. Optics, Ajoy Ghatak, Tata McGraw Hill Education 2005.

Semester I

Department of Mechanical Engineering

Course Code: PHP1005 **Course: Physics for Mechanical Engineering Lab**

L: 0Hrs.T: 0Hrs.P: 2Hrs. Per week **Total Credits: 1**

Course Outcomes

The Physics Laboratory course will consist of experiments illustrating the principles of physics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in physics laboratory and draw valid conclusions.

Course Outcomes

After successful completion of the course students will be able to

1. Prepare for measurements used in various experiments and analyse errors involved in the measurements.
2. Explore various methods for finding experimental parameters.
3. Acquire the experimental and graph plotting skills.
4. Prepare laboratory reports on the experimental results.
5. Identify principle involved in an experiment.

List of Experiment:

1. Error analysis and graph plotting.
2. Study of Ohm's law.
3. Study of Oscillations.
4. To find magnetic field by deflection magnetometer.
5. To find wavelength of laser light by diffraction grating.
6. Study of total internal reflection using Laser source.
7. Determination of velocity of sound in liquid–standing ultrasonic waves.
8. Data analysis using Mathematica.
9. Study of VI characteristics of Diode.
10. Current Voltage (I-V) characteristics of Solar cell.
11. Study of Hall Effect.
12. Demo experiment on Spectroscopy.
13. Optical Flatness of a surface.
14. Study of Aerofoil Shapes.

Suggested References

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

Semester I
Department of Mechanical Engineering

Course Code: MAT1001 **Course Name: Applied Mathematics I**
L: 2Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits: 03**

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:

1. 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.
2. Solve higher order ordinary differential equations with constant and variable coefficients.
3. Find best fit curve by method of least square method and calculate correlation, regressions.
4. Recognize and understand discrete, continuous probability distributions and apply Binomial distribution, Poisson distribution and Normal distribution to appropriate problems.
5. Internalize multivariable calculus and apply it find Jacobians, maxima and minima of function / Solve numerical integrations by Newton coat formulas and Gauss-Legendre Quadrature.

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 parabolas and 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, Euler's Theorem, chain rule, total derivative, Jacobians, Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 5: **Probability:** (8 hours) (**For All Branches except Mechanical Branch**)

Probability spaces, conditional probability, independence, Bay's Theorem, Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

OR

Module 5: Numerical Integration (8 hours***)*** (**Only for Mechanical Branch**)

Simpson's 1/3rd rule, 3/8th rule, Trapezoidal rule, Gauss-Legendre Quadrature.

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: 2nd Ed: J*. R. Spiegal, Schaum series.*
8. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India).
9. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Semester I
Department of Mechanical Engineering

Course Code: MAP1001 **Course: Computational Mathematics Lab**

L: 0 Hrs., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits: 1**

Course Objectives:

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

Proposed Course Outcomes:

By using open-source software Sage Math Students will be able to

CO1: Download Sage Math and use it as an advance calculator.

CO2: Sketch and analyze function graphs.

CO3: Apply the concepts of differential calculus to find extreme value of continuous functions and analyze solutions of differential equations

CO4: Evaluate improper integrals and its applications to find length, area, volume, centre of gravity and mass.

CO5: Analyze and calculate Eigen values, Eigen vectors, rank nullity, and solve system of linear equations of a matrix / linear map.

CO6: Analyze the data to find best fit curve.

Mapping of Course outcomes (COs) with Experiments

Exp. No.	Name of Experiments	Mapped COs
1	To use SageMath as advanced calculator	CO1
2	2D Plotting with SageMath	CO2
3	3D Plotting with SageMath	CO2
4	Differential Calculus with SageMath	CO3
5	Solution of differential equations in SageMath	CO3
6	Basics of Linear Algebra	CO5
7	Curve Fitting by using SageMath	CO6
8	Integral Calculus with SageMath	CO4

Semester I

Department of Mechanical Engineering

Course Code: MET1001 **Course: Mechanical Marvels**

L: 1 Hrs, T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 1**

Course Objective:

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

Course Outcomes:

1. **To know about the evolution of Mechanical Engineering as a discipline.**
2. **To develop awareness about latest trends in Mechanical Engineering.**

Syllabus:

Progression in Mechanical Engineering from Ancient to Modern, Mechanical Engineering in day to day life, Technical Disruptions, Cutting edge technologies in Mechanical Engineering Like Drone, Robots, Electric vehicles, UAS, Space Technology, Defence Technology, Marine Technology, Future Fuels, Advanced Materials , green manufacturing, modern machines and infrastructure etc.

Semester I

Department of Mechanical Engineering

Course Code: MET1002 **Course: Engineering Mechanics**

L: 3 Hrs, T: 0 Hr., P: 0 Hrs Per Week **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 the system of forces and their effects on machine element.

2. Analyze the trusses and understand the importance of friction concept.

3. Understand the physical significance of Center of Gravity, Centroid and Moments of Inertia

4. Apply the knowledge of Kinematics and Kinetics of a Particle

5. Evaluate the system by Work and Energy principle as well as Impulse and Momentum principle

6. Understand and apply the concepts of **Kinematics of a Rigid Body in real life**

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.

Unit 2: Trusses and Friction

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

Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, Problems Involving Dry Friction in various applications, Rolling friction.

Unit 3: Center of Gravity, Centroid and Moments of Inertia

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.

Unit 4: Kinematics and Kinetics of a Particle

Rectilinear Kinematics, General Curvilinear Motion, Motion of a Projectile, Newton's Second Law of Motion and its application, Force and Acceleration

Unit 5: Kinetics of particle by Work and Energy principle and Impulse and Momentum

The Work of a Force, Principle of Work and Energy, Power and Efficiency, Principle of Linear Impulse and Momentum, Angular Momentum, Relation Between Moment of a Force and Angular Momentum, Principle of Angular Impulse and Momentum.

Unit 6: Kinematics of a Rigid Body

Introduction to Kinetics of Rigid bodies; Kinetics of rigid body rotation, Circular motion of rigid bodies, Kinetics of rolling bodies.

Text Books

1. Bansal R.K. (10030), A Text Book of Engineering Mechanics, Laxmi Publications

2. S.S. Bhavikatti (10037), Engineering Mechanics, New Age Publications

3. A.K. Sharma, Fundamental of Engineering Mechanics, Sai Publications

Reference Books

1. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, Pearson Educations, Forth

edition, 2003.

2. Beer and Johnston, Vector Mechanics for Engineers, Vol.1 “Statics” and Vol.2 “Dynamics,

McGraw Hill International Edition, 1995.

3. SuhasNitsure, Engineering Mechanics, Technical Publications, Pune, 2007.

4. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

5. S.S. Deo, (10037), Engineering Mechanics, Nirali Publications.

Semester I

Department of Mechanical Engineering

Course Code: MET1003 **Course: Engineering Graphics**

L: 2Hr., T: 0Hrs. P: 0 Hrs., Per week **Total Credits: 2**

Course Outcomes:

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

1. Draw and interpret technical drawings
2. Convert 2-D to 3-D drawing and vice versa.
3. Represent the various positions of planes and solids in different orientations.
4. 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, First & Third angle projection methods. Orthographic Projections: 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: Projections of Solids: Projections of regular solids inclined to both the Planes (including Auxiliary Views) – Prism, Pyramid, Cylinder, Cone.

UNIT 5: Sections of Solids and Development of Surfaces: Sections of Solids - Prism, Pyramid, Cylinder, Cone and Development of lateral surfaces of solids.

UNIT 6: Isometric Projections: Principles of Isometric projection - Isometric Scale, Isometric View, and Conversion of Orthographic views to Isometric Views / Projection.

Text Books:

1. Engineering Drawing by N.D. Bhatt, Charotar Publishing House Pvt. Ltd.
2. Engineering Drawing with an Introduction to AutoCAD" by D. A. Jolhe Tata McGraw Hill Publications
3. Engineering Drawing by R.K. Dhawan, S. Chand Publications
4. 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

Department of Mechanical Engineering

Course Code: MEP1003 **Course: Engineering Graphics Lab**

L: 0 Hrs. T: 0 Hrs. P: 4 Hrs. Per week **Total Credits: 2**

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:

1. Draw and interpret technical drawings.
2. Plan the sheet layout for the given drawing.
3. Convert 2-D to 3-D drawing and vice versa
4. Represent the various positions of planes and solids in different orientations.
5. Develop the solid surface for sheet metal working
6. 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
4	Projection of Planes
5	Projections of Solids
6	Section of solids and Development of surfaces
7	Isometric projection

Suggested Text/ Reference Books:

i. Bhatt N.D. Panchal V.M. & Ingle P.R., Engineering drawing, Charotar Publiishing house.
ii. Jolhe D.A., Engineering drawing with an Introduction to Auto CAD", Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
iii. Shah M.B. & Rana B.C., Engineering drawing and Computer Graphic, Pearson Education.
iv. Agarwal B & Agarwal C.M. Engineering Graphics, TMH PUBLICATION.
v. Narayana K.L & P Kannaiah, Text Book on Engineering Drawing, Scitech Publishers.
vi. (Corresponding set of) CAD Software Theory and USER Manuals.

Semester I

Department of Mechanical Engineering

Course Code: HUT1002 **Course: English for Professional Communication**
L: 2 Hrs.T:0 Hrs. P: 0 Hrs. Per weeks **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 I

Department of Mechanical Engineering

Course Code: HUP1002 Course: English for Professional Communication Lab
L: 0Hrs.T: 0Hrs.P: 2Hrs. Per week 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. Analyse and apply the effective strategies for Personal Interviews
CO5. Implement essential language skills- listening, speaking, reading, and writing

Syllabus
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 I
Department of Mechanical Engineering
Course: Liberal/Performing Art Courses

Course Code: HUP0001-1 Course Name: Fundamentals of Indian Classical Dance: Bharatnatayam
L: 0 hr, T: 0 hr, P: 2 hrs per week Total Credits: 01

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 skills to perform the dance form at its basic level.
CO3: Evaluate their strengths and interest to take bridge course to give *Pratham* (1st level formal exam of Bharatnatayam).

Syllabus
Practical -1: Orientation in Bharatnatayam
Practical-2: Tattu Adavu till 8, Naatta Adavu 4 Steps, Pakka Adavu 1 step, Metta Adavu 1 Step, Kuditta Metta 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

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Course Code: HUP0001-2 Course Name: Fundamentals of Indian Classical Dance: Kathak
L: 0 hr, T: 0 hr, P: 2 hrs per week Total Credits: 01

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

Course Outcomes

On completion of the course, students will be able to achieve the following:
CO1: Understand the importance of dance and Kathak as an Indian dance form
CO2: Develop skills to perform the dance form at its basic level.
CO3: Evaluate their strengths and interest to take bridge course to give *Prarambhik* (1st level formal exam of Kathak).

Syllabus
Practical -1: Orientation in Kathak. Correct posture of kathak, Basic Movements and exercise Stepping, Chakkar of 5 counts (Bhramari),
Practical -2: practice sessions of practical 1
Practical -3: Hastaks, Hastaks and Steppings, Reciting asamyukta Mudra shloka, Hastak and steppings
Practical -4: practice sessions of practical 3
Practical -5: Todas and Asamyukta hasta mudra shlok, Vandana of Shlok, 2 Todas and Vandana, Ghante Ki Tihai,
Practical -6: practice sessions of practical 5
Practical -7: 2 1 Chakkardar Toda and Ginnti Ki Tihai, 2 Todas and 1 Chakkardar Toda, practice sessions
Practical -8: Final performances.

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

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Course Code: HUP0001-3 **Course Name: Introduction to Digital Photography**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

Course objective
The course aims to develop basic skills of students in digital photography 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: Develop an understanding of the technical aspects and aesthetics of Photography. CO2: Apply the rules of digital photography for creating photographs.
CO3: Develop skills to enhance photographs through post processing.
CO4: Create a portfolio of their photographs in selected genre.

Syllabus
Practical 1: **Orientation in digital photography:** Genres, camera handling and settings
Practical 2: **Rules of Composition**
Practical 3: **Rules of Composition**: practice sessions
Practical 4: **Understanding Exposure and Art of Pre-Visualization**
Practical 5: **Rules of Composition and Art of Pre-Visualization:** practice sessions
Practical 6: **Post Processing Photographs and Portfolio creation**
Practical 7: **Post Processing Photographs:** practice sessions
Practical 8: **Portfolio finalization and presentation in selected genre.**

Reference material

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

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Course Code: HUP0001-4 **Course Name: Introduction to Japanese Language and Culture**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

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 to write 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)

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Course Code: HUP0001-5 **Course Name: Art of Theatre**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

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.

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Course Code: HUP0001-6 **Course Name: Introduction to French Language**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

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 India and France
CO2. Learn to use simple language structures in everyday communication.
CO3. Develop ability to write in basic French about themselves and others.
CO4. Develop ability to understand beginner level texts in French

Syllabus

List of Practicals:

Practical-1: Orientation about France, the language, and culture
Practical-2: Communication Skills 1: Vocabulary building for everyday conversations
Practical -3: Practice sessions
Practical-4: Reading and writing Skills : Reading and writing simple text in French
Practical-5: Practice sessions
Practical-6: Communication Skills 2: listening comprehension
Practical-7: Practice sessions
Practical-8: Writing Skills: Write basic French and practice

Recommended reading

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

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Course Code: HUP0001-7 **Course Name: Introduction to Spanish Language**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

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

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Course Code: HUP0001-8 **Course Name: Art of Painting**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

Course objective
Painting is fundamentally about learning to see, and to transport that vision onto paper through a variety of 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 the ability 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 **Practical2:** 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: HUP0001-9 **Course Name: Art of Drawing**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

Course objective

Drawing is fundamentally about learning to see, and to transport that vision onto paper through a variety of 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 the ability 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** Practical 2: **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: HUP0001-10 **Course Name: Nature camp**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

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

Course outcome:
After the completion of the course the students will be able to do the following:
CO1: Develop an affinity with nature by observing and understanding it marvels with guidance from experts
CO2: Develop an understanding of the challenges and solutions associated with nature and its conservation.

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

1. Awareness about each element of biodiversity (camps on moths, butterflies, birds, other wildlife etc.)
2. Environment management (water, forest, wildlife) – practices of Forest Department in managing a tiger reserve, and other aspects of water and forest conservation.
3. Sustainable natural resource management - initiatives by rural communities and local NGOs 4. Man-animal conflict and solutions (socio-economic and technical) – role of local communities and Forest Department
5. Traditional practices in environment conservation – role of local communities and local NGOs

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Course Code: PEP0001-21 **Course Name: Disaster Management through Adventure Sports**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

Objectives of the Course:

To enable the student:

1. To inculcate rational thinking and scientific temper among the students.
2. To develop critical awareness about the social realities among the students.
3. To build up confidence, courage and character through adventure sports.

Course Outcomes:

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

1. Understand the meaning and importance of Adventure sports.
2. Learn the various types of adventure sports, the equipment and resources required to practice disaster Management activities.
3. Learn the safety measures about different risk and their management.
4. To apply Disaster management theory to institutional & societal problems and situations.

Course Content:

1. Basic adventure
2. First AID
3. Various types of knots
4. Shelter making
5. Disaster management
6. Team building and goal setting
7. Realization of fear, risk and their roles and analyzing safety Management Plan.

==========

Course Code: PEP0001-22 Course Name: Self-defence Essentials and Basics Knowledge of Defence Forces
L: 0 hr, T: 0 hr, P: 2 hrs per week Total Credits: 01

Course Outcomes:
On completion of the Course the student will be able to:

1. Understand the meaning, need and fitness requirements to implement self-defence.
2. Learn the basic techniques of selected combative sports.
3. Learn to prepare basic Physical Training for Defence forces.
4. Implement survival techniques during emergencies.

Course Content:

1. General conditioning and self-defence specific conditioning.
2. Applications of techniques of combative sports for self-defence.
3. Self-defence techniques for specific situations: chain snatching, knife or stick attack, holding from back or front etc.
4. Basic Military Knowledge and exposure making students Confident, bold, disciplined and trains them to join Armed Forces.

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Course Code: CHP0001-31 **Course Name: Art of Indian Traditional cuisine**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

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

CO1: Understand the factors that affect regional eating habits and the uniqueingredients found in various states of India
CO2: Get insight to prepare popular dishes from various regions of India. ·

Module 1: Indian Regional foods and snacks - factors effecting eating habits.Module 2:
Indian gravies – ingredients, their importance
Module 3: Indian Sweets - ingredients, their importance
Module 4: Presentation of Indian Meals, Menu Planning, Food CostingModule 5:
Food Preservatives and Safety

List of experiments:

1) Introduction to cookery : does and don'ts
2) Introduction to Indian cuisine, philosophy and classification.
3) Regional influence on Indian Food- factors affecting eating habits
4) Preparation of Garam masala and or Chat masala with ingredients and theirimportance
5) Preparation of different gravies such as white, yellow or brown gravieswith ingredients and theirimportance
6) Preparation of Indian sweets like Besan ke laddu with ingredients and theirimportance
7) Presentation of meal, Menu planning and Food costing
8) Common chemical food preservatives and their safety standards.

Reference books

[1] Arora, K.,; Theory of cookery; First Edition, Frank Brothers Company (Pub) Pvt. Ltd., 2008 ISBN:9788184095036, 8184095031
[2] Philip, Thangam . E.,; Modern Cookery: Vol. 1; Sixth Edition, OrientBlackSwan., 2008 ISBN:9788125040446, 8125040447ali
[3] Parvinder S;Quantity Food Production Operations and Indian Cuisine (OxfordHigher Education); FirstEdition; Oxford University Press, 2011 ISBN 10: 0198068492 ISBN 13: 9780198068495
[4] Singh, Yogesh; A Culinary Tour of India; First Edition I.K. International PublishingHouse Pvt. Ltd. ISBN 978-93-84588-48-9
[5] Singh Shakesh;Simplifying Indian Cuisine;First Edition, Aman Publications, ISBN81-8204-054-X
[6] Dubey Krishna Gopal; The Indian Cuisine;PHI Learning Pvt. Ltd.ISBN978-81 203-4170-8

Course Code: CHP0001-32 **Course Name: Introduction to Remedies by Ayurveda**
L: 0 hr, T: 0 hr, P: 2 hrs per week **Total Credits: 01**

Course outcome:

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

CO1: Know basic principle of Ayurvedic formulations.
CO1. CO2: Different types of Natural Remedies.
CO2. CO3: Basic idea about their Characterization

Module 1- Introduction to Ayurveda
Module 2- Different types of Ayurvedic formulations: Churn, Bhasma, Vati, TailumModule 3- Introduction to Methods of preparation
Module 4 -Characterization, applications

Practicals based on above syllabus

1) Preparations of some medicinal oils like Bramhi tel, Bramhi Awala, Vatnashak Tel, Bhurngraj Tel etc.
2) Preparation of Churn, like Trifala Churn, Hingastak Churn, Trikut Churn etc.
3) Preparation of some Bhasmas and vati

Books

1) Chemistry and Pharmacology of Ayurvedic Medicinal Plants by Mukund Sabnis, Chaukhambha Amarbharati Prakashan.
2) Everyday Ayurveda by Shailesh Rathod
3) A text Book of Rasashastra by Vikas Dhole and Prakash Paranjpe
4) A text Book of Bhaiajya Kalpana Vij¯nana

Books

1) Chemistry and Pharmacology of Ayurvedic Medicinal Plants by Mukund Sabnis, Chaukhambha Amarbharati Prakashan.
2) Everyday Ayurveda by Shailesh Rathod
3) A text Book of Rasashastra by Vikas Dhole and Prakash Paranjpe
4) A text Book of Bhaiajya Kalpana Vij¯nana

Semester I

Department of Mechanical Engineering

Course Code: HUT1004 Course: Foundational Course in Universal Human Values
L: 1Hrs. T: 0Hrs. P: 0Hrs. per week 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.

Reference Material

The primary resource material for teaching this course consists of

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 Vidya ek Parichay,* 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

Department of Mechanical Engineering

Course Code: CHT2004 **Course: Chemistry for Mechanical Engineers**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 2**

Course outcomes:

After completing the course, the students will be able to:

1. Apply the knowledge of chemistry in water and wastewater technology and suggest the method of its treatment.
2. Explain the recent trans-formative technique for harnessing the energies and its applicability.
3. Identify techniques for the analysis of the materials and apply their knowledge for their qualitative and quantitative analysis.
4. Explain the principles of nanomaterials and polymers and their applications in various fields including the non-renewable and sustainable energy sources as well as deterioration of steel dues to atmospheric reactions.

Unit I: Water Technology

Introduction, sources and impurities, Hardness of water, Alkalinity of Water, Process for Potable water,

Membrane technology: Desalination of seawater by reverse osmosis using Polysulfone membrane, Softening of Water for Boiler Feed Water using Ion-Exchange Resins.

Unit II: Energy Storage

Batteries: Classification of batteries, components, constructions and working of Li-ion battery (Li-CoO2).

Fuel Cell: Introduction, construction and working of Hydrogen-Air and Methanol-Oxygen Fuel Cell.

Green Fuel: Hydrogen production (Photocatalytic water splitting), storage and its applications.

Solar Energy: Introduction, photovoltaic cells, construction and working of dye sensitized solar cell.

Fuels: Knocking in IC engines, octane and cetane number, flash and fire point.

Unit III: Characterization of Materials using Analytical Techniques

Fundamentals of spectroscopy, Electromagnetic spectrum

Spectroscopic methods: UV-visible spectroscopy- Beer's law, Double Beam spectrophotometer, Instrumentation,

NMR Spectroscopy: Principle, Chemical Shift, Splitting of signals and applications of NMR. Electron microscopy: Scanning electron microscopy (SEM), Tunneling electron microscope, Instrumentation, applications.

Unit IV: Engineering Materials and Corrosion Science

Nanomaterials: Introduction, Size-dependent properties (Surface area to volume ratio, optical and catalytic properties), classification of nanomaterials, Synthesis of nanomaterials, Top Down and Bottom-up approach, application of nanomaterial in energy and hydrogen storage.

Polymers: Classification, properties and various important polymers for solar panels, etc.

Corrosion of Steel: Introduction, Types of Corrosion, Prevention of Corrosion.

Text Books

1. Text Book of Engineering Chemistry, S. S. Dara, S. Chand and Company Ltd., New Delhi.
2. Textbook of Engineering Chemistry, P. C. Jain and Monica Jain, Dhanpat Rai and Sons, New Delhi.
3. Text Book of Environmental Chemistry and Pollution Control, S. S. Dara; S. Chand and Company Ltd., New Delhi.
4. Textbook of Engineering Chemistry, S. N. Narkhede, R. T. Jadhav, A. B. Bhake, A. U. Zadgaonkar, Das Ganu Prakashan, Nagpur.
5. Applied Chemistry, A. V. Bharati and Walekar, Tech Max Publications, Pune.
6. Shikha Agrawal , Engineering Chemistry : Fundamentals and Applications, Cambridge University Press.
7. Dr. Rajshree Khare, A Textbook of Engineering Chemistry(AICTE), S.K. Kataria & Sons

Reference Books

1. Engineering Chemistry by Gyngell, McGraw Hill Publishing Company, New Delhi.
2. Engineering Chemistry (Vol I), Rajaram and Curiacose, Tata McGraw Hill Publishing Company, New Delhi.
3. Engineering Chemistry (Vol II), Rajaram and Curiacose, Tata McGraw Hill Publishing Company, New Delhi.
4. Engineering Chemistry, Saraswat and Thakur, Vikas Publication, New Delhi.
5. Engineering Chemistry, B. S. Sivasankar, Tata Mcgraw Hill Publishing Company, New Delhi.
6. Engineering Chemistry, O. G. Palanna, Tata Mcgraw Hill Publishing Company, New Delhi.
7. Engineering Chemistry, R. Shivakumar, Tata Mcgraw Hill Publishing Company, New Delhi.
8. C. N. R. Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley-VCH, 2004.

Semester II

Department of Mechanical Engineering

Course Code: CHP2004 **Course: Chemistry Lab for Mechanical Engineers**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 1**

Course Outcomes:

After completing the course, the students will be able to

CO1: Identify the various impurities present in water and waste water samples and quantitatively estimate their amount.

CO2: Apply the knowledge of chemical principles for safe handling and uses of hazardous chemicals, and liquids fuels on the basis of their physical and chemical properties.

CO3: Demonstrate various analytical/spectroscopic tools for qualitative and quantitative analysis.

List of Experiments:

1. Handing of various glassware, apparatus and Materials safety data sheets (MSDS) of hazardous materials.
2. To determine the types and extent of alkalinity in water/wastewater samples.
3. To estimate temporary, permanent, and total hardness in the water sample.
4. Estimation of copper in brass (Cu metal alloy) sample by using iodometry principles.
5. Determination of viscosity of lubricating oil using Redwood-Viscometer.
6. Determination of pH, turbidity and suspended solids in water/wastewater samples.
7. Determination of flash point of liquid fuel using Open Flash Point apparatus.
8. Determination of flash point of liquid fuel using closed Flash Point apparatus.
9. Quantitative analysis using Lambert-Beer's law using electronic spectroscopy.
10. Estimation of Ferrous and Ferric ions.
11. Prediction of H-NMR using open-online software tools.
12. Determination of the Acid value of an oil.
13. Determination of the Saponification value of an oil.
14. Determination of Chemical Oxygen Demand (COD) of water/wastewater sample.

Text Books

1) A Textbook on Experiments and Calculations in Engineering Chemistry by S. S. Dara, S. Chand Publications.
2) Advanced Practical Physical Chemistry by J. B. Yadav, Krishna's Prakashan Media (P) Limited.

Reference Books:

1) Collection of Interesting General Chemistry Experiments, A by A. J. Elias, Universities Press Publications.

Semester II
Department of Mechanical Engineering

Course Code: MAT2001 **Course: Applied Mathematics - II**

L: 2 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **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 students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes

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

1. 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.
2. Evaluate definite and improper integrals using Beta, Gamma functions. Also trace Cartesian curves.
3. Solve multiple integration by change of order, change of variable methods and apply it to find area, volume, mass and center of gravity.
4. Understand geometric meaning of gradient, curl, divergence
5. Perform line, surface and volume integrals of vector-valued functions. Analyze and compare different sets of data and classify the data by means of diagrams and graph.

Syllabus

Module 1: ***Matrices:*** (8 hours)
Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms, Introduction to n-dimensional space.

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

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

Module 4: Vector Calculus (Differentiation) (7hours)

Scalar point function, Vector point function, vector differentiation, gradient, divergence and curl, directional derivatives with their physical interpretations, solenoidal and irrotational motions, Scalar potential function.

Module 5: Vector Calculus (Integration) (7 hours**) (All Branches except Biomedical Engineering)**

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.

OR

Module 5: Descriptive Statistics (7- Lectures)(Only for Bio-Medical Engineering)

Types of statistical data: categorical, ranked, discrete, and continuous. Distinction between univariate, bi-variate, and multivariate statistics, Visualization techniques such as joint contingency tables, scatter plots, 2D histograms and line graphs, Measures of central tendency and Dispersion.

Topics for self-learning

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

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 10030.
5. P. N. Wartikar and J. N. Wartikar, A text book of Applied Mathematics Volume I & II, Pune Vidhyarthi Griha Prakashan, 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

Department of Mechanical Engineering

Course Code: MET2001 **Course: Thermal and Fluid Sciences**

L: 3Hrs. T: 0Hrs. P: 0Hrs. per week **Total Credits: 3**

Course Objectives

The objective of the course is to learn the fundamentals of Engineering Thermodynamics and fluid mechanics.

Course Outcomes:

The students will be able to

1. Demonstrate an understanding of the fundamental laws and key terminology in thermodynamics.
2. Apply knowledge of thermodynamics to estimate heat and work transfer using steam as the working medium.
3. Evaluate the air standard cycles and vapor cycles, demonstrating the ability to analyze their performance and characteristics.
4. Understand the different types and properties of fluids, and apply various methods to measure pressure.
5. Analyze the principles of buoyancy and flotation to assess the stability of floating bodies and apply hydrostatic laws to submerged surfaces.
6. Comprehend the types of fluid flows and assess fluid flow kinematics

Syllabus

Unit – I: Introduction to Thermodynamics: Basic concepts and laws of Thermodynamics and their applications. Ideal Gas equation of state, Internal energy and specific heats of gases, Universal Gas Constant.

Unit –II: Properties of Steam: Formation of Steam, Application of Steam Table, Dryness fraction, Internal energy of steam, T-S diagram, Mollier chart. Work and Heat transfer during various Thermo dynamics processes with steam as working fluid. Determination of dryness fraction using various calorimeters, Properties of gases and gas mixtures.

Unit –III: Air Standard Cycles: Otto and Diesel cycle, Vapour Cycles: Simple and Modified Rankine cycle with reheat & regeneration, Binary cycle. Refrigeration cycles.

Unit – IV: Introduction to Fluid Mechanics: Properties & Types of fluids. Concept and measurement of Fluid pressure.

Unit – V: Hydrostatics: Pascal's Law, Forces on submerged plane, inclined, curved surfaces. Relating Buoyancy & Flotation to Stability of floating and submerged bodies.

Unit – VI: Kinematics of Fluid Flow: Types of flow. Continuity equation in Cartesian Coordinates, Velocity and Acceleration at a point. Stream function & Velocity potential function, Stream line, equipotential lines, Path line, Streak line, Stream tube.

Text Books:

1. Engineering Thermodynamics: P. K. Nag, Tata McGraw Hill Education; 6th edition, 10037.
2. Thermodynamics-An Engineering approach: Yunus A. Cengel, Michael A. Boles, McGraw Hill Education; 8th edition, 10037
3. Fluid Mechanics: Fundamentals and Applications, Yunus A. Çengel, John M. Cimbala, McGraw-Hill Education, 10038 4th Edition
4. Fluid Mechanics: Som & Biswas - McGraw Hill Education, 3rd edition, 10037

Reference Books:

1. Fundamentals of Engineering Thermodynamics: Michael J. Moran, Howard N. Shapiro, Wiley, 8th edition, 10034
2. Basic Engineering Thermodynamics: Rayner Joel, Longman; 5th edition, 1996
3. Fluid Mechanics, F. M. White, Henry Xue, McGraw Hill; 9thEdition, 2021

Semester II

Department of Mechanical Engineering

Course Code: MET2002 **Course: Theory of Mechanisms & Elasticity**

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

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

Course Outcome:

1. Describe the functioning of a machine, the relationship between the number of links and joints and to determine its mobility.
2. Explain the inversions of mechanism and their applications.
3. Classify and synthesize the cams for different follower motions.
4. Understand basic concept of stress, strain and their relations based on linear elasticity, material behavior due to different types of loading.
5. Learn analytical and graphical analysis of compound stresses and analysis of strain energy.
6. Develop shear force – bending moment diagram of beams under different loading conditions & support conditions and analyze 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

Department of Mechanical Engineering

Course Code: EET2004 **Course: Basics of Electrical Systems**

L: 2 Hrs., T:0Hrs., P:0Hrs., Per week **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.

Course Outcomes:

Syllabus

Introduction to Electrical System:

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's currentand voltage laws, analysis of simple circuits with DC excitation.

AC Circuits: Representation of sinusoidal waveforms, peak and RMS values. Concept of Impedance,Power, Energy.

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.

Introduction to power converters:

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

Energy Storage Systems:

Types of Batteries, working principle, Important Characteristics for Batteries, design and selection ofbattery pack for given application, battery charging, and BMS introduction.

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. 19thEdition, 2015.
4. Mechatronics: Principles, Concepts and Applications, Mahalik N.P., Tata McGraw Hill

Reference Books:

1. D. C. Kulshreshtha, "Basic Electrical Engineering", Mc Graw Hill, 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 II
Department of Mechanical Engineering

Course Code: MET2003 **Course: Programming for Problem Solving**

L: 1 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 1**

Course Objective:

Course Outcomes: On successful completion of course student will learn:

1. To formulate simple algorithms for arithmetic and logical problems, translate the algorithms to programs (in C language), test and execute the programs and correct syntax and logical errors.
2. To implement conditional branching, iteration and recursion, to decompose a problem into functions and synthesize a complete program using divide and conquer approach.
3. To use arrays to solve various matrix operation, searching, sorting and pointers, Structures for the formulation of algorithms and programs.
4. To understand basics of file operation and to apply various I / O operations for file handling programming.

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 / Pseudocode with examples. Arithmetic expressions and precedence

UNIT - II: C Programming Language Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements, Preprocessor Directives, Decision Control Statement-if, if-else, Nested if-else statement, Switch case, Loops.

UNIT - III: Arrays and Basic Algorithms Arrays: 1-D, 2-D, Character arrays and Strings. Searching, Basic Sorting Algorithms, Finding roots of equations, example programs (no formal definition required). File handling Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading, writing and closing the file.

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: Yashwant Kanetkar, BPB Publication

Semester II

Department of Mechanical Engineering

Course Code: MEP2003 **Course: Programming for Problem Solving Lab**

L: 0Hr., T: 0Hrs. P: 2 Hrs. Per week **Total Credits: 01**

Course Outcomes:

On successful completion of course student will be able to:

1. Understand the fundamentals of C programming and choose the loops and decision-making statements to solve and execute the given problem.
2. Implement different Operations on arrays also design functions to solve the given problem using C-programming.
3. Understand pointers, structures, unions and apply them to develop programs. Implement file
4. Operations in C programming for a given application

Semester II

Department of Mechanical Engineering

Course Code: HUT2001 **Course: Foundational Literature of Indian Civilization**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 2**

Course outcome:

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

CO1: Understand the Indian knowledge system and its scientific approach

CO2: Get introduced to the Vedic corpus and recognize the multi-faceted nature of the knowledge contained in the Vedic corpus

CO3: Understand the salient features of the philosophical systems of the Vedic and non-Vedic schools

CO4: Develop a basic understanding of the ancient wisdom recorded in various Indian literary work

Syllabus

1. **Unit 1: Overview of Indian Knowledge System:** Importance of ancient knowledge, defining IKS, IKS classification framework, Historicity of IKS, Some unique aspects of IKS.
2. **Unit 2: The Vedic corpus:** Introduction of Vedas, four Vedas, divisions of four Vedas, six Vedangas, Distinct features of Vedic life.
3. **Unit 3: Indian Philosophical systems:** Development and unique features, Vedic schools of philosophy, *Samkhya* and *Yoga* School of philosophy, *Nayay* and *Vaisesika* school of philosophy, *Purva-mimamsa* and *Vedanta* schools of Philosophy, Non-vedic philosophies: Jainism, Buddhism, and other approaches
4. **Unit 4: Indian wisdom through ages:** *Panchtantras,* ***Purans*****:** contents and issues of interests, ***Itihasa:*** uniqueness of the two epics (Ramayan and Mahabharata), Key issues and messages from Ramayana, Mahabharata – a source of worldly wisdom*;* **Indian ancient Sanskrit literature:** *Kalidas, Vishakadutta*, *Bhavbhuti, Shudraka**

***any one text as decided by the course teacher**

Reference material

1. B. Mahadevan, Vinayak Rajat Bhar, Nagendra Pavana R. N., *"Introduction to Indian Knowledge System: Concepts and Applications"* PHI, 2022
2. S.C. Chatterjee and D.M. Datta, *An introduction to Indian Philosophy,* University of Calcutta, 1984

Semester II

Department of Mechanical Engineering

Course Code: MET2004 **Course: Fab Lab - I**

L: 1 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **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:

1. Understand casting technique for the production of casted components.
2. Identify an appropriate molding pattern and various carpentry joints.
3. Understand the machining parameters and cutting tool for various machining operations.
4. Distinguish with hot and cold working method for the manufacturing of metal components.
5. Understand various fitting joints and sheet metal operations.
6. Apply the knowledge of suitable joining processes to carry out fabrication work.

Syllabus

Unit - I:

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

Unit - II:

Introduction to pattern making for metal casting, different types of carpentry tools, holding devices, different types of carpentry joints.

Unit - III:

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

Unit - IV

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

Unit - V:

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

Unit - VI:

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

Text Books

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

Reference Books

1. Kalpakjian 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

Department of Mechanical Engineering

Course Code: MEP2004 **Course: Fab Lab - I**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **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:

1. Prepare a sand mould for casting and perform pattern making.
2. Perform different machining operations on lathe machine and parts fitting job.
3. 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
Department of Mechanical Engineering

Course Code: PET2001 & PEP2001 **Course: Sports-Yoga-Recreation**

L: 1 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 2**

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

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

Course Outcomes:

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

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

Course Content:

Unit 1: - Theory: Introduction

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

Unit 2: - Practical- Exercises for Health and Wellness

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

Unit 3: - Yoga

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

References:

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

Bridge Courses: Finishing School Certificate for a UG certificate course on Industry 4.0 Technologies			
In association with TATA-Technologies Ltd (Additional 8 Credits)			
	1	Certificate courses in association with TATA-Technologies Ltd on	Offline certification Course offered by RCOEM-TATA-CIIIT
	RTC01	Basics of Solid Modeling	13 Hrs. -1 Credit each (any 8 to be selected)
	RTC02	3-D Printing	
	RTC03	Reverse Engineering	
	RTC04	Multi Body Dynamics (MBD)	
	RTC05	Internet of Things	
	RTC06	CNC Operations and Programming	
	RTC07	Finite Element Analysis	
	RTC08	Manufacturing Execution System	
	RTC09	Robotic Welding	
	RTC10	AutoCAD Drafting	
	RTC11	Profile engraving and Laser cutting (SIL)	
	RTC12	Electro Discharge Machining (P 20)	
	RTC13	Solar Technician	
	RTC14	Computer proficiency	
OR	2	One Month Internship at Industry	As prescribed by Industry
OR	3	Project Work (one month)	As prescribed by Industry/Institute

13 Hrs/ 1 Credit Courses offered by RCOEM-TATA-CIIIT (RTC)

Course Code: RTC01 **Course Name: Basics of Solid Modeling**
L: 1 hr, T:0, P: 0 hrs per week **Total Credits: 01**

Course Objective:

The aim of the course is to help the student to attain the industry identified competency through various teaching learning experiences.

Course Contents:

- Introduction to Design Tools - CAD (CATIAv6/Delmia V5)
- Concept Creation and 3D Modelling
- Detail Design & Engineering
- Introduction to GUI & Getting Started with CATIA
- Sketcher, Workbench Pad, Shaft, pocket & RP
- Drawing Shapes, Modifying sketch and constraints
- Part Design Workbench Practice example
- Sketch based and dress-up features, Holes & Fillet
- Transformation features, Practice example
- Design for Assembly and Design for Manufacturing.

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Course Code: RTC02 **Course Name: 3-D Printing**
L: 1 hr, T:0, P: 0 hrs per week **Total Credits: 01**

Course Objective:

The aim of the course is to help the student to attain the industry identified competency through various teaching learning experiences.

Course Contents:

- Intro to Product Design Development
- Introduction to 3D Printing Technology
- Geometric/solid modeling
- Facet generation and File types Obj, Stl, Prt etc
- Slicing softwares, Cura
- Part orientations and Slicing considerations
- Slicing parameter settings
- 3-D Printing materials PLA, ABS, TPU, Wood

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Course Code: RTC03 **Course Name: Reverse Engineering**
L: 1 hr, T:0, P: 0 hrs per week **Total Credits: 01**

Course Objective:

The aim of the course is to help the student to attain the industry identified competency through various teaching learning experiences.

- Introduction to Reverse Engineering
- Geometry acquisition Hardware and software
- 3D Scanner and Data Processing
- Inspection Software
- Hands-on on Reverse Engineering Software
- live Scan technology EinScan- 3D Scanner
- real-time data capture with 3D scanner
- Scanning / Inspection software. EinScan- 3D
- 3D Scanning (Laser and White / Blue Light)
- Scanned Data to 3D Model, clean up tools
- Convert raw 3D scan data into high quality models
- 3D Inspection & Drag and drop Report generation

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Course Code: RTC04 **Course Name: Multi Body Dynamics (MBD)**
L: 1 hr, T:0, P: 0 hrs per week **Total Credits: 01**

Course Objective:

The aim of the course is to help the student to attain the industry identified competency through various teaching learning experiences.

- Introduction to MSC Adams
- Starting a New Modelling Session
- Setting up the Model/ Session Parameters
- Setting up Coordinate Systems & amp,
- Define and Connect the Moving parts with Joints
- Run the Simulation & review the results
- Simulating a Four Bar Mechanism
- Simulating a Five Bar Mechanism
- Simulating a Single slider Crank Mechanism

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Course Code: RTC05 **Course Name: Internet of Things**
L: 1 hr, T:0, P: 0 hrs per week **Total Credits: 01**

Course Objective:

The aim of the course is to help the student to attain the industry identified competency through various teaching learning experiences.

- Distinguish the IoT from other related technologies.
- Different types of sensors and actuators
- Explain the IoT architectures.
- Apply the IoT architecture concepts for specific IoT applications.
- Understand the implementation aspect of IoT architecture.
- IoT Applications using Arduino IDE (Home Automation/Agriculture etc.).

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Course Code: RTC06 **Course Name: CNC Operations and Programming**
L: 1 hr, T: 0 hr, P: 0 hrs per week **Total Credits: 01**

Course Objective:

The aim of the course is to help the student to attain the industry identified competency through various teaching learning experiences.

- Introduction to Various Manufacturing Processes
- Introduction to Advance Manufacturing Processes
- Fanuc interface and operating panel
- CNC Programming and Milling operations
- CNC Programming and Turning operations
- G-Codes & M-Codes for Milling & Turning
- CNC Programming for Drilling operations

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Course Code: RTC07 **Course Name: Finite Element Analysis**

L: 1 hr, T:0, P: 0 hrs per week **Total Credits: 01**

Course Objective:

The aim of the course is to help the student to attain the industry identified competency through various teaching learning experiences.

- Basics of Strength of Material
- Introduction to Geometric Model & FE Model
- Introduction to Finite Element Analysis (FEA)
- Introduction to MSC NASTRAN and PATRAN
- Linear static structural analysis
- Modal Analysis (Free-Free Run)
- Linear Static Analysis

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Course Code: RTC08 **Course Name: Manufacturing Execution System**

L: 1 hr, T:0, P: 0 hrs per week **Total Credits: 01**

Course Objective:

The aim of the course is to help the student to attain the industry identified competency through various teaching learning experiences.

- Introduction to MES, Objective MES, Benefits
- Discrete, Continuous & Batch Manufacturing
- Manufacturing Organization Structure
- MES functionality, Integration of Business Layer
- Integration of Shop floor system
- MES Components and Systems Introduction
- Automation & Process Control, Automation Purpose
- Sensors and Actuators - Limit Switch, Prox. Sensor
- Integration of PLC, Conveyor Belt, Sensors.

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Course Code: RTC09 **Course Name: Robotic Welding**
L: 1 hr, T: 0 hr, P: 0 hrs per week **Total Credits: 01**

Course Objective:

The aim of the course is to help the student to attain the industry identified competency through various teaching learning experiences.

- Basics of Industrial Robotics
- Various applications in industries
- Introduction to Yasakawa Arc welding Robot
- Product Description and Specifications: ROBOTS
- Robot Transport and Installation
- Operation of ROBOT: ROBOT Programming
- Basic & logical command used in program

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Course Code: RTC10 **Course Name: AutoCAD Drafting**
L: 1 hr, T: 0 hr, P: 0 hrs per week **Total Credits: 01**

The objective of this course id to provide a foundational understanding of AutoCAD's key features. Each segment introduces the basics of AutoCAD setting of units, managing layers. The basic drawing tools are followed by precision tools and the subsequent tools and techniques, building upon the previous knowledge. Ultimately, this course equips students with practical skills and knowledge that are directly applicable in professional settings, enabling them to create accurate, efficient, and standardized technical drawings while preparing them for future advancements in CAD technology and applications.

- **Introduction to AutoCAD**

  Overview of AutoCAD interface
  Basic navigation: Zoom, Pan, Orbit
  Setting up units and drawing limits
  Creating and managing layers
- **Basic Drawing Tools**

  Using line, circle, arc, and polyline tools
  Exploring editing commands: Move, Copy, Rotate, Scale
- **Precision Drawing Techniques**

  Understanding snaps and grid settings
  Applying polar and object snap tracking
- **Working with Text and Annotations**

  Adding and formatting text
  Introduction to dimensioning tools

- **Advanced Editing**

  Exploring trim, extend, fillet, and chamfer commands
  Using grips for editing efficiency
- **Blocks and External References**

  Creating and managing blocks
  Understanding and utilizing external references (Xrefs)
- **Introduction to 3D Modelling**

  Basics of 3D workspace
  Creating simple 3D shapes: extrude, revolve

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Course Code: RTC11 **Course Name: Profile engraving and Laser cutting**
L: 1 hr, T: 0 hr, P: 0 hrs per week **Total Credits: 01**

The objectives of laser cutting and engraving involve precise material processing through the use of focused laser beams. These techniques aim to achieve high-precision cutting of various materials, including metals, plastics, glass and wood to produce intricate designs.

- Lasers in Manufacturing:
- Fundamentals of Laser Technology
- Laser System: Construction and Types
- Types of Lasers in Material Removal, Process and Performance Parameters
- A Case-study on cutting a Circular Part using CO2 Laser Machine
- Importance and Applications

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Course Code: RTC11 **Course Name: Electro Discharge Machining**
L: 1 hr, T: 0 hr, P: 0 hrs per week **Total Credits: 01**

The objective of course is to covers the details of the advanced machining theory processes. To understand material removal by using plasma ionised column energy for machining of super alloy materials and complex parts with high accuracy by using Electrical Discharge Machining.

- Electrical Discharge Machining (EDM): Working principle, process description
- Mechanism of material removal, selection of tool electrode and dielectric fluid
- Process capabilities, limitations, and applications.
- Wirecut electro discharge machining

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Course Code: RTC13 **Course Name: Solar Technician**
L: 1 hr, T: 0 hr, P: 0 hrs per week **Total Credits: 01**

The course aims to furnish participants with detailed knowledge solar photovoltaic systems. Participants will acquire a solid foundation in the fundamentals solar photovoltaic plants covering component selection based on specific requirements, system installation procedures, and maintenance guidelines

Course Contents

- Introduction to Solar Energy : Basic Terminologies and measuring instruments
- Solar Photovoltaic Technology :
    - Construction and working of solar cells and Modules
    - Different PV technologies
    - Types of Solar PV plants
    - Site survey for PV plant
    - System Design and Sizing
    - Installation Practices
    - Maintenance Procedures

==========

Course Code: RTC14 **Course Name: Computer proficiency**
L: 1 hr, T: 0 hr, P: 0 hrs per week **Total Credits: 01**

The objective of this course is to equip students with a comprehensive and practical understanding of fundamental computer skills, including proficiency in operating systems, office productivity software, internet and email usage, basic troubleshooting, file management, and ethical considerations, empowering them to confidently navigate the digital landscape, efficiently utilize computer resources, and adapt to evolving technologies while promoting responsible and ethical computing practices.

- Introduction to fundamental computer skills.
- Introduction to office productivity software such as MS Word Excel, advanced excel tools etc.
- Data entry and data processing tasks using software like Microsoft Excel or other data management tools.
- Maintaining records, logs, and documentation.
- Develop compelling presentations using software such as Microsoft PowerPoint or Google Slides.
- Collaborate with others through various online tools and platforms, including video conferencing, file sharing, and project management tools.
- Learn about computer ethics, copyright laws, and intellectual property rights related to digital content.

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Bridge Courses after First Year B Tech
(For the students of Mechanical Engineering)
The course for a Certified Mechanical Draftsman

Expected Job Roles - Mechanical Draftsman, Technical Assistant, Certified Apprentice

Module 1 – Machine Drawing and Solid Modeling (45 Hrs, 4 Credits)
Contents

UNIT 1: Conventional representations of standard machine elements like: Bolts, Nuts, Washers, Rivets, and Keys & Couplings. Thread terminology, Types of Threads & their representations. Machining Symbols.

UNIT 2: Limits: Terminology Fits: Types & Applications of fits. Dimensional Tolerance, Geometrical Tolerance.

UNIT 3: Assembly and Dismantling Principles: Study of some Standard Assemblies. Subassembly Drawing, Full Assembly Drawing, Exploded Views. Preparation of Bill of material. Production drawing preparation.

UNIT 4: Detailing of Drawings, Introduction to drawings, creating new drawings and views, Adding details to drawings, Adding notes to drawings, Adding tolerance and symbols

Module 2 – Technical and Soft Skills (45 Hrs. 4 Credits)
Contents
UNIT1: Overview of Mechanical Engineering – Basic awareness of a Manufacturing Industry, Different typesof Materials, Storekeeping, Basics of Safety – Safety at workplace
UNIT2: Tools used in Mechanical Workshop and Machines shops
UNIT2: Technical Communication – Preparing Reports, Minutes of Meeting, Comparative Statements, Quotations, etc.
UNIT3: IT Awareness - Word, Excel, Power Point, Database Management etc.
UNIT4: Soft Skills – Professional work ethics, Discipline,

Other Modules –

- Fundamentals of Engineering Mechanics.
- English for Professional Communication
- Universal Human Values
- Fundamentals of Thermal and Fluid Sciences
- Introduction to Theory of Mechanisms and Elasticity
- Basics of Electrical and Electronics Systems
- Basics of Programming for Problem Solving

Text Books

1. Machine Drawing by N. D. Bhat, Charotar Publications
2. Machine Drawing by K. L. Narayan, R. Kannaiah, and K. V. Reddy, New Age Int. Publishers.

OR

Any 8 courses of 1 credit (13 hrs) with support from the External Auditing Agencies

1. Industrial Safety and Risk Assessment Studies
2. Safety Audits
3. Emergency Preparedness and Response Plan
4. Disaster Management Plan
5. Hazard Studies and Fire Load Evaluation
6. Energy Audits, Environmental and Green Audits
7. Six Sigma, Lean Engineering, 7 QC Tools
8. 5-S and Kaizen
9. Design Of Experimentation

Semester III

Department of Mechanical Engineering

Course Code: MAT3001 **Course: Statistics for Engineers**

L: 2Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 2**

Course Pre-requisite: Basics of Probability and statistics**.**

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

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

CO1. Grasp the meaning of discrete and continuous random variables, probability distribution. Interpret the meaning of probabilities derived from distributions. This involves understanding what the calculated probabilities represent in practical terms and drawing conclusions from the results.
CO2. Understand sampling distribution and can use appropriate sampling distribution for estimating the parameters of population.
CO3. Understand the fundamental concept of hypothesis testing, including the null hypothesis (H0) and alternative hypothesis (H1), significance levels, p-values, and the basic logic behind hypothesis testing.

Syllabus

Module 1: Probability Distribution (9 hours)
Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

Module 2: **Sampling, sampling Distributions and Estimation:** (9 hours)
Introduction to sampling, sampling with and without replacement, introduction to sampling distributions, sampling distribution of means, sampling distribution of proportion, standard errors. Central limit theorem, Introduction, point estimates, interval estimates, confidence intervals, p-value, calculating interval estimates of the mean from large samples, calculating interval estimates of the proportions from large samples, interval estimates using the t distribution.

Module 3: Testing of Hypothesis (**9 hours)**
Testing of Hypothesis for single mean and proportion, Testing of Hypothesis for difference of mean and proportion, Test for ratio of variances - Chi-square test for goodness of fit, F-distribution.

Text Books:

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

Reference Books:

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

Semester III

Department of Mechanical Engineering

Course Code: MAP3002 **Course: Statistics for Engineers Lab**

L:0 Hr., T:0 Hr., P:2Hrs., Per week **Total Credits: 1**

Course Pre-requisite: Basics of Probability and statistics**.**

Course Objectives:

The Statistics for Engineer Lab course will consist of experiments demonstrating the principles of Statistics relevant to the study of Science and Engineering. Students will show that they have learnt Laboratory skills that will enable them to various aspects of Mechanical Engineering, ranging from data analysis and quality control to experimental design and risk assessment, enabling engineers to make informed decisions, improve processes, and design reliable systems. On successful completion of the course students shall be able to:

Course Outcomes:

By using open source software-R Students will be able to

CO1. Analyze the data and identify patterns, trends, and outliers.
CO2. Make inferences about population parameters based on sample data.
CO3. To compare observed results with expected results**.**
CO4. Analyse experimental data, identify significant factors, and make informed decisions to improve processes, products, and systems by using Annova test.
CO5. Predictions about future outcomes based on historical data which is useful in forecasting demand, estimating product performance, or predicting system behaviour.
CO6. Apply the statistical concepts to analyze the data and give appropriate decision.

Mapping of Course Outcomes (COs) with Experiments

Exp. No.	Name of Experiments	Mapped COs
1	To use R software for visualization of data.	CO1
2	Testing of Hypothesis for large sample Test	CO2
3	Testing of Hypothesis for small sample Test	CO2
4	Chi-square test	CO3
5	Analysis of Variances	CO4
6	Estimation of Simple correlation and regression model, significance and confidence interval	CO5
7	Estimation of Multiple correlation and regression model, significance and confidence interval	CO5
8	Case study Project	CO6

Text Books:

1. Peter Daalguard , Introductory Statistics with R , Springer 2022.
2. M R. Spiegal, Theory and Problems of probability and statistics :,2nded :,Schaum series
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Reference Books:

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

Semester III

Department of Mechanical Engineering

Course Code: MET3001 **Course: Material Science and Testing**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

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

CO1. Understand the fundamentals of various engineering materials and their crystal structure.
CO2. Interpret and explain the phase diagram and make use of this knowledge to illustrate the Iron carbide equilibrium diagram.
CO3. Understand the composition of alloy steel, copper, aluminum, Nickel, Titanium alloys.
CO4. Estimate Mechanical properties of engineering materials using various tests.

Unit I: Structure of materials: crystal structure, space lattice structure. Imperfection in crystal, strengthening mechanisms and slip systems, critically resolved shear stress, Mechanism of plastic deformation. Introduction to Pure metal and alloys, composite materials, Ceramics and Polymers.

Unit II: Cooling curve of pure metal and alloy, Iron Carbon equilibrium diagram, types of steel, heat treatment of steel, solidification of steel, microstructure development. Types of cast Iron, Cast Iron-production processes, Micro structural details.

Unit III: Introduction to alloying of steel, stainless steel and tool steels, Copper and copper alloys, Aluminum and Its alloys, Nickel based super alloys and Titanium alloys, Magnesium and its alloys.

Unit IV: Mechanical Property measurement: Tensile, compression and torsion tests; concept of true and engineering stress-strain curves, Hardness test: Rockwell, Brinell and Vickers tests. Impact test, Fatigue test, creep test. Introduction to nondestructive testing (NDT).

Some of The topics shall be delivered by expert from industry.

Text Books:

1. V. D. Kodgire & S. V. Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House.
2. L. Krishna Reddy, Principles of Engineering metallurgy , New Age International Publishers

Reference Books:

1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, “Material Science and Engineering', Prentice Hall of India Private Limited, 1999. 4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.
4. Sindney H Avner, Introduction to Physical Metallurgy, Mc-Graw Hill Education (India) Pvt. Ltd.

Semester III

Department of Mechanical Engineering

Course Code: MEP3001 **Course: Material Science and Testing Lab**

L: 0 Hr., T: 0 Hr., P: 2 Hrs. Per week **Total Credits: 1**

Course Outcomes

CO1. Ability to identify phases and composition of various alloys by metallographic examination using metallurgical microscope.
CO2. Ability to get hands on experience on various heat treatment processes.
CO3. Ability to measure hardness and toughness of engineering materials.
CO4. Ability to understand working, principle and utilization of UTM to derive various material properties.

The laboratory will have following Practical:

Name of Experiment:

1. To study the Metallurgical Microscopes and Preparation of specimen for metallographic examination.
2. Micro-structural examination of different types of Steels.
3. Micro-structural study of White Cast Iron and Grey Cast Iron and Micro-structural study of Malleable Cast Iron and Nodular Cast Iron.
4. To study the effect of normalizing on properties of steel.
5. To study the effect of annealing on properties of steel.
6. Effect of hardening process on properties of steels.
7. Measurement of hardness with the help of Rockwell Hardness Tester.
8. Measurement of hardness with the help of Brinell Hardness Tester.
9. Determination of tensile properties of ductile material.
10. Determination of impact properties by Izod /Charpy test.

Semester III

Department of Mechanical Engineering

Course Code: MEP3002 **Course: Machine Drawing and CAD Lab**

L: 0 Hr., T: 0 Hr., P: 4 Hrs. Per week **Total Credits: 2**

Course Objectives

1. To develop an ability to construct assembly and disability of machine and its components considering limits, fits and dimensioned tolerances as idell of geometric toleranced to components and assemblies on Engineering Drawings.
2. To develop an ability to create solid models of machine component and assembly.

Course Outcomes

1. Ability to select standard machine elements as per the standards.
2. Ability to draw and read production drawings.
3. Ability to use the Drafting and Design package e.g. Catia V6.
4. Ability to model machine components using geometric modeling software and able to construct detailed draft views of part or assembly

Syllabus

UNIT 1:
Conventional representations of standard machine elements like: Bolts, Nuts, Washers, Rivets, and Keys & Couplings. Selection of standard machine elements. Thread terminology, Types of Threads & their representations. Machining Symbols.

UNIT 2:
Limits: Terminology Fits: Types & Applications of fits. Dimensional Tolerance, Geometrical Tolerance. Tolerance Grades & Tolerance Charts, calculations of dimensional tolerance.

UNIT 3:
Assembly and Dismantling Principles: Study of some Standard Assemblies. Subassembly Drawing, Full Assembly Drawing, Exploded Views. Preparation of Bill of material. Production drawing preparation.

UNIT 4: Part modeling and assembly
Module-1 Introduction to modeling and basic concepts , Using solid modeling software interface Selecting and Editing, Sketcher geometry. Creating datum Features: Planes and Axes.

UNIT 5:
Creating datum Features: Planes and Axes , Creating extrudes, Revolves and Ribs ,Creating sweeps and blends (geometric features),Creating holes, shells and drafts, Creating rounds, chamfers ,Copy and mirror tools (Editing features)),Creating patterns. Module -2 Assembling with constraints, exploding assemblies

UNIT 6:

Detailing of Drawings, Introduction to drawings, Creating new drawings and views, Adding details to drawings, Adding notes to drawings, Adding tolerance and symbols

Text Books

1. Machine Drawing by N. D. Bhat, Charotar Publications
2. Machine Drawing by K.L.Narayan, R. Kannaiah, K.V.Reddy, New Age Int. Publishers

Reference Books

1. Machine Drawing by R. K. Dhawan, S. Chand Publications
2. Machine Drawing by P. S. Gill, S. K. Kataria & Sons
3. Engineering Drawing Practice for Schools & Colleges (SP-46:1988): Bureau of Indian Standards.
4. SP46 : 2003, Indian Standards.

Semester III

Department of Mechanical Engineering

Course Code: MET3003 **Course: Manufacturing Engineering**

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

Course Objectives:

The objective of the course is:

1. To familiarize and get acquainted with major manufacturing process and required Machine tools.
2. To identify, discuss and select the appropriate process, associated machine and equipment for manufacturing required product.

Course Outcomes:

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

CO1. Analyze the various casting techniques and patterns suitability for different types of casted components.
CO2. Identify the machining parameters, cutting tool materials and cutting fluids for various machining operations.
CO3. Distinguish with constructional details, mechanisms involved and working principle of various production machines.
CO4. Analyze the suitability of hot and cold working methods for the manufacturing of metal components.
CO5. Apply the knowledge of suitable joining processes to carry out fabrication work.
CO6. Identify and select the suitable unconventional machining process with its working principle for a given application.

Syllabus:

Unit - I

Mould making and Casting - Types of sand moulding, moulding machines & moulding procedure, moulding sand – types, properties, composition and applications, casting defects.

Pattern making - Types, material, allowances, core – types, materials and its properties. Special Casting Processes - Investment casting, centrifugal casting, shell moulding.

Unit - II

Metal Cutting : Single and multi-point cutting, chip formation, Tool wear and tool life, Surface finish and integrity, Cutting fluids, Cutting tool materials and machinability.

Lathe: Introduction, type, specification, construction, work holding devices & tools, mechanism and attachments for various operations, taper turning, thread cutting operations on Lathe.

Unit - III

Shaper: Introduction, type, specification, Quick return Mechanisms, Table feed mechanism, work holding devices, shaper operations.

Milling Machine: Introduction, specification, types, mechanisms and attachments for milling, milling operations, Indexing-simple, compound and differential.

Unit - IV

Forming Processes : Fundamentals of hot and cold working processes, Smithy and forging operations plastic deformation and yield criteria, bulk forming (rolling, extrusion, drawing) and sheet forming (shearing, deep drawing bending)

Unit - V

Welding: Principles of Welding, classification and types, arc welding, TIG and MIG processes and their parameter selection, welding of cast iron, welding electrode – types, composition, specification. Resistance Welding, Principle, equipment and processes, Gas welding, brazing & soldering.

Unit - VI

Unconventional Machine Processes: Characteristics, operation, applications, limitations and selection of processes parameters of Abrasive Jet Machining, Ultrasonic Machining, Plasma Arc Machining, die sink and wire EDM and Laser Beam Machining.

Text Books

1. Manufacturing Technology, Volume - I & II - P.N. Rao, Tata McGraw Hill Pub. Company, New Delhi.

2. Manufacturing Science - A. Ghosh & A. K. Malik - East West Press Pvt. Ltd. New Delhi.

Reference Books

1. Kalpakjian and Schimd, Manufacturing processes for engineering materials, 5th Edition - Pearson India, 2014.

2. Mikell P. Groover, Fundamentals of Modern Manufacturing : Materials, Processes, and System.

Semester III

Department of Mechanical Engineering

Course Code: MEP3004 **Course: Fab lab-II**

L: 0 Hr., T: 0 Hr., P: 4 Hrs. Per week **Total Credits: 2**

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. Perform different machining operations on lathe drilling, shaper and milling machine.
CO2. Understand the basic components of CNC machines and part programming features.
CO3. Understand principle and working of unconventional machining process.
CO4. Prepare a sand mould and identify various casting process operational characteristics.

List of Experiments:

1. Practical on lathe machine to perform operations for turning, facing, step turning, taper turning and threading.
2. Practical on milling machine for spur gear cutting.
3. Practical on Shaper machine to perform operations for horizontal and inclined surface, slotting
4. CNC machines set up and part programming features.
5. CNC Turning machine introduction, demonstration and part programming features.
6. CNC milling machine introduction, demonstration and part programming features.
7. Unconventional machining demonstration and operations on Electric Discharge Machining.
8. Unconventional machining demonstration and operations on Laser cutting.
9. Mould preparation and casting of metals after preparation of suitable moulds.
10. Study of various casting defects & observations of the actual casting.
11. 3D Printing: Demonstration.

As per availability virtual lab session to be conducted.

Text Books

1. Manufacturing Technology, Volume - I & II - P.N. Rao, Tata McGraw Hill Pub. Company, New Delhi.
2. Manufacturing Science - A. Ghosh & A. K. Malik - East West Press Pvt. Ltd. New Delhi.

Reference Books

1. Kalpakjian and Schimd, Manufacturing processes for engineering materials, 5th Edition - Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and System.

Semester III

Department of Mechanical Engineering

Course Code: HUT3005 **Course: Engineering Economics**

L: 2 Hr., T: 1 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course objective

The course aims to equip engineering students to understand the core concepts of Economics in order to bring efficiency in engineering projects/endeavours.

Course Outcomes

At the end of the course, the student will be able to:

CO1. Understand the basic concepts of engineering economics.
CO2. Evaluate the strategic role of engineers in business and engineering economic decision making
CO3. Understand revenue and cost concepts in different market structure for better decision-making.
CO4. Evaluate various forces impacting price and output in difference market.
CO5. Review the elements of financial statements.
CO6. Discuss and interpret the role and functioning of financial institutions and markets.

Syllabus

Unit 1: Foundation of Engineering Economics:

Definition of Economics, basic concepts of Economics (value, goods, wealth, income, savings, utility); definition and scope of engineering economics; **demand and supply:** Laws and elasticity.

Unit 2: Engineering Economic decision:

Rational decision-making process, Engineer's role in business, types of strategic engineering economic decisions, fundamental principles in engineering economics, methods to evaluate business and engineering projects (the teacher can take up one method from the book).

Unit 3: Cost and Revenues:

Revenue concepts: Marginal Revenue, Average revenue, operating and non-operating revenue;
Cost concepts: Marginal cost, Average cost, Sunk cost, Opportunity cost, Recurring cost, Non-recurring cost, Incremental cost, Cash cost, Book costs, life cycle cost, direct and indirect costs. Application of the concepts in business/industry.

Unit 4: Money Management:

Time value of money; interest – types and formulas;
Inflation: types, causes, inflation adjusted decisions; Break-even analysis, measures of inflation - Index numbers.

Unit 5: Basic Accounting: Balance sheet, Income Statement, Ratio analysis, Depreciation.
Financial markets: Call Money, Treasury Bills, Bond, Stock, Derivatives.

Books:

1. Panneerselvam. R., (2020) *Engineering Economics*, PHI learning, private limited, Delhi, 2nd ed.
2. Park.C., (2018) *Fundamentals of Engineering Economics*, Pearson India Education Services, Pvt. Ltd, 3rd ed.
3. Dewett.K.K. (2006), *Modern Economic Theory*, S. Chand, New Delhi, 2006.
4. Bhole, L.M. and Jitendra Mahakund (2017), *Financial Institutions and Markets*, Tata McGraw Hill (2007) 6th ed.
5. Chandra, Prasanna (2008) *Financial Management: Theory and Practise*, Tata MacGraw Hill Publishing Company Limited, New Delhi

Reference Books:

1. Ahuja H.L., (2017) *Managerial Economics, Analysis of managerial Decision making*, S. Chand and company Limited, New Delhi, 9th ed.
2. Dwivedi, D.N., *Managerial Economics*, Vikas Publishing House Pvt. Ltd, Nodia (2015) 8th ed.
3. Peterson, H. Craig and Lewis, W.Chis. & Jain. Sudhir K., *Managerial Economics*. Prentice Hall of India (2008) 4th ed.

Semester III

Department of Mechanical Engineering

Course Code: MEP3005 **Course: Field Project- Rural Technology**

L: 0 Hr., T: 0 Hr., P: 4 Hrs. Per week **Total Credits: 2**

Semester III

Department of Mechanical Engineering

Course Code: CHT3001 **Course: Environmental Science**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course Outcomes:
After completion of this unit, students would be able to:

CO1. Develop an understanding of pollution and its types.
CO2. Learn about different kinds of sources of pollution.
CO3. Explain sustainable development, its goals, targets, challenges and global strategies for sustainable development
CO4. Understand different methods of assessing environmental quality and associated risks.

Syllabus

Unit 1: Environmental Pollution I

Air pollution: Sources of air pollution; Primary and secondary pollutants; carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide; other important air pollutants. Indoor air pollution; adverse health impacts of air pollutants; National Ambient Air Quality
Water pollution: Sources of water pollution; marine pollution and groundwater pollution; Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life, treatment scheme for waste water from different industry.

Unit 2: Environmental Pollution II

Soil pollution and solid waste: Soil pollutants, hazardous wastes and their sources; Impact on human health. Introduction, types of e-wastes, environmental impact, e-waste recycling, e-waste management rules.
Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health, recent advances in noise pollution control and benefits.
Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.

Unit 3: Environmental Sustainability

Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs
Green Technology: goals and significance, sustainability
Green chemistry, challenges to green technology, advantage and disadvantages of green processes, Eco mark certification- its importance and implementation.

Unit 4: Environmental laws and regulation

Introduction to environmental laws and regulation: Constitutional provisions- Article
48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control.

Environmental management system: ISO 14001
Environmental audit and impact assessment; Environmental risk assessment Pollution control and management.

Reference Books:

1. Ahluwalia, V. K. (2015). Environmental Pollution, and Health. The Energy and Resources Institute (TERI).
2. B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut
3. P Aarne Vesilind, J. Jeffrey Peirce and Ruth F. Weiner, Environmental Pollution and Control, Butterworth-Heinemann
4. P.T. Anastas & J.C. Warner, Green Chemistry: Theory & practice, Oxford University Press.
5. Environmental Pollution and its control Techniques by Dr. S.S. Dara.

Semester III

Department of Mechanical Engineering

Course Code: MET2980-1 **Course: Facilities Planning**
L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course Objective: To maximize the efficient use of physical space within facilities. Effective space utilization involves planning, configuring, and managing space to accommodate current and future needs while minimizing waste.

Course Outcome:

At the end of this course students will demonstrate the ability to:

1. Understand fundamentals of facilities planning, including its importance, principles, and key components.
2. Analyze different types of facility layouts, such as process, product, cellular, and fixed-position layouts, and to understand their applications and implications.
3. Equip with the knowledge and tools necessary to optimize resource utilization within facilities, including space, equipment, and personnel.
4. Introduce to lean principles and methodologies and demonstrate how they can be applied to facilities planning to improve efficiency, minimize waste, and enhance productivity.
5. Familiarize students with the use of technology and software tools in facilities planning, including CAD (Computer-Aided Design) software, simulation tools, and other relevant technologies.
6. Encourage students to critically evaluate the sustainability and environmental impact of facilities planning decisions, and to explore strategies for integrating sustainability principles into facility design and management.

Unit 1: Introduction to Facilities Planning: Understand the importance of facilities planning in various industries. Identify the key elements and principles of facilities planning. Analyze the role of facilities planning in optimizing resource utilization. Evaluate case studies to illustrate the significance of effective facilities planning. Explore the relationship between facilities planning and overall organizational efficiency. Discuss emerging trends and challenges in facilities planning.

Unit 2: **Facility Location Analysis:** Analyze different methods and techniques for facility location analysis. Apply quantitative and qualitative factors in determining optimal facility locations. Evaluate the impact of location decisions on operational efficiency and cost. Interpret location models and algorithms to support decision-making processes. Explore case studies and real-world examples of successful facility location strategies. Discuss the implications of globalization on facility location decisions.

Unit 3: Layout Planning and Design: Understand the principles and objectives of layout planning and design. Analyze different types of layouts, such as process, product, cellular, and fixed-position layouts. Apply quantitative techniques, such as flow analysis and space utilization, in layout design. Evaluate the role of technology and automation in modern layout planning. Explore case studies to illustrate effective layout planning strategies across industries. Discuss the importance of ergonomic considerations in layout design.

Unit 4: Material Handling Systems: Identify the components and functions of material handling systems. Analyze different types of material handling equipment and their applications. Evaluate material flow patterns and efficiency in warehouse and distribution environments. Apply principles of logistics and supply chain management in material handling systems. Explore case studies to illustrate best practices in material handling system design. Discuss emerging technologies and trends in material handling systems.

Unit 5: **Facility Design and Maintenance:** Understand the principles of facility design and its impact on operational performance. Analyze factors influencing facility design decisions, such as capacity, flexibility, and sustainability. Evaluate strategies for optimizing facility layout and design to enhance productivity. Discuss the importance of preventive and predictive maintenance in facility management. Explore case studies to illustrate effective facility design and maintenance practices. Discuss the role of energy management and environmental sustainability in facility operations.

Unit 6: Facility Planning and Management Software: Familiarize with various software tools and technologies used in facilities planning and management. Develop proficiency in using CAD (Computer-Aided Design) software for layout planning and design. Explore simulation software for modelling and optimizing facility processes. Evaluate the capabilities and limitations of different facility planning software applications. Apply software tools to analyze and improve facility performance. Discuss ethical considerations and data security issues related to facility planning software.

References:

Text Books:

1. Facilities Planning by James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, Publisher: Wiley
2. Facility Layout and Location: An Analytical Approach, by Sanjay Kumar, Publisher: CRC Press.
3. Operations Management, by Nigel Slack, Alistair Brandon-Jones, and Robert Johnston Publisher: Pearson Education Limited.
4. Introduction to Material Handling Systems, by David O. Chikwendu, Publisher: CRC Press
5. Plant Layout and Material Handling by G. K. Agrawal

Reference Books:

1. Facilities Design, by Sunderesh S. Heragu, Publisher: CRC Press.
2. Facilities Planning and Design by Alberto García-Díaz and Juan Llorens-Montes Publisher: Springer
3. Facilities Planning by James A. Tompkins, John A. White, Yavuz A. Bozer and J. M. A. Tanchoco, Publisher, Wiley

Semester III

Department of Mechanical Engineering

Course Code: MET2980-2 **Course: Product Design and 3D Printing**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course Objectives:

- To understand the fundamental principles and methodologies of 3D printing technology and its applications.
- To develop proficiency in using computer-aided design (CAD) software for product design.
- To apply design thinking principles in product ideation and Fused Deposition Modeling (FDM) 3-D printing

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

CO1. Demonstrate Proficiency in CAD for Product Design: Utilize CAD software proficiently to create detailed and innovative 3D models for product design projects.
CO2. Apply Design Thinking in Product Development: Apply design thinking methodologies to identify problems, generate ideas, and prototype solutions effectively.
CO3. Operate FDM 3D Printers: Understand the principles of FDM technology, operate Ultimaker 3D printers efficiently.
CO4. Execute Complete 3D Printing Projects: Manage the entire 3D printing process from design optimization to post-processing, ensuring the successful realization of product prototypes.
CO5. Critically evaluate 3D Printing Applications: Analyze the potential applications of 3D printing across various industries and evaluate their impact on innovation and sustainability.

Syllabus

Introduction to Product Design- Principles of design, Design thinking process, Design research and ideation techniques, Fundamentals of 3D Printing

Overview of 3D printing technologies-Materials used in 3D printing, Applications and case studies, Computer-Aided Design (CAD) for Product Design

Introduction to CAD software-2D sketching and 3D modeling techniques, Fused Deposition Modeling (FDM), Understanding FDM technology 3D printers, features and operation, Material selection and print settings, Slicing.

Design Thinking in Product Development- Problem identification and definition-Ideation techniques (brainstorming, mind mapping, etc.), Prototyping and iteration

Hands-on 3D Printing -Preparing 3D models for printing, Ultimaker setup and operation, Post-processing techniques

Advanced Topics in 3D Printing- Additive manufacturing trends, Future prospects and challenges, Sustainability in 3D printing

Textbooks:

1. Product Design and Development by Karl T. Ulrich and Steven D. Eppinger
2. Ultimaker Essentials by Richard Underwood

Reference Books:

1. The Design of Everyday Things by Don Norman
2. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" by Ian Gibson, David W. Rosen, and Brent Stucker

Delivery Methods:

1. Lectures: Traditional classroom lectures to deliver theoretical concepts and frameworks.
2. Workshops: Practical sessions focusing on CAD software usage, design thinking exercises, and hands-on 3D printing activities, including Ultimaker operation.
3. Group Projects: Collaborative projects to apply learned concepts and develop real-world design solutions.
4. Guest Lectures: Industry experts and professionals invited to share insights and case studies on 3D printing applications.
5. Online Resources: Access to online tutorials, video lectures, and interactive learning materials for self-paced learning.

Mode of Evaluation:

1. Assignments and Tests: Regular assignments to assess understanding of theoretical concepts, CAD proficiency, and design thinking application.
2. MCQs: Periodic quizzes to evaluate comprehension of lecture materials and readings.
3. Group Projects: Evaluation of group projects based on creativity, feasibility, and effectiveness of design solutions, including 3D printing prototypes.
4. Practical Exams and viva: Hands-on practical exams to assess skills in Ultimaker operation, FDM printing setup, and troubleshooting.
5. End Semester Exam: Comprehensive exam covering all aspects of the course, including theory, practical skills, and critical analysis of 3D printing applications.

Semester III

Department of Mechanical Engineering

Course Code: MET2980-3 **Course: Mechanical Engineering in Daily Life**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 2**

Course Objectives:

CO1. Understand the fundamental concept of mechanical engineering
CO2. Know the principle of operation and working of various manufacturing processes
CO3. Apply the thermodynamic concept to household appliances and systems
CO4. Usage of fluid devices for domestic applications
CO5. Recognize the impact of mechanical engineering on societal advancements

Course Outline:

Unit I: Introduction to Mechanical Engineering: Overview of Mechanical Engineering, Historical development and significance, Basic concepts and principles and Role of mechanical engineers in society.

Unit II: Materials and Manufacturing: Properties of engineering materials, Material selection criteria, Manufacturing processes (e.g., casting, machining, forming), Applications of materials and manufacturing in daily life (e.g., automobiles, appliances)

Unit III: Thermodynamics, refrigeration and air conditioning: Basic concepts of thermodynamics, Laws of thermodynamics. Application of thermodynamics in daily life. Basic of **refrigeration and air conditioning. Domestic refrigeration system and its applications. S**mart home devices.

Unit IV: Fluid Mechanics: Properties of fluids, Fluid statics and dynamics, Bernoulli's equation and its applications such as venturimetrer and orifice meter. Applications of fluid devices in daily life.

Unit V: Environmental Impact and Sustainability: Sustainable practices in mechanical engineering, Case studies of sustainable technologies and practices. Introduction to renewable energy technologies.

Text books

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw-Hill Publication.
2. Refrigeration and Air conditioning, C.P. Arora, Tata McGraw Hill Publication.
3. Fluid Mechanics and Hydraulic Machines, R. K. Rajput, S Chand Publication.

Reference books

1. Modern Engineering Thermo dynamics, Robert Balmer, Publisher-AcademicPress.

Semester IV

Department of Mechanical Engineering

Course Code: MAT4001 **Course: Numerical Methods**

L: 2 Hr., T: 0 Hr., P: 0 Hrs. Per week **Total Credits: 3**

Semester IV

Department of Mechanical Engineering

Course Code: MAP4001 **Course: Numerical Methods Lab**

L: 0 Hr., T: 0 Hr., P: 2 Hrs. Per week **Total Credits: 1**

Semester IV

Department of Mechanical Engineering

Course Code: MET4001 **Course: Mechanics of Solids**

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

Course Objectives: To satisfy functional and strength requirements of machine elements.

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

CO1. Determine the bending stresses, shear stresses, slope and deflection in beams.
CO2. Understand the concept of torsional shear failure of circular shaft and evaluate the stresses subjected to torsional loads. Also decide the dimensions of columns and struts for its stability.
CO3. Analyze cylinders, spherical shells and rotating discs.
CO4. Design of various temporary and permanent joints for various applications.
CO5. Determine the safe dimensions of Power screw and mechanical springs.
CO6. Understand the concept, working and applications of brakes and clutches.

Syllabus

Unit 1:
Bending and shear stresses in beams: Theory of simple bending, significance of moment of inertia, beam of uniform strength, variation of shear stress in different section of beam.
Slope and deflection of beams: Beam differential equation, determination of slope and deflection by various methods i.e. double integration method, Macaulay's method, Moment-area method, Castiglione's theorem. Introduction to Maxwell's reciprocal deflection theorem and Betti's theorem of reciprocal deflection.

Unit 2:
Torsion of circular shaft: Theory of torsion, significance of polar moment of inertia, Torsion of tapered shaft, strain energy in torsion, combined bending and torsion.
Column and strut: Euler's theory of column, concept of equivalent length, slenderness ratio and radius of gyration, Rankine's formula.

Unit 3:
Cylinders and rotating disc: Theory of thin and thick cylinders, hoop and circumferential stresses developed in thin cylinders, stresses developed in thin rotating ring (flywheel) and disc of uniform thickness.

Unit 4:
Design of joints:
Temporary and permanent joints, Cotter joint, knuckle joint, bolted, riveted and welded joint for axial and eccentric loading.

Unit 5:
Design of mechanical springs: Classification and application of springs, design of closed coil helical springs, springs in series and parallel, design of leaf spring for automotive applications.

Design of Power Screw: Terminology of power screw, types of power screw, Design of screw and toggle jack. Simple applications of power screw.

Unit 6:

Design of Brakes: Requirement, Kinematics of friction drives, Design of Block brake, band brake, band and block brake, internal expanding shoe brake.

Design of Clutches: Positive and friction Clutches, Material for Friction Surfaces, Single Disc or Plate Clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch. Recent advancement of clutches in automotive sector.

Textbooks:

1. Strength of Materials by S.S. Rattan, McGraw-Hills Education (India) Publication, India.
2. Strength of Materials by S.S. Bhavikatti, Vikas Publishing house, Noida, India.
3. Design of Machine Elements by V. B. Bhandari, Tata Mc-Graw Hill publications.

Reference Books:

1. Strength of Materials by F. L. Singer, Harper and row Publication.
2. Engineering Mechanics of Solid by Egor P. Popov, Prentice Hall of India Publication.
3. Machine Design: An integrated approach by Robert L. Norton, Prentice Hall, Pearson publication.
4. Design Data: Data Book of Engineers by PSG College-Kalaikathir Achchagam - Coimbatore

Mode of Evaluation:

1. Assignments and mid-term tests: Regular assignments and mid-term tests to assess the understanding of theoretical concepts.
2. MCQs: MCQ test will be conducted to prepare the students for competitive examinations like GATE and IES.

End Semester Exam: Comprehensive examination at the end of the semester covering all theoretical and practical aspects of the course.

Semester IV

Department of Mechanical Engineering

Course Code: MET4003 **Course: Kinematics and Dynamics of Machinery**

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

Course Objectives:
To cover the kinematics and dynamics of planar single degree of freedom mechanisms, to develop skills for designing and analyzing linkages, cams, gears and other mechanisms and to provide a foundation for the study of Machine Design course.

Course Outcomes: Students shall be able to

CO1. Determine the displacement, velocity and acceleration at any point in a rigid link of a given mechanism.
CO2. Demonstrate the understanding of successfully addressing issues related to kinematics of Spur gears and gear trains
CO3. Demonstrate the gyroscopic effect on airplane, ship, four wheeler, and two wheeler
CO4. Examine the balancing of the rotating and reciprocating elements to avoid the failure
CO5. Analyze the free and forced vibrations in SDOF systems
CO6. Analyze the free and forced vibrations in TDOF systems

Contents:

Unit-I: Kinematic Analysis of Mechanisms
Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, kinematic analysis of simple mechanisms- slider crank mechanism, coincident points- Coriolis component of acceleration **(6)**

Unit-II: Kinematics of Gear and Gear Trains
Involute and cycloidal gear tooth profiles, gear terminologies, fundamental law of gearing and conjugate action, spur gear, length of path of contact, length of arc of contact, contact ratio and interference/undercutting, kinematics of regular and epicyclic gear trains **(6)**

Unit-III: Gyroscopic Motion
Rigid body motion in space, Euler's equation of motion, simple precession and gyroscopic couple, gyroscopic effect on airplane, ship, vehicles and grinding mills **(6)**

Unit-IV: Balancing of Masses

Inertia forces and their balancing for rotating and reciprocating machines, static & dynamic balancing in rotating machines, balancing by vector diagram, balancing of Inline engines, radial engines, Multi cylinder radial engines **(6)**

Unit –V: Single degree vibratory Systems
Derivation of equation of motion for vibratory system, free vibration of single-degree of freedom system with and without damping. Logarithmic decrement and damping estimation Forced vibration of single degree of freedom and vibration isolation, whirling speed of shaft and Vibration absorbers **(6)**

Unit -VI: Two degree vibratory Systems

Equation of motion for two-degree-of-freedom system, Natural frequencies and mode shapes vibration absorber. Torsional oscillations of two-disc and three disc rotors, with varying cross-section and gear ratio **(6)**

(**Total: 36 Lectures)**

Text Books:

1. Theory of Machines: S.S. Rattan, Tata McGraw Hill Publishers, 3rd edition onwards

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. Theory of Mechanisms and Machines: Ghosh& Mallik, Tata McGraw Hill
4. Theory of Machines: Thoman Bevan, CBS publication
5. Theory of Machines and Mechanisms: Uicker and Shigley, Tata McGraw Hill

Semester IV

Department of Mechanical Engineering

Course Code: MEP4003 **Course: Kinematics and Dynamics of Machinery Lab**

L: 0 Hr., T: 0 Hr., P: 2 Hrs. Per week **Total Credits: 1**

Course Objectives:

To exemplify concepts of gyroscopic effects, static and dynamic mass balancing and to teach linear vibration analysis of one and two degree of freedom rigid body systems.

Course Outcomes: Students shall be able to

CO1. Demonstrate the effect of gyroscopic couple on an airplane, ship, four wheelers and two wheelers.
CO2. Determine the frequency of Longitudinal, Transverse and Torsional vibrations.
CO3. Understand the effects of jumping phenomenon in cams and whirling speed of a shaft
CO4. Understand and examine the balancing of the rotating and reciprocating elements to avoid the failure of machine components.

Objectives of this lab are to impart practical knowledge on design and analysis of mechanisms for the specified type of motion in a machine. With the study of rigid bodies motions and forces for the transmission systems, machine kinematics and dynamics can be well understood.
Mechanisms form the basis of any machine and it is an assemblage of rigid bodies so that they move upon each other with definite relative motion.
Demonstration exercises are provided with wide varieties of transmission element models to understand machine kinematics. Various experiments with gyroscopes, balancing machines, cam dynamics, governors, whirling of shaft and vibrations of a spring mass system are available to understand machine dynamics.

List of Practicals

Sr. No.	Practical
1	Simple and Compound Pendulum
2	Bi-filar Suspension
3	Motorized Gyroscope
4	Cam Dynamics
5	Whirling of Shaft
6	Balancing of Rotary Masses
7	Balancing of a Single Reciprocating Mass
8	Natural Vibrations of a spring mass system
9	Free Vibrations of an equivalent spring mass system
10	Forced Vibrations of an equivalent spring mass system
11	Free Torsional vibrations of single rotor system
12	Free Torsional vibrations of two rotor system

Semester IV

Department of Mechanical Engineering

Course Code: MET4004 **Course: Fluid Dynamics and Hydraulic machines**

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

Course Objectives

1. To understand the fluids and dynamics of fluids using concepts of continuity equation.
2. To study the fundamentals of basic fluid machines used in practice.

Course Outcomes: The students will be able

CO1. To understand basic principles of fluid dynamics.
CO2. To identify various flows and to estimate the head losses for flow through pipes & apply boundary layer concepts.
CO3. To understand effect of hydrodynamic forces on various types of vanes.
CO4. To apply knowledge to evaluate performance of hydraulic turbines.
CO5. To analyze functioning & characteristics of centrifugal and reciprocating pump.
CO6. To understand functioning of various other hydraulic machines.

Syllabus

Unit I
Introduction to fluid mechanics: Kinematics & Dynamics of Fluid Flow: Linear Momentum Equation. Euler's equation, Bernoulli's equation. Applications of Bernoulli's equation Venturimeter, Orifice, Pitot tube. (Numericals):

Unit II
Viscous Flow: Introduction to laminar and turbulent flow, Reynolds number and its Significance. Flow of viscous fluids through pipe. Boundary layer Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation).
Flow Through Pipes: Losses in pipes. Pipes in series and parallel. Dimensional analysis: Buckingham's π-theorem (Numericals).

Unit III
Basics of turbo machinery: Impact of jet and jet propulsion: Momentum principle, Dynamic action of jet on fixed and moving plates, curved vanes, series of plates and vanes, velocity triangles and their analysis, Introduction to hydroelectric power plant.

Unit IV
Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles –draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.

Unit-V

Theory of Rotodynamic machines – Various efficiencies , velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves , concept of NPSH – (net positive suction head),priming,cavitation in pumps, Reciprocating pump – working principle.

Unit-VI

Hydraulic Machines: Hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic jack, hydraulic lift, hydraulic ram, fluid couplings, fluid torque converter and air lift pump.

Text Books:

1. Fluid Mechanics & Machines: R. K. Bansal- Laxmi publications.
2. A text book of Fluid Mechanics: R.K. Rajput, S.Chand Publication.
3. Fluid Mechanics & Fluid Power Engineering: D. S. Kumar -S. K. Kataria Publications

Reference Books:

1. Theory of Turbo-Machines: A. T. Sayer- McGraw Hill.
2. Fluid Mechanics: Som & Biswas - Tata McGraw-Hill.

Semester IV

Department of Mechanical Engineering

Course Code: MEP4004 **Course: Fluid Dynamics and Hydraulic Machines Lab**

L: 0 Hr., T: 0 Hr., P: 2 Hrs. Per week **Total Credits: 1**

Course Objectives

The objective of this course is to give practical insite on constructional details of various hydraulic machines also to enable the students to evaluate performance of these machines.

Course Outcomes:

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

CO1. Use knowledge of various discharge measuring devices such as orifice, mouthpiece and venturimeter for determining Cd, Cc, Cv.
CO2. Determine the major and minor losses in the various pipes
CO3. Graphically present the output of Impulse and Reaction turbines
CO4. Ability to perform practicals of rotodyanamic pump and positive displacement pump.

List of Experiments

1. Determination of coefficient of discharge for Venturi meter.
2. Determination of coefficient of discharge for Orifice meter.
3. Determination of hydraulic coefficients Cd and Cv for orifice.
4. Determination of hydraulic coefficients Cd and Cv for mouthpiece.
5. Determination of Darcy Friction factors for different pipes.
6. To calculate efficiency of Pelton turbine.
7. To calculate efficiency of Francis turbine.
8. To calculate efficiency of Centrifugal pump.
9. To calculate efficiency of Reciprocating pump.
10. To determine minor losses in pipe flow.

Semester IV

Department of Mechanical Engineering

Course Code: MET4005 **Course: Heat Transfer**

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

Course Objectives

1. To understand basic of Heat Transfer Mechanisms governing laws and their applications in heat transfer analysis.

Course Outcomes

CO1. Understand and analyze basic modes of heat transfer and apply mathematical equations to analyse steady state heat conduction.
CO2. Analyze heat conduction with internal heat generation, extended surfaces and unsteady state heat transfer.
CO3. Demonstrate the concept and mechanism of forced convection for flow over flat plate, external, internal flows through conduits.
CO4. Understand the concept of natural convection, boiling and condensation.
CO5. Apply the basic laws of radiation heat transfer and their applications.
CO6. Analyse the performance practical applications of heat exchangers.

Syllabus

Unit – I: Introduction, Basic modes of Heat Transfer, Conduction, Convection and Radiation, Laws of Heat Transfer, General Heat conduction equation in Cartesian Coordinates, Thermal conductivity and diffusivity, One dimensional steady state conduction equation for the plane wall, Cylinder and Sphere, Thermal resistance of composite structures, Contact resistance, overall heat transfer coefficient, critical thickness of insulation.

Unit – II: Conduction with internal heat generation for plane wall, Cylinder and sphere, Extended Surfaces, Types of Fins, Fins of uniform cross section area, temperature distribution and their heat transfer rate, Fin efficiency and effectiveness, Unsteady state Heat transfer, Lumped Heat Capacity analysis, Heisler charts, Biot number, Fourier number and their significance.

Unit – III: Forced convection, physical significance of non-dimensional parameters, Flow of high, moderate and low Prandtl number fluid over flat surface, Concept of velocity and thermal boundary layer thickness, Local and average Heat Transfer coefficient, empirical co-relation for external, internal flow, Laminar and turbulent flow through conduits.

Unit – IV: Free or Natural Convection, Grashoff number, Rayleigh number, horizontal and vertical plate, empirical correlations for Cylinders and sphere, Heat transfer with phase change, pool boiling curve and regimes of pool boiling, film and drop wise condensation, Laminar film condensation on vertical surface, Film condensation on horizontal tubes.

Unit - V: Radiation, nature of thermal radiation, black body radiation, radiation intensity, laws of radiation-Kirchoffs, Planks, Weins displacement, Stefen-Boltzmann and Lamberts Cosine law, Emissivity, absorptivity, transmissivity, reflectivity, radiosity, emissive power, irradiation, Radiation network, radiation exchange between surfaces, idea of shape factor and reciprocity theorem, radiation between parallel plates, Cylinder and sphere, radiation shields, effect of radiation on temperature measurement.

Unit – VI: Heat exchanger : Classification, overall heat transfer coefficient, Fouling factor, LMTD method of heat exchanger analysis, Analysis for parallel, counter flow and cross flow arrangement, effectiveness-NTU method, heat exchanger analysis by NTU method

Text Books

1. Heat and Mass transfer, Y. A. Cengel, McGraw Hill.
2. Kumar D. S., Heat Transfer, S K Kataria & Sons.
3. Kothandaraman C. P., Fundamentals of Heat & Mass Transfer, New Age Techno Press.

Reference Books

1. Holman J. P., Heat Transfer, Mc Graw Hill.
2. M Tirumaleshwar, Fundamentals of Heat & Mass Transfer, Pearson.

Semester IV

Department of Mechanical Engineering

Course Code: MEP4005 **Course: Heat Transfer Lab**

L: 0 Hr., T: 0 Hr., P: 2 Hrs. Per week **Total Credits: 1**

Course Objectives

To understand various modes of heat transfer factors affecting the rate of heat transfer and thermal performance of various heat transfer systems.

Course Outcomes

CO1. To analyse steady state conduction heat transfer in various geometries.
CO2. To analyse natural and forced convention in various arrangements.
CO3. To understand radiation heat transfer in different geometries.
CO4. To analyse the performance of heat exchangers.

List of Experiments

1. To determine thermal conductivity of composite wall.
2. To determine thermal conductivity of insulating powder.
3. To determine thermal conductivity of lagging material.
4. To determine thermal conductivity of metal rod.
5. To determine the critical heat flux.
6. To determine heat transfer coefficient in natural convection.
7. To determine heat transfer coefficient in forced convection.
8. To determine heat transfer coefficient for a pin fin in natural and forced convection.
9. To determine effectiveness of heat pipe.
10. To determine emissivity of a test plate.
11. To determine Stefan Boltzman constant
12. To determine the effectiveness of a concentric tube heat exchanger.

Semester IV

Department of Mechanical Engineering

Course Code: MET2990-1 **Course:**

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

Semester IV

Department of Mechanical Engineering

Course Code: MET2990-2 **Course: Project Management**

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

Course Objective: To achieve project goals and targets while keeping in mind the project scope, time, quality, and cost. It facilitates the project workflow with team collaboration on a single project.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

CO1. Provide students with an understanding of fundamental concepts, principles, and techniques in project management.
CO2. Equip students with essential skills and knowledge required for effective project planning, execution, monitoring, and control.
CO3. Develop students' ability to apply project management tools and techniques in real-world scenarios.
CO4. Enhance students' communication, leadership, and teamwork skills necessary for successful project management.
CO5. Foster critical thinking and problem-solving abilities in the context of project management challenges.

Prepare students for further study or professional certification in project management.

Unit 1: Introduction to Project Management: Understanding the concept of a project, Differentiating projects from routine operations, Historical background and evolution of project management, Project life cycle phases and their characteristics, Role of project managers and key stakeholders

Unit 2: Project Initiation and Planning: Defining project scope, objectives, and deliverables, Stakeholder identification and analysis, Conducting feasibility studies and risk assessments, Developing a project charter and preliminary project plan, Establishing project management processes and methodologies

Unit 3: Project Execution and Implementation: Creating detailed project plans: Work Breakdown Structure (WBS), schedules, and resource allocation, Managing project teams: roles, responsibilities, and communication, Procurement and vendor management, Quality assurance and control, Handling project changes and deviations

Unit 4: Project Monitoring and Control: Establishing performance metrics and indicators, Monitoring project progress and performance, Identifying and analyzing variances, Implementing corrective and preventive actions, Communicating project status to stakeholders

Unit 5: Project Risk Management: Understanding the concept of risk in project management, Risk identification, analysis, and prioritization, Risk response planning and implementation, Monitoring and controlling project risks, Integrating risk management into project planning and execution.

Unit 6: Project Closure and Evaluation: Closing project phases and the entire project, Conducting project reviews and lessons learned sessions, Documenting project outcomes and deliverables, Celebrating project success and acknowledging team contributions, Handing over project deliverables and resources

References:

1. **A Guide to the Project Management Body of Knowledge (PMBOK® Guide)**
   Author: Project Management Institute (PMI), Publication Year: 2021, Publisher: Project Management Institute

2. **Project Management: The Managerial Process**
   Author: Erik W. Larson, Clifford F. Gray, Publication Year: 2020, Publisher: McGraw-Hill Education

3. **Project Management for the Unofficial Project Manager**
   Author: Kory Kogon, Suzette Blakemore, James Wood, Publication Year: 2015 Publisher: Wiley

Semester IV

Department of Mechanical Engineering

Course Code: MET2990-3 **Course:**

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

Semester V

Department of Mechanical Engineering

Course Code: MET5002 **Course: Design of Machine Elements**

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

Course Description:
This course provides an in-depth understanding of the principles and practices involved in the design of various machine elements essential for engineering applications. Emphasis is placed on the analysis, selection, and design of rigid and flexible couplings, shafts, sliding and rolling contact bearings, and drives including gears, chains, and belts.

Course Objectives:

1. To develop a comprehensive understanding of the fundamental concepts underlying the design of machine elements
2. To familiarize students with the principles of selecting appropriate materials and manufacturing processes for machine components.
3. To equip students with practical experience with design calculations, simulation tools, and relevant case studies.

Course Outcomes: Students will be able to

CO1. Understand the fundamental concepts of machine design.
CO2. Apply design principles for mechanical components subjected to dynamic loading.
CO3. Design the shaft based on different criteria.
CO4. Apply the design considerations for both rigid and flexible couplings.
CO5. Apply appropriate selection criteria to select suitable bearings to meet performance, reliability, and durability standards.
CO6. Apply the design principles and analyze the mechanical drives.

Course Outline:

Introduction to Machine Element Design
Definition of Machine Design, types of Machine Design, Basic procedure of design process Overview of machine elements and their significance in engineering design. selection of material, preferred number. Aesthetic and ergonomic considerations in design. Basic terminology, design considerations, and factors influencing machine element design.

Design against static and dynamic load: Theories of static failure, Stress concentration etc. Overview of fatigue phenomena and its significance in engineering design, stress concentration factors, and notch sensitivity, S-N curves, Fluctuating stresses, Fatigue failure, Soderberg and Goodman criterion, Design of mechanical components subjected to dynamic loading for finite and infinite life.

Shaft Design
Design of shaft on the Basis of Strength, rigidity and critical speed. ASME Code for shaft Design, Design of splines and keys.

Rigid and Flexible Couplings
Types of couplings and their applications. Design considerations for rigid and flexible couplings.
Analysis of torque transmission, misalignment compensation, and vibration damping.

Rolling Contact Bearings: Principles of operation and classification of rolling contact bearings. Bearing life calculations, load ratings, and selection criteria.

Sliding Contact Bearings: Principles of lubrication and friction in sliding contact bearings. Types of sliding contact bearings and their design considerations. Bearing materials, surface finish, and lubrication regimes.

Drives: Gears
Gear types, terminology, and classifications. Gear tooth geometry, strength analysis, and design calculations. Gear materials, lubrication, and efficiency considerations. Design of Gears (Beam strength and wear criterion, AGMA method)

Drives: Chain and Belt
Chain drives: types, selection criteria, and design considerations. Belt drives: types, pulley design, and tensioning systems. Power transmission efficiency, wear analysis, and maintenance practices.

Recommended Resources:

Text and Reference books:

1. Bhandari V.B., Design of Machine Elements, Tata Mc-Graw Hill publications.
2. Machine Design" by Robert L. Norton
3. Data, Design. "Data Book of Engineers by PSG College." Kalaikathir Achchagam, Coimbatore.(PSG Design Data Book.)

Online resources: Engineering handbooks, academic journals, and industry publications.
Software tools: CATIA, ANSYS, OCTAVE/MATLAB, etc., for design simulation and analysis.

Teaching Methodology:
Lectures, demonstrations, and multimedia presentations to introduce theoretical concepts. Practical sessions involving design calculations, problem-solving exercises, and case studies.

Hands-on workshops utilizing software tools for design simulation and analysis. Guest lectures from industry experts to provide real-world insights and applications.

Assessment:
Assignments and quizzes to assess understanding of theoretical concepts.
Design projects focusing on the analysis and design of machine elements.
Midterm and final examinations covering the entire course content.

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