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Curriculum Structure and Evaluation Scheme
To be implemented for 2025-29 & 2026-30 Batch
Department of Mechanical Engineering

B.Tech. in Mechanical Engineering with Multidisciplinary Minor

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Curriculum Structure and Evaluation Scheme
To be implemented for 2025-29 & 2026-30 Batch
Department of Mechanical Engineering

Class: S. Y. B. Tech **Semester:** III

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+ SL	Total Hrs	Credits	Scheme	Theory (%Marks)			Practical (%Marks)	
									Max	Min. for passing		Max.	Min. for passing
ME2094	Mathematics for Mechanical Engineers	2	-	-	36	60	2	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
ME241	Mechanics of Solids	3	-	-	54	90	3	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
ME237	Fluid Mechanics	3	-	-	54	90	3	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
ME243	Metrology and Quality control	2	-	-	36	60	2	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
ME2114	Manufacturing Processes and Machine Tool	3	-	-	54	90	3	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
-	Multidisciplinary Minor-I	3	-	-	54	90	3	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
ME2334	Machine Drawing Lab	-	-	2	06	30	1	ISE ESE	--- ---	---		50 50	50 50
ME239	Fluid Mechanics lab	-	-	2	06	30	1	ISE ESE	--- ---	---		50 50	50 50
ME245	Metrology and Quality control Lab	-	-	2	06	30	1	ISE ESE	--- ---	---		50 50	50 50
ME2354	Workshop Practice-I	-	-	2	06	30	1	ISE	---	---		50	50
-	Professional Skills Development and Foreign Languages	-	-	2	06	30	1	ISE	---	---		100	50
	TOTAL	**16**	**-**	**10**	**318**	**630**	**21**						
	TOTAL CONTACT HOURS	**26**											

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, TW: Term Work, SL: Self-Learning.

Total Contact Hours/week : 26
Total Credits : 21

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Sr. No.	Subject Name		Course Code
1.	Professional Skills Development and Foreign Languages	Professional Leadership Skills	SH2635
2.		Interpersonal Skills	SH2615
3.		Innovation Tools and Methods for Entrepreneurs	SH2695
4.		Personal Effectiveness and Body Language	SH2595
5.		German Language – Level III	SH2735
6.		Japanese Language – Level III	SH2715

Note:

1. A student has to complete any two courses out of six choices offered under Choice Based Professional Skills Development Programme. A course in each semester will be allocated without any repetition.
2. Foreign Language course selected in F. Y. B. Tech Sem-I will remain the same with next levels in Sem-III & IV. (No new entries in S. Y. B. Tech Sem-III)

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Department of Mechanical Engineering

Class: S. Y. B. Tech **Semester:** IV

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+ SL	Total Hrs	Credits	Scheme	Theory (%Marks)			Practical (%Marks)	
									Max	Min. for passing		Max	Min. for passing
ME236	Kinematics of Machines	3	-	-	54	90	3	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
ME248	Design of Machine Elements	3	-	-	54	90	3	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
ME250	Engineering Thermodynamics	3	-	-	54	90	3	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
ME2144	Material Science and Metallurgy	3	-	-	54	90	3	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
ME2381	Object Oriented Programming using C++	2	-	-	36	60	2	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
-	Multidisciplinary Minor-II	3	-	-	54	90	3	ISE UT1 UT2 ESE	20 15 15 50	40	40	---	---
SH2175	Environmental Science	1	-	2	24	60	2	ISE ESE	50 50	40 40	40	---	---
ME2224	CAD Modelling Lab	-	-	2	06	30	1	ISE ESE	---	---	---	50 50	50 50
ME2401	Object Oriented Programming using C++ Lab	-	-	2	06	30	1	ISE ESE	---	---	---	50 50	50 50
ME2244	Material Science and Metallurgy Lab	-	-	2	06	30	1	ISE ESE	---	---	---	50 50	50 50
ME246	Workshop Practice-II	-	-	2	06	30	1	ISE ESE	---	---	---	50 50	50 50
ME244	MOOCS-I**	-	-	-	30	30	1	ISE	---	---	---	100	50
-	Professional Skills Development and Foreign Languages	-	-	2	06	30	1	ISE	---	---	---	100	50
	TOTAL	**18**	**-**	**12**	**390**	**750**	**25**						
	TOTAL CONTACT HOURS	**30**											

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, TW: Term Work, SL: Self-Learning.

Total Contact Hours/week : 30
Total Credits : 25

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Note: Students are required to undergo industrial training of minimum two weeks in the vacation of Semester-IV and its evaluation will be carried out in the Semester-V.

Note:** MOOCS-I course certification marks will be caried out for the credits.

Sr. No.	Subject Name		Course Code
1.	Professional Skills Development and Foreign Languages	Professional Leadership Skills	SH2635
2.		Interpersonal Skills	SH2615
3.		Innovation Tools and Methods for Entrepreneurs	SH2695
4.		Personal Effectiveness and Body Language	SH2595
5.		German Language – Level IV	SH2645
6.		Japanese Language – Level IV	SH2625

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Department of Mechanical Engineering

Class: T. Y. B. Tech **Semester:** V

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+ SL	Total Hrs	Credits	Scheme	Theory (%Marks)			Practical (%Marks)	
									Max	Min. for Passing		Max	Min. for passing
ME385	Dynamics of Machines	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
ME3114	Heat and Mass Transfer	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
-	Program Elective -I	2	-	-	36	60	2	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
-	Open Elective-I	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
-	Multidisciplinary Minor-III	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
-	Multidisciplinary Minor-IV	1	-	2	24	60	2	ISE	---	---	---	50	50
								ESE	---	---	---	50	50
SH3036	Scholastic Aptitude-I	2*	-	-			Audit	ISE	100	50 (P/NP)	---	--	--
ME383	Kinematics and Dynamics of Machines Lab	-	-	2	06	30	1	ISE	---	---	---	50	50
								ESE				50	50
ME3255	Software Training Lab-I	-	-	2	06	30	1	ISE	---	---	---	50	50
								ESE				50	50
ME3214	Heat and Mass Transfer Lab	-	-	2	06	30	1	ISE	---	---	---	50	50
								ESE				50	50
ME381	Mini Project	-	-	6	18	90	3	ISE	---	---	---	50	50
								ESE	---	---	---	50	50
ME3836	Industrial Training	-	-	-	30	30	1	ISE	---	----	---	100	50
ME371	MOOCS-II**	-	-	-	30	30	1	ISE	---	---	---	100	50
	TOTAL	**15**	**-**	**14**	**372**	**720**	**24**						
	TOTAL CONTACT HOURS	**29**											

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, P = Pass, NP = Not Pass, TW: Term Work, SL: Self-Learning.

Total Contact Hours/week : 29
Total Credits : 24

Note*: Students should complete 5 days (30 Hours) of Scholastic Aptitude training program organized by the Institute.

Note:** MOOC-II course certification marks will be carried out for the credits

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Sr. No.	Software courses
1.	NX CAD & CAM
2.	CATIA
3.	Python Programming
4.	Software Development using C++
5.	MATLAB

Program Elective-I

Sr. No	Course Code	Domain	Course
1.	**ME389**	Design	Design Thinking
2.	**ME333**		Engineering Optimization
3.	**ME3314**		Mechanics of Composite Material
4.	**ME335**		Automotive drive system
5.	**ME393**	Thermal	Fuel Cell Technology
6.	**ME343**		Alternative sources of energy
7.	**ME345**		Hybrid and Electric Vehicles
8.	**ME3514**	Manufacturing	World Class Manufacturing
9.	**ME337**		Tool Engineering
10.	**ME3534**		Non-Traditional Machining Process
11.	**ME3594**		Production and Operations Management
12.	**ME397**	Mechatronics	Sensor Technology and Applications

Open Elective I			
Sr. No.	**Course Code**	**Open Elective Subject Name**	**Offered by the department**
1	OE3411	Energy Audit and Management	Electrical Engineering
2	OE3431	Data Science	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
3	OE3105	Network Administration	Computer Science and Engineering
4	OE3065	Environmental Impact Assessment	Civil Engineering
5	OE3382	Disaster Management	Civil Engineering

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Open Elective I			
Sr. No.	**Course Code**	**Open Elective Subject Name**	**Offered by the department**
6	OE3651	Distributed Systems	Computer Science and Information Technology
7	OE3611	Object Oriented Modeling and Design	Computer Science and Information Technology
8	OE3471	New Product Design & Development	Mechanical Engineering
9	OE3491	Non-Conventional Energy Sources	Mechanical Engineering
10	OE3045	Renewable Energy Sources	Robotics & Automation
11	OE3631	Robotics Engineering & Applications	Robotics & Automation
12	OE3531	Factory Automation	Mechatronics Engineering
13	OE3551	Cyber Physical System	Mechatronics Engineering
14	OE3571	Internet of Things	Electronics & Telecommunication Engineering
15	OE3591	Drone Technology	Electronics & Telecommunication Engineering
16	OE3511	Hydrogen Fuel Cell Technology	Mechanical Engineering
17	OE3411	Energy Audit and Management	Electrical Engineering
18	OE3431	Data Science	Computer Science & Engineering (Artificial Intelligence and Machine Learning)

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Class: T. Y. B. Tech **Semester:** VI

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+ SL	Total Hrs	Credits	Scheme	Theory (%Marks)			Practical (%Marks)	
									Max	Min. for passing		Max	Min. for passing
ME3105	Finite Element Method	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
ME378	Machine Design	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
ME3124	Applied Thermal Engineering	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
ME316	Research Methodology	2	-	-	36	60	2	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
-	Program Elective-II	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
-	Open Elective-II	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
-	Multidisciplinary Minor-V	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								~~UT2~~	~~15~~			---	---
								ESE	50	40		---	---
SH3066	Scholastic Aptitude-II	2*					Audit	ISE	100	50 (P/NP)	--	--	--
ME3645	CAE Lab	-	-	2	06	30	1	ISE	---	---		50	50
								ESE	---	---		50	50
ME390	Applied Thermal Engineering Lab	-	-	2	06	30	1	ISE	---	---		50	50
								ESE	---	---		50	50
ME332	Minor Project	-	-	12	36	180	6	ISE	---	---		50	50
								ESE	---	---		50	50
	TOTAL	**20**	**-**	**16**	**408**	**840**	**28**						
	TOTAL CONTACT HOURS	**36**											

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, P = Pass, NP = Not Pass, TW: Term Work, SL: Self-Learning.

Total Contact Hours/week : 36
Total Credits : 28

Note*: Students should complete 5 days (30 Hours) of Scholastic Aptitude training program organized by the Institute.

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Program Elective – II

Sr. No.	Course Code	Discipline	Course
1.	**ME384**	Design	Product Design & Development tools
2.	**ME328**		Smart Material and Systems
3.	**ME3304**		Engineering Acoustics
4.	**ME312**		Automotive Chassis System
5.	**ME382**		Process Equipments and Engineering
6.	**ME3364**	Thermal	Energy Conservation & Management
7.	**ME3384**		Gas Turbine & Jet Propulsion
8.	**ME340**		Computational Fluid Dynamics (CFD)
9.	**ME3424**		Alternative Fuels
10.	**ME318**	Manufacturing	Operations Research
11.	**ME324**		Surface Engineering
12.	**ME326**		Micromachining
13.	**ME330**		Green Manufacturing
14.	**ME3484**		Computer Integrated Manufacturing
15.	**ME3544**	Management	Industrial Organization and Management
16.	**ME386**	Mechatronics	Automation in Manufacturing

Open Elective II			
Sr. No.	**Course Code**	**Open Elective Subject Name**	**Offered by the department**
1	OE3721	Industrial Safety	Electrical Engineering
2	OE3421	Data Mining	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
3	OE3681	AI for Agriculture	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
4	OE3481	Information Technology Foundation Program	Computer Science and Engineering
5	OE3661	AI for Cybersecurity	Computer Science and Engineering
6	OE3085	Materials Management	Civil Engineering
7	OE3501	Operations Research	Civil Engineering

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Open Elective II			
Sr. No.	**Course Code**	**Open Elective Subject Name**	**Offered by the department**
8	OE3581	Plumbing (Water and Sanitation)	Civil Engineering
9	OE3402	Cyber Security	Computer Science and Information Technology
10	OE3641	AI for Manufacturing	Computer Science and Information Technology
11	OE3285	Supply Chain Management	Mechanical Engineering
12	OE3325	Entrepreneurship Development	Mechanical Engineering
13	OE3025	Reliability Engineering	Robotics & Automation
14	OE3621	Flexible Manufacturing System	Robotics & Automation
15	OE3521	Image Processing	Electronics & Telecommunication Engineering
16	OE3541	Fuzzy Logic & Nueral Network	Electronics & Telecommunication Engineering
17	OE3701	AI for Sustainability	Electronics & Telecommunication Engineering
18	OE3441	Supply Chain Analytics	Mechatronics Engineering
19	OE3461	Mobile Robotics	Mechatronics Engineering
20	OE3561	Project Management	Mechanical Engineering
21	OE3243	Marketing for Engineers	MBA

CAE Lab (ME3645)

Sr. No.	Software courses
1.	ABAQUES
2.	HYPERMESH
3.	ANSYS
4.	Computational Fluid Dynamics (CFD)

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Class: Final Year B. Tech **Semester:** VII

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+ SL	Total Hrs	Credits	Scheme	Theory (%Marks)			Practical (%Marks)	
									Max.	Min. for passing		Max.	Min. for passing
ME437	Industry and mobile textile	2	-	-	36	60	2	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
ME439	Fluid and Turbo machinery	3	-	-	54	90	3	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
ME4055	Industrial Engineering	3	-	-	54	90	3	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
-	Program Elective-III	3	-	-	54	90	3	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
-	Program Elective-IV	3	-	-	54	90	3	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
-	Program Elective-IV Lab	-	-	2	06	30	1	ISE	--	---	----	50	50
								ESE	--	---	----	50	50
ME4075	Mechanical System Design Lab	-	-	4	12	60	2	ISE	--	---	----	50	50
								ESE	--	---	----	50	50
ME441	Fluid and Turbo machinery Lab	-	-	2	06	30	1	ISE	--	---	----	50	50
								ESE	--	---	----	50	50
ME4095	Industrial Engineering Lab	-	-	2	06	30	1	ISE	--	---	----	100	50
ME4134	Workshop Practice III (IR4)	-	-	2	06	30	1	ISE	--	---	----	50	50
	TOTAL	**14**	**-**	**12**	**288**	**600**	**20**						
	TOTAL CONTACT HOURS	**26**											

ISE: In Semester Evaluation, MSE: Mid Semester Examination, ESE = End Semester Exam, TW: Term Work, SL: Self-Learning.

Total Contact Hours/week : 26
Total Credits : 20

****Note:** A 4-hour session will be allotted in the timetable for Capstone Project Phase-II on the second, fourth, and fifth Saturdays.

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Program Elective-III

Sr. No.	Course Code	Discipline	Course
1.	**ME443**	Design	Advanced Finite Element Methods
2.	**ME4154**		Condition Monitoring
3.	**ME4231**		CAD customization
4.	**ME4194**		Autotronics & Vehicle Intelligence
5.	**ME445**		Engineering Failure Analysis
6.	**ME447**		Vehicle Dynamics
7.	**ME4234**	Thermal	Cryogenics
8.	**ME425**		Design of Heat Exchanger
9.	**ME427**		Battery Thermal Management system
10.	**ME449**	Manufacturing	Digital Manufacturing
11.	**ME413**		Control Engineering
12.	**ME415**		Advanced Welding Technology
13.	**ME455**		Enterprise and resources planning
14.	**ME4931**	Mechatronics	Industrial Robotics

Program Elective-IV Theory

Sr.No.	Course Code	Discipline	Course
1.	**ME4394**	Design	Mechanical Vibration
2.	**ME4414**		Experimental Stress Analysis
3.	**ME4434**		Engineering Tribology
4.	**ME495**		Noise & Vibration Control in Technical Textile
5.	**ME457**		Machine Learning for Mechanical Engineering
6.	**ME421**		Data Analytics
7.	**ME4494**	Thermal	I C Engines
8.	**ME4514**		Refrigeration and Air conditioning
9.	**ME4534**		Automotive Engineering
10.	**ME4554**	Manufacturing	Industrial Hydraulics and Pneumatics
11.	**ME459**		Additive Manufacturing
12.	**ME461**		Mechatronics and IoT
13.	**ME497**	Mechatronics	Mechatronics system Design

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Program Elective-IV Lab

Sr. No	Course Code	Discipline	Course
1.	**ME4634**	Design	Mechanical Vibration Lab.
2.	**ME4654**		Experimental Stress Analysis Lab.
3.	**ME467**		Engineering Tribology Lab.
4.	**ME499**		Noise & Vibration Control in Technical Textile Lab
5.	**ME469**		Machine Learning for Mechanical Engineering Lab
6.	**ME463**		Data Analytics Lab
7.	**ME4734**	Thermal	I C Engines Lab
8.	**ME4754**		Refrigeration and Air conditioning Lab
9.	**ME4774**		Automotive Engineering Lab
10.	**ME479**	Manufacturing	Industrial Hydraulics and Pneumatics Lab
11.	**ME483**		Additive Manufacturing Lab
12.	**ME485**		Mechatronics and IoT Lab
13.	**ME487**	Mechatronics	Mechatronics system Design Lab

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Choice based Internship Model
Model I: Industry Internship (II)

Class: Final Year B. Tech **Semester:** VIII

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+SL	Total Hrs	Credits	Scheme	Theory (%Marks) Max.	Theory (%Marks) Min. for passing		Practical (%Marks) Max.	Practical (%Marks) Min. for passing
OE4383	Finance for Engineers (Online Course)	2	-	-	60	60	2	ISE	25	40	40	---	---
								ESE	75	40		---	---
OE4363	Engineering Management & Economics (Online Course)	2	-	-	60	60	2	ISE	25	40	40	---	---
								ESE	75	40		---	---
IP4025	Industry Internship & Project	-	-	-	360	360	12	ISE	---	----		50	50
								ESE	---	---		50	50
	TOTAL	-	-	-	480	480	16						

ISE: In Semester Evaluation, ESE: End Semester Exam, TW: Term Work, SL: Self-Learning.

Total Contact Hours/week : --
Total Credits : 16

Note:
1] Weekly Contact hours are not mentioned as student is expected to be in industry regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.
2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.
Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.

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K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Curriculum Structure and Evaluation Scheme
To be implemented for 2025-29 & 2026-30 Batch
Department of Mechanical Engineering
Model II: Research Internship (RI)

Class: Final Year B. Tech **Semester:** VIII

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+ SL	Total Hrs	Credits	Scheme	Theory (%Marks)			Practical (%Marks)	
									Max.	Min. for passing		Max.	Min. for passing
OE4383	Finance for Engineers (Online Course)	2	-	-	60	60	2	ISE	25	40	40	---	---
								ESE	75	40		---	---
OE4363	Engineering Management & Economics (Online Course)	2	-	-	60	60	2	ISE	25	40	40	---	---
								ESE	75	40		---	---
RE4045	Research Internship	-	-	-	360	360	12	ISE	---	----		50	50
								ESE	---	---		50	50
	TOTAL	**-**	**-**	**-**	**480**	**480**	**16**						

ISE: In Semester Evaluation, ESE: End Semester Exam, TW: Term Work, SL: Self-Learning.

Total Contact Hours/week : -
Total Credits : 16

Note:
1] Weekly Contact hours are not mentioned as student is expected to be in outside research organization regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.
2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.
3] Students who opt for a research internship need to undergo a minimum of one month of research internship in outside research organizations or laboratories.

Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.

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Curriculum Structure and Evaluation Scheme
To be implemented for 2025-29 & 2026-30 Batch
Department of Mechanical Engineering
Model III: Entrepreneurial Internship (EI)

Class: Final Year B. Tech **Semester:** VIII

Course Code	Course	Teaching Scheme						Evaluation Scheme						
		L	T	P	TW+ SL	Total Hrs	Credits	Scheme	Theory (%Marks) Max	Min. for passing		Practical (%Marks) Max	Min. for passing	
ED4105	Project Management (Online Course)	2	-	-	60	60	2	ISE	25	40	40	-	-	
								ESE	75	40		-	-	
ED4045	Commercial Aspects of the Project (Online Course)	2	-	-	60	60	2	ISE	25	40	40	-	-	
								ESE	75	40		-	-	
ED4065	Entrepreneurship Development Program (EDP)	-	-	-	30	30	1	ISE	--	--	--	100	50	
ED4085	Entrepreneurial Internship	-	-	-	330	330	11	ISE	---	--	--	50	50	
								ESE				50		
	Total	-	-	-	**480**	**480**	**16**							

ISE: In Semester Evaluation, ESE: End Semester Exam, TW: Term Work, SL: Self-Learning.

Total Contact Hours/week : -
Total Credits : 16

Note:

1] Weekly Contact hours are not mentioned as student is expected to be in outside research organization regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.

2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.

3] A one week Entrepreneurship Development Program (EDP) will be conducted after completion of 7th semester and before start of 8th semester.

4] Students who opt for an entrepreneurial internship need to undergo a one-month internship at an outside reputed organization or firm

Multidisciplinary Minor

- Student should choose any one specialization given by the department and complete all the five courses under the specialization to earn 170 Credits.
- Following are the baskets of multidisciplinary minor courses

Multidisciplinary Minor Baskets					
MDM Basket Name	**Sr. No.**	**Course Code**	**Course Name**	**Semester**	**Offered by Department**
Construction Engineering	1	CEMD2011	Building Construction and Planning	III	Civil Engineering
	2	CEMD2021	Building Estimation and Valuation	IV	
	3	CEMD3011	Infrastructure Engineering	V	
	4	CEMD3031	Smart Cities and Sustainable Development	V	
	5	CEMD3021	Environmental Engineering	VI	
Software Programming	1	CSMD2011	Introduction to Data Structures	III	Computer Science & Engineering
	2	CSMD204	Fundamentals of Database Systems	IV	
	3	CSMD305	Software Testing	V	
	4	CSMD3031	Object-oriented Programming in Python	V	
	5	CSMD3021	Artificial Intelligence	VI	
Electrical Power System	1	EEMD2011	Electrical Power Generation	III	Electrical Engineering
	2	EEMD2021	Power System	IV	
	3	EEMD3011	Electrical Machines	V	
	4	EEMD3051	Electrical Technology	V	

	5	EEMD3021	Smart Grid	VI	
Electronics System Design	1	ECMD2011	Electronics Devices and Applications	III	Electronics &Telecommunication Engineering
	2	ECMD2021	Electronics Communication Systems	IV	
	3	ECMD3011	Advanced Communication Systems	V	
	4	ECMD3031	Electronic Product Design	V	
	5	ECMD3021	Industrial Electronics	VI	
Software Development	1	CIMD2011	Data Structures	III	Computer Science & Information Technology
	2	CIMD2021	Computer Algorithms	IV	
	3	CIMD3011	Introduction to DBMS	V	
	4	CIMD3031	OOP using Java	V	
	5	CIMD3021	Software Engineering	VI	
Product Design and Development	1	MEMD2031	Design Thinking	III	Mechanical Engineering
	2	MEMD2041	Behavioral Engineering and Design	IV	
	3	MEMD3051	Product Design Tools and Techniques	V	
	4	MEMD3071	Design and Prototyping	V	
	5	MEMD3041	Marketing and Business Fundamentals for New Products	VI	
Automobile Engineering	1	MEMD205	I. C. Engine	III	Mechanical Engineering
	2	MEMD206	Automotive Drivetrain	IV	
	3	MEMD309	Automotive Chassis Systems	V	

	4	MEMD311	Automotive Engineering Laboratory	V	
	5	MEMD306	Electric Vehicles	VI	
Mechatronics Engineering	1	MCMD2011	Fundamentals of Mechatronics	III	Mechatronics Engineering
	2	MCMD2021	Industrial Fluid Power	IV	
	3	MCMD3011	Sensor and Instrumentation	V	
	4	MCMD3031	Industrial Automation	V	
	5	MCMD3021	Industrial Robotics	VI	
Artificial Intelligence	1	AIMD2011	Object Oriented Programming	III	Computer Science & Engineering (AI-ML)
	2	AIMD2021	Data Structures and Algorithms	IV	
	3	AIMD3011	Machine Learning	V	
	4	AIMD3031	Business Intelligence	V	
	5	AIMD3021	Principles of AI	VI	
Robotics & Automation	1	RAMD2011	Fundamentals of Robotics & Automation	III	Robotics & Automation
	2	RAMD2021	Sensors and Actuators	IV	
	3	RAMD3011	Kinematic & Dynamics for Robots	V	
	4	RAMD3051	Robot Programming	V	
	5	RAMD3021	Industrial Automation & Control	VI	

B.Tech. in Mechanical Engineering with Double Minor (Multidisciplinary and Specialization Minor)

B.Tech. in Mechanical Engineering with Double Minor degree

1. It is required to complete SIX courses (each of 3 credits) from ONLINE platform to earn total of 18 credits under Double Minor (DM) certification.
2. Student must complete and earn the credits for all the six courses starting from Second Year First semester (3rd semester) to Final Year Second Semester (8th semester).
3. Basket of the DM courses and respective semester is mentioned in the following table.

Sr. No.	Semester	Course	Code
1	III	DM – I	EEDM3XXX
2	IV	DM – II	EEDM4XXX
3	V	DM – III	EEDM5XXX
4	VI	DM – IV	EEDM6XXX
5	VII	DM – V	EEDM7XXX
6	VIII	DM – VI	EEDM8XXX

4. To select course platform, first preference must be given to NPTEL.
5. Other than NPTEL, courses from COURSERA and UDEMY platforms are allowed to register only in following cases,
    a. If timeline of NPTEL course is not in line with timeline of academic calendar.
    b. The suitable succeeding course in line with previous course is not available on NPTEL.
    c. If any other unavoidable circumstances occurs.
6. Platform and course selection must be as per recommendation of BOS of the department.
7. Student will get the credits of respective DM course in following conditions,
    a. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
    b. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA (oral) exam.
8. While selecting online course, following points must be taken care of,
    a. Selected course must be of basic or fundamental level.
    b. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective) or in Multidisciplinary Minor (MDM)
    c. Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for UDEMY, COURSERA courses.

B.Tech. in Mechanical Engineering with Honor and Multidisciplinary Minor

B.Tech. in Mechanical Engineering with Honor and Multidisciplinary

Minor degree

1. It is required to complete SIX courses (each of 3 credits) from ONLINE platform to earn total of 18 credits under Honor certification.
2. Student must complete and earn the credits for all the six courses starting from Second Year First semester (3rd semester) to Final Year Second Semester (8th semester).
3. Basket of the Honor courses and respective semester is mentioned in the following table.

Sr. No.	Semester	Course	Code
1	III	Honor - I	EEH3XXX
2	IV	Honor - II	EEH4XXX
3	V	Honor - III	EEH5XXX
4	VI	Honor - IV	EEH6XXX
5	VII	Honor - V	EEH7XXX
6	VIII	Honor - VI	EEH8XXX

4. To select course platform, first preference must be given to NPTEL.
5. Other than NPTEL, courses from COURSERA and UDEMY platforms are allowed to register only in following cases,
    a. If timeline of NPTEL course is not in line with timeline of academic calendar.
    b. The suitable succeeding course in line with previous course is not available on NPTEL.
    c. If any other unavoidable circumstances occurs.
6. Platform and course selection must be as per recommendation of BOS.
7. Student will get the credits of respective Honor course in following conditions,
    a. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
    b. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA (oral) exam.
8. While selecting online course, following points must be taken care of,
    a. Selected course must be of advanced level and not basic or fundamental level.
    b. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective)
    c. Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for COURSERA, UDEMY courses.

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B.Tech. in Mechanical Engineering-Honors with Research and Multidisciplinary Minor

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Curriculum Structure and Evaluation Scheme
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Department of Mechanical Engineering

Honors with Research and Multidisciplinary Minor

The student will work on Research Project or Dissertation for 18 Credits in the Fourth Year in respective discipline. The distribution of 18 Credits for Research project in Sem-VII and Sem-VIII is given below. To get B.Tech. in Mechanical Engineering-Honors with Research and Multidisciplinary Minor degree Student need to earn total 192 Credits which consist 174 credits of regular Multidisciplinary Minor courses and 18 credits of Research courses.

Class: Final Year B. Tech **Semester:** VII

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+ SL	Total Hrs	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max.	Min. for passing		Max.	Min. for passing
REH4011	Intellectual Property Rights	-	-	-	60	60	2	ISE	50	40	40	---	---
								ESE	50	40		---	---
REH4031	Research project (Synopsis) phase - I	-	-	-	60	60	2	ISE	--	--	--	50	50
								ESE	--	--		50	50
REH4051	Research Specific core course - I (Online NPTEL course)	-	-	-	90	90	3	ISE	50	40	40	--	--
								ESE	50	40		--	--
	TOTAL	-	-	-	**210**	**210**	**7**						

ISE: In Semester Evaluation, ESE: End Semester Exam, TW: Term work, SL: Self Learning.

Note: For Evaluation of Online NPTEL course ISE Marks will be marks obtained by students in the assignments given by NPTEL, students who will secure NPTEL certification will be only eligible for ESE of the same course which will be conducted at institute.

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Department of Mechanical Engineering

Class: Final Year B. Tech **Semester:** VIII

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+ SL	Total Hrs	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max.	Min. for passing		Max.	Min. for passing
REH4021	Research project phase - II	-	-	-	330	330	11	ISE	--	--	--	50	50
								ESE	--	--		50	
	TOTAL	-	-	-	**330**	**330**	**11**						

ISE: In Semester Evaluation, ESE: End Semester Exam, TW: Term work, SL: Self Learning.

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K.E. Society's
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(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
S. Y. B. Tech. Syllabus
To be implemented for 2025-29 & 2026-30 Batch
Department of Mechanical Engineering

Class: **S. Y. B. Tech.**	Semester: **III**
Course Code: **ME2094**	Course Name: **Mathematics for Mechanical Engineers**

L	T	P	Credits
2	--	--	2

Course Description: Mathematics for Mechanical Engineering is offered at the third semester of the second year of engineering degree course. This course intends to build the competency in the students to apply the concepts learned in respective modules to various Engineering Problems. It contains six units that accomplish the fundamentals of mathematics required for Engineers.

Course Learning Outcomes:
After successful completion of the course the student should be able to:
1. Solve the differential equation using the appropriate concept.
2. Determine the Laplace & inverse Laplace transform of various functions.
3. Solve Problems on different probability distributions.
4. Develop Fourier series of periodic functions.

Prerequisite:
1. Linear algebra, Interpolation, and Ordinary Differential Equation
2. Calculus

Course Content

Unit No	Description	Hrs.
1.	**Linear Differential Equations with constant coefficients:** Definition, complete solution of Linear Differential Equation with constant coefficients (All Types to find Particular Integral & General type)	04
2.	**Linear Differential Equations with variable coefficients:** Solution of Linear Differential Equation with Variable coefficients (Cauchy Linear differential equation, Legendre's Linear differential equation)	04
3.	**Laplace Transform:** Definition of Laplace transform, Laplace transform of standard functions, properties of Laplace transform.	04
4.	**Inverse Laplace Transform:** Definition of inverse Laplace transform, Properties of inverse Laplace transform, convolution theorem, Application to solve ordinary differential equation with one dependent variable.	04
5.	**Probability:** Introduction, Binomial probability distribution, Poisson probability	04

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	distribution, and Normal probability distributions.	
6.	**Fourier Series:** Definition, Eulers Formulae, Expansions of Functions, Change of Interval, Even and Odd Function.	**04**

References:

Text Books:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- Ronald E. Walpole, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineering and Scientists, Pearson Prentice Hall.

Reference Books:

- Erwin Kreyszig, Advanced Engineering Mathematics, Wiley.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi.
- N. P. Bali, Ashok Saxena and N. Ch. S. N. Iyengar, A Text Book of Engineering Mathematics, Laxmi Publications.
- Peter V. O'Neil, Advanced Engineering Mathematics, Cole Publishing House.
- S. C. Gupta, Fundamentals of statistics, Himalaya Publishing House.

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S. Y. B. Tech. Syllabus
To be implemented for 2024-28 NEP Batch
Department of Mechanical Engineering

Class: **S. Y. B. Tech.**	Semester: **III**
Course Code: **ME241**	Course Name: **Mechanics of Solids**

L	T	P	Credits
3	--	--	3

Course Description:
This course explores the core principles of mechanics of materials, focusing on how structural members respond to different types of loads. Topics include stress–strain relationships, elastic constants, torsion in shafts, shear force and bending moment diagrams, and the analysis of bending and shear stresses in beams. Students will also study methods for determining slope and deflection, learn to apply Mohr's circle for principal stress analysis, and examine column stability through Euler's and Rankine's approaches. By the end of the course, learners will be equipped with analytical tools to evaluate and design basic structural components in engineering practice.

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

1. Calculate different types of stresses and strains induced in machine components, including thermal and torsional effects.
2. Analyze shear force and bending moment diagrams for beams.
3. Compute bending stress and shear stress distributions for beams.
4. Estimate slope and deflection of beams using analytical and graphical methods.
5. Determine principal stresses and strains in plane stress systems.
6. Evaluate the stability of axially loaded columns under different end conditions.

Prerequisite:
Applied Mechanics and Engineering Mathematics.

Course Content

Unit No	Description	Hrs
1.	**Stress and Strain:** Concept of stress and strain, types of stresses, Poisson's ratio, volumetric stress and strain, Elastic constants and their relationship, Stress and strain in determinate, homogeneous and composite bars under concentrated loads, Thermal stresses. Torsion in round shafts. Strain energy due to direct stresses and impact loads.	06
2.	**Shear force and bending moment diagrams:** Concept and definition of shear force (SF) and Bending Moment (BM) in determinate beams under concentrated load, uniformly distributed load, uniformly varying loads and couples. Relation between shear force, bending moment and intensity of loading, Calculation of variation in shear force and bending moment along the length of determinate beam and construction of SF and BM diagrams.	06
3.	**Stresses in beam:** **Bending Stress-**Theory of simple bending, Derivation of flexure	06

	formula. Bending stress distribution diagram for various cross sections of a beam. **Shear stress**-Shear stress distribution across the beam section, Derivation of shear stress distribution formulae. Shear stress distribution diagram for various cross sections of a beam. viz. Rectangular, T and I section.	
4.	**Slope and Deflection of Beams:** Concept and definition, relation between BM, slope and deflection. Calculation of slope and deflection by double integration method, Moment area method and Macaulay's method for simply supported and cantilever beams.	**06**
5.	**Compound Stresses:** Normal and shear stresses on any oblique planes, Principal stress and Principal planes by analytical methods and Mohr's Circle for 2-D stress and strain analysis.	**06**
6.	**Axially Loaded columns:** Concept of critical load and buckling, derivation of Euler's formulae for buckling load with hinged ends, concept of equivalent length for various end conditions. Limitations of Euler's formula, Rankine's formula.	**06**

References:

Text Books:

- Ramamurthum, Strength of Materials, Dhanpat Rai and Sons, New Delhi.
- R.K. Rajput, Strength of Material, Laxmi Publication, New Delhi.

Reference Books:

- G.H. Rider, Strength of Material, Mac Millan India Ltd.
- Ferdinand P Beer and E.R. Johnston JR. John Dewolf, Mechanics of Materials, McGraw Hill Book company.
- Gere &Timoshenko, Mechanics of Material, CSB Publisher.
- Timoshenko and Young, Elements of Strength of Materials, East-West Press. Pvt. Limited, New Delhi.
- Hibbler, Mechanics of Materials, Pearson Education Publication.
- Den Hartong, Strength of Materials, McGraw Hill, New York.

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S. Y. B. Tech. Syllabus
To be implemented for 2024-28 NEP Batch
Department of Mechanical Engineering

Class: **S. Y. B. Tech.**	Semester: **III**
Course Code: **ME237**	Course Name: **Fluid Mechanics**

L	T	P	Credits
3	--	--	3

Course Description:
Fluid Mechanics is core technology subject in mechanical engineering. Basically, mechanical Engineering deals with conversion of one form of energy in to other useful form for the comfort of human being. Conversion of fluid energy in to mechanical energy and mechanical energy in to fluid energy plays important role, that is the scope of subject- fluid mechanics & fluid machinery. As far as applications are concerned, fluid & turbo machines, Industrial hydraulics & pneumatics, Tribology, RAC Process equipment design, piping Engineering, Irrigation Engineering requires basics of fluid mechanics

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

1. Define, calculate, measure properties of fluid
2. Apply continuity equation, Bernoulli's equation, equation of motion and momentum equation for different flow system.
3. Identify different types of flows & forces acting on fluid.
4. Estimate different energy losses in fluid flow.
5. Estimate forces acting on bodies submerged in fluid
6. Apply basic concept of fluid mechanics for dimensional analysis & compressible flow.

Prerequisite:
Nil

Course Content

Unit No	Description	Hrs
1.	**Properties of Fluids:** Properties of the Fluids- Introduction, Definition, Laws, Types of Fluid, Viscosity, Comprehensibility, Surface Tension & Capillarity, Vapor Pressure & cavitations, Static Pressure, Pressure Head, Pressure Intensity in a Droplet, Soap Bubble, Capillarity, Insensitivity of pressure, Pascal's Law, Absolute, gauge, Vacuum, Atmospheric pressure, Pressure Measurements, Numerical Treatment.	06
2.	**Kinematics of Fluid Flow:** Introduction, Types of Flow, & Flow Lines. Continuity Equation in Cartesian Co- Ordinates System, Acceleration of Fluid Particles Streamline, Path line, Streak line, Stream Tube, Stream Function Numerical Treatment, pipe network analysis.	05
3.	**Dynamics of Fluid Flow:** Dynamics of Fluid Flow- Introduction, Euler's Equation of Motion. Integration of Euler's Equation, Bernoulli's Equation, Energy	06

	Correction Factor & Momentum Correction Factor. Venturiemeter, Orifice Meter, flow over triangular notches. Momentum Equation- Introduction & Derivation, Application of Momentum Equation Numerical Treatment Sub contents of main Unit.	
4.	**Laminar flow & Flow through pipes:** Laminar Flow-Introduction, Laminar Flow Through Circular Pipe. Laminar Flow Through Parallel Plates. Numerical Treatment Flow Through Pipe- Introduction, Losses of Energy, Darcy's Equation Chezy's Equation, Minor Losses Flow Through Series Pipes, Parallels Pipes, Equivalent Pipes, Siphon Pipe Branched Pipes, Hydraulic Gradient & Total energy line. Numerical Treatment.	**07**
5.	**Forces on submerged bodies:** Boundary Layer Theory- Thickness, Characteristics, Separation, Control. Forces on Immersed Bodies- Types of Drag on Aero foil, Lift. Numerical Treatment.	**06**
6.	**Compressible Flow & dimensional analysis:** **Compressible Flow-** Introduction to Compressible Flow, Mach number and Mach cone. Stagnation Temperature, Stagnation Pressure. Adiabatic Flow, Isentropic Flow, Problems, Condition for Maximum. Introduction to CFD. **Discharge Dimensional Analysis & Similitude-** Introduction, Dimensionally Homogenous Equation. Buckingham's II Theorem. Dimensionless Parameters, Similitude, Model Testing. Numerical Treatment Unit.	**06**

References:

Text Books:

- Bansal, R. K., Fluid Mechanics, Laxmi Publications.
- Fox, R. W., McDonald, A. T., & Pritchard, P. J., An Introduction to Fluid Mechanics, Wiley.

Reference Books:

- Som, S. K., Biswas, G., & Chakraborty, S., Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill Education.
- White, F. M., Fluid Mechanics, McGraw Hill Education.

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S. Y. B. Tech. Syllabus
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Department of Mechanical Engineering

Class: **S. Y. B. Tech.**	Semester: **III**
Course Code: **ME243**	Course Name: **Metrology and Quality Control**

L	T	P	Credits
2	–	–	2

Course Description:
This course provides fundamental knowledge of Metrology and Quality Control used in manufacturing and industrial engineering applications. The course covers principles of measurement systems, linear and angular measurements, geometrical measurements, surface finish evaluation, limits and fits, gauging techniques, and advanced measuring instruments. It also introduces concepts of quality control, statistical quality control techniques, control charts, acceptance sampling, Total Quality Management (TQM), ISO standards, and Six Sigma. The course emphasizes the importance of precision measurement and quality assurance in modern manufacturing industries, including recent trends such as digital measurement systems and AI-based Statistical Process Control (SPC).

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

1. Explain the fundamentals of metrology, measurement systems, standards, and errors in measurement.
2. Use linear, angular, and geometrical measuring instruments for engineering measurements and inspection.
3. Analyze limits, fits, tolerances, and gauging systems used in manufacturing applications.
4. Evaluate surface finish and geometrical features using appropriate measurement techniques and instruments.
5. Apply statistical quality control tools and control charts for process and product quality analysis.
6. Utilize the concepts of quality management, acceptance sampling in industrial applications.

Prerequisite:

1. Basic knowledge of Engineering Drawing and Manufacturing Processes
2. Familiarity with workshop practices and measuring instruments
3. Basic concepts of production and mechanical engineering systems

Course Content

Unit No	Description	Hrs
1.	**Fundamentals of Metrology and Measurement Systems:** Introduction to Metrology and its importance in manufacturing and inspection; Standards of measurement – International standards, Primary, Secondary and Working standards; Systems of units – SI, CGS, FPS and MKS systems; Measurement methods – Direct and indirect measurement, Primary, Secondary and Tertiary measurements, Absolute and Comparative measurement; Elements of measurement	04

	system and characteristics of measuring instruments; Accuracy and Precision; Errors in measurement – Gross, Systematic and Random errors	
2.	**Linear and Angular Measurements:** Linear measuring instruments – Steel rule, Vernier caliper and Micrometer; Slip gauges and their applications; Comparators – Mechanical, Electrical and Pneumatic comparators; Angular measurement – Bevel protractor, Sine bar, Angle gauges, Autocollimators and Angle Dekkors; Calibration and care of precision instruments; Inline and In-Process Integration using optical sensing and laser-based systems	**04**
3.	**Measurement of Geometrical Features and Surface Finish:** Measurement of straightness, flatness, roundness and cylindricity; Measurement of concentricity and parallelism; Surface roughness and surface finish terminology; Surface roughness measurement methods and instruments; Optical measuring instruments – Tool Maker's Microscope; Introduction to Coordinate Measuring Machine (CMM)	**04**
4.	**Limits, Fits, Gauging and Advanced Measuring Instruments:** Concept of limits, tolerances and fits; Types of fits – Clearance, Transition and Interference fits; Hole basis and shaft basis systems; Practical applications of GD&T, Gauges and gauging – Plug gauge, Ring gauge and Snap gauge; Dial indicators and electronic measuring instruments; Introduction to digital and automated measurement systems	**04**
5.	**Fundamentals of Quality Control:** Meaning and importance of quality and quality control; Quality concepts – Quality assurance, Quality management and inspection; Objectives and need of quality control in industries; Quality costs and factors affecting quality; Statistical concepts in quality control – Mean, Median, Mode, Range and Standard Deviation; Seven basic quality control tools – Check sheet, Histogram, Pareto chart, Cause-and-effect diagram, Scatter diagram, Control chart and Flow chart; Using AI for Statistical Process Control (SPC) to predict and prevent defects before they occur	**04**
6.	**Statistical Quality Control Techniques:** Introduction to Statistical Quality Control (SQC); Process control; Control charts for variables – $\bar{X}$-chart and R-chart; Control charts for attributes – p-chart and c-chart; Acceptance sampling – Single sampling plan and Operating Characteristic (OC) curve.	**04**

References:

Text Books:

- R. K. Jain, Engineering Metrology, Khanna Publishers.
- N. V. Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press.
- I. C. Gupta, A Textbook of Engineering Metrology, Dhanpat Rai Publications.

- E. L. Grant and R. S. Leavenworth, Statistical Quality Control, McGraw Hill.
- Dale H. Besterfield, Total Quality Management, Pearson Education.

Reference Books:

- R. K. Rajput, Mechanical Measurements and Metrology, S. Chand Publications.
- Acheson J. Duncan, Quality Control and Industrial Statistics, Irwin Publications.
- Connie L. Dotson, Fundamentals of Dimensional Metrology, Cengage Learning.
- Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley India.
- Mahajan, Engineering Metrology, Dhanpat Rai Publications.

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Class: **S. Y. B. Tech.**	Semester: **III**
Course Code: **ME2114**	Course Name **Manufacturing Processes and Machine Tools**

L	T	P	Credits
3	–	–	3

Course Description:
Manufacturing is activity in which materials converted into products thereby adding value of the original material. Proper selection of materials and processes are vital for minimizing the waste & maximizing the efficiency.
The subject Manufacturing processes & Machine tools focused on the study of basic manufacturing processes. Also, it covers working principles, operations performed, accessories & attachments used on different machine tools.
This course intends to build the competency in the students to identify & select a proper manufacturing process and machine tools for manufacturing different components used in engineering industry

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Choose suitable Engineering forming process for production of component of required specification.
2. Recommend an appropriate casting process and required furnaces for a given application.
3. Select appropriate joining process for given application.
4. Explain construction and working of different machine tools
5. Identify the need and significance of Industry 4.0 in modern manufacturing systems.

Prerequisite:
Nil

Course Content

Unit No	Description	Hrs
1.	**Forming Process:** a) Introduction, types and importance of Rolling, Forging, Extrusion, Wire, rod and pipe drawing, Sheet Metal Working. b) Introduction to plastics, blow molding, injection molding, extrusion, calendaring and thermoforming.	06
2.	**Casting Process: Pattern and Mold Making:** a) Casting as manufacturing Process, advantages and disadvantages of casting processes. core boxes and gating systems. Types of patterns and cores and core boxes, materials used and selection criteria for pattern making, pattern allowances. Components of gating system and its importance,	08

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	solidification control devices: chills, ceramics bricks, directional solidification. b) Types of moulding and core making sands and their properties, green sand Moulding, shell Moulding, CO2 Moulding, Investment casting. Moulding machines and core making machines, Permanent mould casting Process-Gravity and pressure die-casting, Centrifugal casting, Continuous casting. Pollution Control in foundries. Types o melting Furnaces-Cupola furnace, oil/gas fired furnaces, crucible furnaces, Electrical furnaces. Metal pouring equipment, Cleaning- fettling and inspection of casting, Defects in casting.	
3.	**Joining Processes:** Welding processes: Arc, TIG, MIG, submerged arc welding and Resistance welding, Brazing and Soldering, Welding of dissimilar metals. Welding defects, Welding symbols and Different standards used in welding.	**05**
4.	**Machine Tools for Metal Cutting:** Introduction to machining parameters- speed, feed and depth of cut. Introduction of Lathe, Capstan, turret lathe, Boring Machines, Drilling, shaping machine, planning machine and milling machine. Construction and working of Turning center and Machining Center.	**06**
5.	**Evolution of Industrial Revolutions and Industry 4.0 Concepts**: Evolution of industrial revolutions (1.0 → 4.0), Need for Industry 4.0 in modern manufacturing, Comparison: Traditional vs Smart Manufacturing. Internet of Things (IoT) in manufacturing, Artificial Intelligence (awareness level). Introduction to Industry 5. O.	**05**
6.	**Fundamentals of Automation, Robotics, and Smart Factories:** Types of automation Fixed, Programmable, Flexible. Role of robotics (industrial robots overview), Importance of data in manufacturing, Data collection from machines. Role of 3D printing in smart manufacturing, Smart factories.	**06**

References:

Text Books:

- P. N. Rao, Manufacturing Technology- Foundry, Forming and Welding, Vol. I", Tata-McGraw-Hill, New Delhi.
- P. L. Jain, Principles of Foundry Technology, Tata McGraw-Hill, New Delhi.
- P. C. Sharma, A Textbook of Production Technology (Manufacturing Processes), S. Chand and Company Pvt. Ltd, New Delhi.
- O. P. Khanna, Foundry technology, Dhanpat Rai Publications Pvt. Ltd, New Delhi.
- O. P. Khanna, Welding Technology. Dhanapat Rai Publications.
- S.K. Hajra Choudhury and A.K. Hajra Choudhury, Elements of Workshop Technology vol. II", Media Promoters and Publishers Pvt. Ltd, New Delhi.

Reference Books:

- Hein and Rosenthal, Principles of metal casting, Tata McGraw-Hill Book,

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Company. New Delhi.
- ASTM Volumes on Welding, casting, forming and material selection.
- ASM Handbook, Volume-15, Casting.
- W.A. J. Chapman, "Workshop Technology", CBS Publishing and Distributors, New Delhi.

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Multidisciplinary Minor- I

Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **CEMD2011**	Course Name: **Building Construction and Planning**

L	T	P	Credits
3	-	-	3

Course Description:
This course introduces students to the fundamentals of building construction and planning. It covers the properties, characteristics, and applications of various building materials used in construction. The course provides knowledge of the functional design and construction of different building components, along with the principles of building planning and relevant building bye-laws. Students learn the basics of planning residential buildings by considering functionality, safety, ventilation, lighting, and aesthetics. The course also includes an overview of building services and finishes commonly employed in modern buildings.

Course Outcomes:
After successful completion of this course, students will be able to:

1. Select suitable building materials for various construction applications based on their properties and uses.
2. Design functional building components considering structural and service requirements.
3. Plan and draw residential buildings in accordance with principles of planning and building bye-laws.
4. Prepare basic plumbing and electrification layouts for buildings.
5. Explain the properties, applications, and procedures of commonly used building finishing materials.

Prerequisite: Basic knowledge of engineering graphics.

Course Content

Unit No.	Details of Content	Hrs.
1.	**Construction Materials:** Properties and applications of various materials viz. cement, stone, aggregate, brick, steel, flooring materials, roofing materials, cladding materials, plumbing materials, mortar, plain cement concrete (PCC), reinforced cement concrete (RCC) and pre-stressed concrete (PSC).	06
2.	**Components of Building I:** Types of structures: Load Bearing Structure and Framed Structure, sectional details of load bearing and framed structure showing substructure components -PCC bed, footing walls, plinth. Concept of soil bearing capacity, types of foundation and their suitability, types of brick and stone masonry, bonds in brickwork.	06

3.	**Components of Building II:** Superstructure components of the buildings: column, beam, slab, wall, sill, lintel, chajja, ventilator, roofing, parapet, ramp, lift and escalator, doors, windows. Staircase: technical terms, classification, functional design.	**06**
4.	**Planning of Buildings and Bye-laws:** Types of buildings, site selection criteria, concept of planning, principles of planning. Bye-laws: definition, necessity, procedure for obtaining building permit, general building requirements: setback, marginal distance, height and FSI as per unified development control and promotion regulations (UDCPR) for Maharashtra state. Introduction and necessity of building drawings, concept of scale, types of building drawings-layout plan, site plan, measured, submission, working and perspective drawing. Introduction to RERA (Real Estate Act, 2016), Introduction to National Building Code (NBC).	**07**
5.	**Building Services:** Concept of plumbing and drainage plan, plumbing systems, types of traps, fittings, septic tank, soak pit, rainwater harvesting, and plumbing layout for buildings, preparation of plumbing and electrification layouts for building.	**06**
6.	**Building Finishes:** Plastering and pointing, types and application procedure Paints-characteristics of ideal paints, constituents, classification, suitability, applying procedure and applications, defects. Varnishes- characteristics of good varnish, ingredients, types, suitability, application procedure and applications. Distemper-ingredients, applying procedure and applications. White washing and colour washing.	**05**

References:

References Books:

- V. B. Sikka, A Course in Civil Engineering Drawing, S. K. Kataria & Sons.
- W. B. McKay, Building Construction, Pearson Education.
- S. Mantri, The A to Z of Practical Building Construction and Its Management, Satya Prakashan.
- C. M. Kale, M. G. Shah, and S. Y. Patki, Building Drawing and Planning: An Integrated Approach to Build Environment, Tata McGraw-Hill Education Pvt. Ltd.

Text Books:

- S. P. Arora and S. P. Bindra, A Textbook of Building Construction, Dhanpat Rai Publications.
- B. C. Punmia, A Textbook of Building Construction, Laxmi Publications.

Government Rules & Regulations:

- Unified Development Control and Promotion Regulations for Maharashtra State (UDCPR 2020), Urban Development Department, Government of Maharashtra.

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Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **CSMD2011**	Course Name: **Introduction to Data Structures**

L	T	P	Credits
3	-	-	3

Course Description:
The Data Structures and Algorithms course is a comprehensive study of fundamental concepts and techniques essential for efficient problem-solving in computer science. Students will explore various data structures, including arrays, linked lists, stacks, queues, trees, graphs, and hash tables, and learn how to analyze their time and space complexity. The course extensively explores the design and analysis of algorithms, encompassing various topics such as sorting, searching, and graph traversal. Emphasis is placed on understanding algorithmic paradigms and their applications. Through programming assignments and theoretical exercises, students will gain practical experience in implementing algorithms and solving real-world problems. This course serves as a foundation for algorithmic thinking and prepares students for advanced computer science topics.

Course Outcomes:
After successful completion of this course, students will be able to:

1. Describe the characteristics of various data structures such as stacks, queues, trees, and graphs.
2. Explain the operations and applications of linear data structures.
3. Compare linear and non-linear data structures with respect to their structure, operations, and applications.
4. Determine and justify appropriate data structures for solving real-world problems effectively.

Prerequisite: Basic knowledge of C programming, Knowledge of basic mathematical concepts

Course Content

Unit No.	Details of Content	Hrs.
1.	**Introduction to Data Structures:** Primitive and non-primitive data structures, Operations on data structures, Algorithms, Abstract Data Types (ADT).	06
2.	**Stack:** Definition & Concepts, Operations on Stack, Applications of Stack, Polish expressions, Reverse Polish Expression and conversions, Recursion.	06
3.	**Queue:** Queue and its sequential representation, Simple Queue, Circular Queue, Double Ended Queue, Priority Queue, Applications of Queue.	06

4.	**Linked List:** Definition and structure of singly linked list, doubly linked list and circular linked list. Operations: creation, traversal, insertion, deletion.	**06**
5.	**Tree:** Definitions and concepts, Terminology, Binary trees, Binary Tree Representations, Binary Tree Traversals, Binary Search Tree, Insertion and Deletion in BST, Applications of Tree.	**06**
6.	**Graph:** Definition and concepts, Graph Representation, Graph Terminology, Graph Traversals – Depth First Search and Breadth First Search. Applications of Graph.	**06**

References:

Text Books:

- Amol M. Jagtap and Ajit S. Mali, Data Structures Using C: A Practical Approach for Beginners, (Publisher not specified).
- Seymour Lipschutz, Data Structures, McGraw-Hill (Schaum's Outlines Series).
- Ashok N. Kamthane, Introduction to Data Structures in C, Pearson Education.

Reference Books:

- Alfred V. Aho, John E. Hopcroft, and Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley.
- ISRD Group, Data Structure Using C, Tata McGraw-Hill (ACE Series).

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Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **EEMD2011**	Course Name: **Electrical Power Generation**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides an understanding of the principles and performance of systems used for the generation of electrical energy. It covers the conversion of primary energy sources such as coal, hydro, natural gas, nuclear, solar, and wind into electrical power through conventional and renewable power plants.
With a multidisciplinary approach, it familiarizes students with modern generation technologies, efficiency considerations, environmental aspects, and the role of electrical energy in the evolving global energy scenario.

Course Outcomes:
After successful completion of this course, students will be able to:

1. State the principle of energy conversion and explain operation of electrical power generation.
2. Analyze the performance of generating power plants.
3. Compare different power generation technologies considering technical, economic, and environmental factors.
4. Estimate power output, efficiency, and performance parameters of various generation systems.
5. Explain working principle with layout, need, and advantages of alternate electrical energy resources.

Prerequisite:
Basic Electrical Engineering, Basic Mechanical Engineering, Basic Civil Engineering, Engineering Physics and Chemistry.

Course Content

Unit No.	Details of Content	Hrs.
1.	**Solar Power Generation:** Solar radiation, solar energy collectors, solar power plant, solar power tower, conversion of solar heat to electricity, PV cells, PV power generation, solar energy storage, Numerical on solar thermal and solar PV power generation.	06
2.	**Wind Power Generation:** Wind speed and power relation, power extracted from wind, components of Wind power system, maximum power operation, operation and layout of standalone and grid connected Wind Turbine Generators (WTG), Numerical on wind power generation.	06

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3.	**Thermal Power Plant:** Main equipment, coal handling plant, pulverizing plant, draft system, boiler, super-heater, re-heater, steam turbine, ash handling plant, condenser and cooling tower, feed water heater, economizer, air preheater, auxiliary supply, layout of thermal power plant. heat balance and efficiency, supercritical technology, Numerical on thermal power generation.	**06**
4.	**Hydro Power Plant:** Main components, storage reservoirs, dam, surge tank, penstock, spillway, tailrace, turbines, layout of hydro-power plant, site selection, run-off and its measurement, hydrograph, flow duration curve, mass curve, Hydro potential in India, problems in hydro-power plant development, Numerical on hydro power generation.	**06**
5.	**Nuclear Power Plant:** Fundamentals of nuclear power, layout of nuclear power plant, selection of site, radioactivity & nuclear reactions, nuclear fission chain reaction in reactors, reactor classification, control of reactors, disposal of nuclear waste and effluent, biological effects of radiation, shielding, development of nuclear power plant in India.	**06**
6.	**Alternate Energy Sources:** **Fuel Cell:** Principle, types of fuel cell, fuel for fuel cells, limitations and future prospects **Biomass Energy:** Availability of biomass, fluidized bed combustion, biomass power plant. **Tidal Energy:** Tidal phenomenon, tidal barrage, tidal power schemes. **Geothermal Energy:** General, heat extraction, vapor-turbine cycle, difficulties and disadvantages	**06**

References:

Text Books:

- B. R. Gupta, Generation of Electrical Energy, S. Chand Publishing.
- S. Rao and B. B. Parulekar, Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers.

Reference Books:

- John Twidell and Tony Weir, Renewable Energy Resources, Taylor & Francis.
- Yasuo Koizumi, Tomio Okawa, and Shoji Mori, Fundamentals of Thermal and Nuclear Power Generation, Elsevier.

Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **ECMD2011**	Course Name: **Electronics Devices and Applications**

L	T	P	Credits
3	-	-	3

Course Description:
This course introduces analog and digital electronics devices along with their circuits and applications. It deals with fundamentals of analog electronic devices such as R-L-C components, Diodes and its applications, BJT and FET. It focuses on working principles of operational amplifiers, electrical parameters of Op-Amp and its applications. This course also consists of number system, their conversions, logic gates, combinational and sequential logic circuits.

Course Outcomes:
After successful completion of this course, students will be able to:

1. Describe the fundamental concepts of electronics and working principles of different devices.
2. Analyze different analog and digital electronics circuits.
3. Design digital electronics circuits with truth table and logic diagram.

Prerequisite:
Fundamental concepts of Mathematics and Physics.

Course Content

Unit No.	Details of Content	Hrs.
1.	**Introduction to Electronic components:** Resistor, Inductor, Capacitor, Transformer, Diodes: P-N Junction Diode, Zener diode, LED, Photo diode. Applications of diodes: Rectifiers, Clippers and Clampers.	06
2.	**Bipolar Junction Transistor & Field Effect Transistor:** Introduction to transistors, BJT characteristics, Common Emitter configuration of BJT. Application of BJT: Transistor as a switch, Transistor as an amplifier. Introduction & types of FET.	06
3.	**Operational Amplifiers:** Block Diagram of Op-Amp, Characteristics of Op-Amp, Virtual ground concept, Inverting and Non-inverting amplifier. Linear Applications of Op-Amp: Adder, Subtractor. Non-linear Applications of Op-Amp: Schmitt Trigger, Comparator.	06
4.	**Fundamentals of Digital System:** Number systems: Decimal, Binary, Octal, Hexadecimal, Binary coded decimal (BCD), Number system conversions, Binary Arithmetic, 1's and 2's complements, Logic gates.	06

5.	**Combinational Logic Circuits:** Standard representation for logic functions, K-map, Minimization of logic functions using K-map, Half Adder, Full Adder, Half Subtractor, Full Subtractor, 1-Bit Comparator, Multiplexer, Demultiplexer, Encoder, Decoder.	**06**
6.	**Sequential Logic Circuits:** S-R flip-flop, D flip-flop, J-K flip-flop, T flip-flop. Applications of flip-flops: Shift registers, Counters: Ripple/asynchronous counters, Synchronous counters, Counters design using flip flops, Ring counter & Twisted ring/ Johnson counter.	**06**

References:

Text Books:

- Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson.
- Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, PHI.
- A. Anand Kumar, Fundamentals of Digital Circuits, PHI.

Reference Books:

- Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Tata McGraw Hill.
- R. P. Jain, Modern Digital Electronics, Tata McGraw Hill.

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Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **CIMD2011**	Course Name: **Data Structures**

L	T	P	Credits
3	-	-	3

Course Description:
This course considers common data structures that are used in various computational problems. Students will explore various data structures, including arrays, linked lists, stacks, queues, trees, and graphs. This course serves as a foundation for algorithmic thinking and prepares students for advanced computer science topics. The course covers various applications of data structures. The course also focuses on typical use cases for these data structures.

Course Outcomes:
After successful completion of this course, students will be able to:

1. Explain basic terminologies of data structures.
2. Write algorithms for operations performed on data structures.
3. Demonstrate the working of various data structures like stack, queue, linked list, tree, graph, etc.
4. Compare static and dynamic representations of data structures.
5. Choose appropriate data structure while developing solution to the problem.

Prerequisite: Basics of C Programming Language.

Course Content

Unit No.	Details of Content	Hrs.
1.	**Introduction to Data Structures:** Introduction to data structures, basic terminologies in data structure, Need and Applications, classification of data structures, Operations on data structures, Abstract Data Types.	06
2.	**Array Data Structures:** Introduction of Array, Representation of Array, Memory allocation of Array, types of arrays, operation in array, Applications of Array, Advantages and Disadvantages of Array.	04
3.	**Stack and Queue:** Stack: Definition, Representation, Operations and Applications of Stack. Queue: Definition, Representation, Operations and Applications of Linear Queue, Circular queue, Deque, Priority Queue.	07
4.	**Linked Lists**: Definition, Terminologies, Representation, Operations, singly linked list, doubly linked list, Circular linked list, Stack using linked list, Queue using linked list.	07

5.	**Trees Terminology in data Structure:** Tree definition, Terminologies and Applications, Binary trees and types. Binary tree traversals, Binary search trees, AVL tree, B tree.	**06**
6.	**Graphs Terminology in data Structure:** Graph Definition, Terminologies and Applications, Types of graphs, Representation of graph using adjacency matrix and adjacency list, Graph traversal Techniques: Depth first and Breath first search.	**06**

References:

Text Books:

- G. S. Baluja, Data Structure Through C: A Practical Approach, Dhanpat Rai Publications.
- S. Tanenbaum, Y. Langsam, and M. J. Augenstein, Data Structures Using C, PHI.

Reference Books:

- Alfred V. Aho, John E. Hopcroft, and J. D. Ullman, Data Structures and Algorithms, Addison-Wesley.
- Ashok N. Kamthane, Introduction to Data Structures in C, Pearson Education.
- Yashwant P. Kanetkar, Data Structures Through C, BPB Publications.

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Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **MEMD2031**	Course Name: **Design Thinking**

L	T	P	Credits
3	-	-	3

Course Description:
Maximizing the success of new products and services can drive growth and shareholder value, lead to significant competitive advantage and leapfrog a company ahead of its competitors. However, innovation is risky and most new products fail in the marketplace. Often, failure is due to an ineffective process. Thus, expertise in the design and marketing of new products is a critical skill for all managers, inside and outside of the marketing department. In this course, we first focus on the tools and techniques associated with analysing market opportunities and then focus on designing new products and services. This course will introduce the new product development process and cover the two main areas of focus:

- Discovery - opportunity identification.
- Design - concept and product design, development and evaluation.

Course Outcomes:
After successful completion of this course, students will be able to:

1. Identify the new product opportunities and sources of new product ideas.
2. Elaborate the product life cycle and product design process.
3. Integrate the customer and end-consumer needs into design process.
4. Assimilate the various product characteristics to design a novel product.
5. Participate effectively in group work sessions and teams to become acquainted with the importance of teamwork and collaboration that is critical to new product success.

Prerequisite:
Course is open to all Students. The course demands application of creativity, sensitivity towards solving problems and liking for doing something new and creative.

Course Content

Unit No.	Details of Content	Hrs.
1.	**Discovery- Opportunity Identification for New products:** Product life cycle, need for new products, strategic planning and new product opportunity, sources of new product ideas, S curves and technology forecasting. Product idea generation, Product Design Process steps.	06
2.	**Creativity and Innovation:** Definition, relevance of Creativity and Innovation in new product design, Improving creativity and innovation, hindrances to creative thinking, importance and formation of teams. Improving creativity and innovation, hindrances to creative thinking, importance and formation of teams.	06

3.	**Identifying Customer Needs:** Understanding customer needs, Voice of the customer, gathering customer needs, organizing and prioritizing needs, Product mission statement, establishing product function.	**06**
4.	**Establishing Product Specification:** Product Teardown and Experimentation, Benchmarking, Quality Function Deployment (QFD)	**06**
5.	**Product Portfolios and Portfolio Architecture:** Product Architecture-types, establishing architecture, Modular design-basic clustering method, advanced functional methods	**06**
6.	**Product Concept Generation, Selection and Testing:** Concept generation process and methods, Concept selection mechanism and techniques, Concept Testing-Purpose, process and methods.	**06**

References:

Reference Books:

- Ulrich, Eppinger, Anita Goel, Product Design and Development, McGraw Hill Publishing.
- Otto & wood, Product Design, Pearson Education, reprint.
- Charles Flurscheim, Industrial Design in Engineering, the Design Council, London.
- Devdas Shetty, Design for product success, Society for Manufacturing Engineering.

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Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **MEMD205**	Course Name: **I. C. Engine**

L	T	P	Credits
3	-	-	3

Course Description:
This course describes the fundamentals of internal combustion engines used in automotive and allied application. The effect of operation and design of internal combustion engines on their performance, efficiency, fuel requirements, and environmental impact is studied. Topics include thermodynamics of engine processes, engine fluid flow; fuel systems in SI and CI engines, combustion, heat transfer and friction phenomena and recent engine technologies are studied under this course. Students examine the design features and operating characteristics of different types of internal combustion engines wise spark-ignition, compression ignition engines.

Course Outcomes:
After successful completion of this course, students will be able to:
1. Explain construction and working of SI and CI engines.
2. Perform a primary thermodynamic analysis of Otto and diesel cycle engines.
3. Select proper fuel system for IC engine.
4. Evaluate engine emissions and pollution norms.
5. Interpret modern engine technologies.

Prerequisite: Nil.

Course Content

Unit No.	Details of Content	Hrs.
1.	**Basics of I. C. Engines:** Introduction, Classification of I. C. Engines, Basic engine components and nomenclature, applications, Difference between two stroke and four stroke engines, difference between SI and CI engines.	06
2.	**Engine Cycles:** Theoretical cycles (Air standard cycles and Fuel Air cycles), Deviation of actual cycles from theoretical cycles, Various losses in actual cycles, Valve timing diagram for high and low speed engine, Port timing diagram.	06
3.	**Engine Systems:** Heat rejection and cooling, Air cooling, liquid cooling, Introduction to lubrication systems, Types of lubrication systems, Air intake system, filters & manifolds, Mufflers and resonators, Supercharging, Turbocharging.	06
4.	**Fuel Systems in I. C. Engines:** Carburetion, A/F ratio, Mixture requirements at different loads and speeds, Simple carburetor, Complete carburetor systems, Introduction to MPFI system, Requirements of injection systems, types of injection system, CRDI systems and its comparison with other systems, Injection pumps, injectors,	06

	nozzles, Governors, trouble shooting in in fuel systems.	
5.	**Engine emissions and control methods:** Emissions from SI and CI engines, need to control emissions, emission Standards, pollution norms like EURO, BHARAT etc. methods to control emissions like catalytic converter.	**06**
6.	**Recent trends in I C Engines:** Alternative Fuels Homogeneous Charge Compression, Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine, Four Valve and Overhead cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine.	**06**

References:

Text Books:

- M. L. Mathur, R. P. Sharma, Internal Combustion Engine, 8, Dhanpat Rai Publications.
- V. Ganeshan, I C Engine, Tata McGraw Hill Publication.
- V. M. Domkundwar, A Course in Internal Combustion Engines, Dhanpat Rai & Co.

Reference Books:

- E. F. Obert, I.C. Engine & Air Pollution, Harper & Row Publishers.
- SAE, Automotive Handbook, Bosch.
- John b Heywood, Internal Combustion Engine, Tata McGraw Hill Publication.

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Department of Mechanical Engineering

Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **MCMD2011**	Course Name: **Fundamentals of Mechatronics**

L	T	P	Credits
3	-	-	3

Course Description:
This course aims at providing fundamental understanding about the basic elements of a mechatronics system, interfacing, and its practical applications.

Course Outcomes:
After successful completion of this course, students will be able to:
1. Identify various elements of mechatronics systems.
2. Select appropriate sensor/Actuator/controller/control algorithm for different applications.
3. Develop PLC/ microcontroller-based applications.

Prerequisite: The students should have knowledge of basic electronics.

Course Content

Unit No.	Details of Content	Hrs.
1.	**Introduction:** Introduction to Mechatronics, Key elements of Mechatronics, Block diagram of mechatronics system, Control systems and Modes of control, Difference between traditional and concurrent design process.	02
2.	**Sensors and transducers:** **Transducers-** classification, Development in Transducer technology **Sensors -** Introduction, Need of Sensors, Classification, Working and Application of- Potentiometer Sensors, Strain Gauge Elements. Capacitive Elements, Eddy Current, Proximity Sensors, Inductive, Proximity Sensors, Light Sensors, Pressure Sensors, Pneumatic Sensors, Pyro electrical Sensors, Piezoelectric Sensors, Shaft Encoders. Selection of Sensors.	08
3.	**Drives and Actuators:** Introduction and Classification of Actuators. Need and Scope. Hydraulic Actuation systems – Linear, Single and Double Acting system, Pneumatic Actuation systems- Gear Motors and Vane Motors. Electrical Actuation Systems – solenoid type Devices, Stepper Motors, and Servo Motor. Selection of Actuators.	06
4.	**Controllers: PLC:** Introduction, definitions, PLC block diagram, Difference between Relay panel and PLC, Selection of PLC, Programming formats, Ladder logic programming. **Microcontroller and Microprocessor:** Introduction, Comparison of Microcontroller and Microprocessor, Architecture – Pin configuration of 8051 Microcontroller, Assembly	08

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	programming.	
5.	**Signal Conditioning:** Operational amplifier circuits, filtering circuits, Analog, and Digital signal conversion.	**06**
6.	**Advanced applications in mechatronics:** Mechatronics in automated manufacturing, Artificial intelligence in mechatronics, Fuzzy logic in mechatronics, Case studies of mechatronics systems.	**06**

References:

Text Books:

- Devdas Shetty and Richard A. Kolk, Mechatronics System Design, PWS Publishing Company (Thomson Learning Inc.).
- William Bolton, Mechatronics: A Multidisciplinary Approach, Pearson Education.
- R. K. Rajput, A Textbook of Mechatronics, S. Chand & Company Pvt. Ltd.
- William Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Prentice Hall.

Reference Books:

- David G. Alciatore and Michael B. Histand, Introduction to Mechatronics and Measurement Systems, McGraw Hill Education.

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Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **AIMD2011**	Course Name: **Object Oriented Programming**

L	T	P	Credits
3	-	-	3

Course Description:
This course introduces object-oriented programming using the Java programming language. Students will learn how to program in Java and use some of its most important APIs. Special importance will be assigned to the object-oriented nature of Java and its use of polymorphism. Hands-on labs and exercises will enable students toward becoming highly skilled Java Application developers.

Course Outcomes:
After successful completion of this course, students will be able to:

1. Identify and integrate basic object-oriented programming concepts and apply them in problem-solving.
2. Construct and test inheritance concepts for reusing the program.
3. Develop and test a program using loops, decision statements, and functions in Python.
4. Evaluate the given Plot data using appropriate Python visualization libraries.

Prerequisite: Basic Programming Skills.

Course Content

Unit No.	Details of Content	Hrs.
1.	**Oops Concepts and Java Programming:** OOP concepts: Procedural and object-oriented programming paradigm, Classes and objects, data abstraction, encapsulation, constructors, inheritance, polymorphism and overloading, Java programming: History of java, comments data types, variables, constants, scope and life time of variables, operators, control flow statements, arrays, console input and output, garbage collection, exploring string class.	06
2.	**Multiple Inheritance, Interfaces and Packages:** Inheritance: Inheritance hierarchies, super and subclasses, preventing inheritance, Polymorphism: dynamic binding, method overriding, Interface: Interfaces VS Abstract classes, implement interfaces, accessing implementations through interface references, Packages: Defining, creating and accessing a package, importing packages.	06
3.	**Introduction to Python fundamentals:** Python introduction, Python syntax, Python comments, Python variables, Python data types, Python numbers, Python casting, Python strings, Python Booleans, Python operators.	06

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4.	**Lists, Tuples, Sets, Dictionaries:** Access, change, add and remove list elements, loop lists, list comprehension, list methods, access, update, unpack tuples, loop tuples, tuple methods, Access, add, remove set items, set methods, access, add, change, remove dictionary items, nested dictionaries, dictionary methods.	**06**
5.	**Python conditional statements:** If-else, while, for, lambda, arrays, Python Iterators, Python scope **Python classes and objects:** Classes, objects, parameterized and non-parameterized init constructor, object methods, self-parameter, association, aggregation and inheritance using python.	**06**
6.	**Python for Machine Learning:** Numpy, Pandas, Matplotlib and Seaborn,	**06**

References:

Text Books:

- Herbert Schildt and Dale Skrien, Java Fundamentals: A Comprehensive Introduction, McGraw Hill.
- Herbert Schildt, Java: The Complete Reference, McGraw Hill.
- Charles Dierbach, Introduction to Computer Science Using Python, Wiley India.
- Reema Thareja, Python Programming Using Problem Solving Approach, Oxford University Press.

Reference Books:

- P. Radhakrishna, Object-Oriented Programming Through Java, CRC Press.
- Charles R. Severance, Python for Everybody: Exploring Data Using Python 3, Shroff Publishers.

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Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **RAMD2011**	Course Name: **Fundamentals of Robotics & Automation**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides an in-depth understanding of the fundamental concepts and applications of robotics and automation. It provides an introduction to robotics, it's history and development, various types of end effectors, grippers, kinematic and dynamics of robotics, robot drive systems, sensors and actuators and fundamentals of robot programming and applications. This course also introduces the need for automation, its types and various applications of automation technology in industries.

Course Outcomes:
After successful completion of this course, students will be able to:
1. Differentiate various robotic configurations and performance metrics.
2. Compare various end effectors, sensors, and drive systems in robotic applications.
3. Illustrate kinematic and dynamic principles applied to robotic systems.
4. Outline robot programming solutions for diverse applications.
5. Distinguish various types and aspects of automation.
6. Relate the knowledge of Programmable Logic Controllers (PLCs) to industrial automation tasks.

Prerequisite: Engineering Science Courses, Engineering Mathematics, Basic Mechanics, Programming Fundamentals.

Course Content

Unit No.	Details of Content	Hrs.
1.	**Introduction to Robots:** Definition - Historical background - Various generations of robots – Robot Anatomy - Robot configuration: Polar, Cylindrical, Cartesian coordinate, Joint-arm configuration - Degree of freedom - Work volume and Dead zone - Dynamic performance: Speed of response and Stability - Precision of movement: Spatial Resolution, Accuracy, Repeatability and Compliance.	06
2.	**Robot End Effectors, Sensors and Drive Systems:** **End Effectors**: Characteristic features - Types: Mechanical grippers, Magnetic grippers, Vacuum cups, Adhesive gripper, Hooks and Scoops - Tools as end effectors - Robot / End-effectors interface - Consideration in Gripper selection and Design **Sensors**: Transducers and Sensors - Sensors in Robotics: Tactile, Proximity and Range Sensors, Miscellaneous sensors and sensor-based systems - Robot Vision System. **Robot Drive System**: Hydraulic, Electric and Pneumatic.	06

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3.	**Robot Kinematics & Dynamics:** Representation of objects in 3-D space-position and orientation, representation of orientation using roll, pitch and yaw angles, representation of orientation using Euler angles. Denavit - Hartenberg notations- link and joint parameters-rules for coordinate assignments, forward and inverse kinematics, Introduction to inverse and forward dynamics, determination of inertia tensor, Lagrange-Euler formation for joint torque	**06**
4.	**Robot Programming and Its Applications:** Lead-through Programming, Walk-through Programming, Use of Teach pendants - Capabilities and limitations. Textural Programming: requirements of robot programming language, problems pertaining to robot programming languages, Common languages/Software used- - Robot program as a path in space Applications: Factors influencing the selection of Robots - Robots for Materials handling, Assembly, Agriculture and Chemical Plants - Advanced applications. Intelligent Robots - Introduction to Mobile Robots, Legged Robots and Remote-Controlled Robots, Automated Guided Robots, Micro Robots - Control and Safety Issues.	**06**
5.	**Introduction to Automation:** Mechanization and Automation - History of Automation - Reasons for automation - Merits and limitations - Automation systems - Types of Automation: Fixed, Flexible and Programmable Automation - Intelligent Industrial Automation - Automation and Robotics.	**06**
6.	**Introduction to Programmable Logic Controller (PLCs):** Principles of operation of Programmable Logic Controller (PLC), PLC verses computer, PLC hardware components, Scan time of a cycle, Industrial PLC, Application of PLCs.	**06**

References:

Text Books:

- Mittal R K & Nagrath, Robotics and Control, McGraw Hill Publication TMH.
- S. K. Saha, Introduction to Robotics, TMH.
- Groover, M.P. Weiss, M. Nagel, R.N. & Odrey, N.G., Ashish Dutta, "Industrial Robotics, Technology, Programming & Applications", Tata McGraw Hill Education Pvt. Ltd. New Delhi.

Reference Books:

- John J Craig, Introduction to Robotics, Pearson Edu.
- Fu K.S, Robotics, McGraw Hill.
- Niku SB, "Introduction to Robotics – Analysis, Control, Applications", John Wiley & Sons Ltd.

NPTEL Course on Robotics:

- https://onlinecourses.nptel.ac.in/noc19_me74/preview.
- https://onlinecourses.nptel.ac.in/noc20_de11/preview.

Class: **S. Y. B. Tech.**	Semester- **III**
Course Code: **ME2334**	Course Name: **Machine Drawing Lab**

L	T	P	Credits
-	-	2	1

Course Description:
Drawing is commonly used mode of communication in engineering industry. The potentialities of drawing as an engineer's language may be made use of as a tool for imparting knowledge and providing information on various aspects of engineering. Appropriate exposure to drawing helps the students to translate different ideas into practical applications. Acquisition of drafting skills as per standard conventions is used to make the drawing of a given object or component so that others can understand and interpret the drawing as intended by the draftsman. Industries follow drafting standards as approved by International Organization for Standardization (ISO).

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

1. Interpret machine drawings and BIS conventions used for standard machine elements and joints.
2. Prepare freehand sketches of machine elements and mechanical joints with proper proportions and labelling.
3. Develop detailed and assembly drawings of machine components following standard drawing practices.
4. Apply limits, fits, tolerances, surface finish symbols and GD & T to develop production drawings of machine components.

Prerequisite:

1. Engineering Graphics and basic drafting conventions.
2. Basic understanding of machine elements and mechanical components.
3. AutoCAD software.

Course Content

Expt. No	Description	Hrs
1.	Study and drawing of BIS conventions for materials, external/internal screw threads, studs, slotted heads, square ends, etc.	02
2.	Drawing of standard BIS representations of springs (helical compression, tension, torsional, conical), etc.	02
3.	Freehand sketching with proper proportion and labeling of nuts, bolts, set screws, etc.	02
4.	Freehand sketches of cotter joints, knuckle joint, flanged coupling, etc.	02
5.	Freehand sketches of Plummer block, foot-step bearing, chain butt riveting, zig-zag riveting, sectional views etc.	02
6.	Detailed and assembly drawing with sectional elevation and dimensions of sleeve & cotter joint or spigot & cotter joint.	02
7.	Detailed and assembly drawing of knuckle joint and stuffing box with	02

	sectional views and dimensioning.	
8.	Detailed and assembly drawing of screw jack or footstep bearing using proper conventions, dimensions and sectional representation.	**02**
9.	Detailed and assembly drawing of protected type flanged coupling or universal coupling showing assembly details, sectional views and tolerances.	**02**
10.	Detailed and assembly drawing of Plummer block or machine vice with dimensions and tolerances.	**02**
11.	Limits, fits (clearance, transition and interference), hole basis and shaft basis systems, surface roughness and machining symbols	**02**
12.	Production drawing of machine components using CAD software incorporating dimensions, tolerances, GD&T symbols (form, orientation, position, profile, runout), MMC/LMC and surface finish indications.	**02**

References:

Text Books:

- K. L. Narayana, P. Kannaiah and K. Venkata Reddy, Machine Drawing, 2nd Edition, New Age International Publishers.
- P. S. Gill, A Textbook of Machine Drawing, 2nd Edition, S. K. Kataria & Sons.
- N. D. Bhat and V. M. Panchal, Machine Drawing, 48th Edition, Charotar Publishing House.
- N. D. Junnarkar, Machine Drawing, Pearson Education.

Reference Books:

- K. C. John, Textbook of Machine Drawing, PHI Learning Pvt. Ltd.
- R. K. Dhawan, A Textbook of Machine Drawing, S. Chand Publishing.

Class: **S. Y. B. Tech.**	Semester: **III**
Course Code: **ME239**	Course Name: **Fluid Mechanics Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This course covers verification of theoretical concepts, calculation of coefficient of discharge of various flow apparatus and determination of losses through pipes. Student will also conduct trials on pumps, compressors and turbine and will evaluate their performance.

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

1. Verify and apply Bernoulli's Theorem.
2. Determine coefficient of discharge of fluid flow apparatus.
3. Calculate various losses through pipes.
4. Analyze flow behavior in series and parallel pipe networks.
5. Identify and classify flow regimes using Reynolds apparatus.
6. Visualize and interpret fluid flow patterns using Hele-Shaw apparatus.

Course Content

Expt. No.	Description (Any 10 experiments)	Hrs.
1.	Verification of Bernoulli's equation.	02
2.	Calibration of Venturimeter.	02
3.	Calibration of Orifice meter.	02
4.	Determination of various hydraulic coefficients for orifice under steady and unsteady flow condition.	02
5.	Calibration of V-notch.	02
6.	Calibration of Rectangular notch.	02
7.	Determination of major losses in pipe fittings.	02
8.	Determination of minor losses in pipe fittings.	02
9.	Determination of loss of head and discharge in parallel and series pipes.	02
10.	To study types of flow by using Reynolds apparatus.	02
11.	Demonstration of flow visualization by using Hele-Shaw apparatus.	02
12.	Industrial Visit.	02

References:

Text Books:

- R.K. Bansal, Fluid Mechanics, Laxmi Publications.
- R.K. Rajput, A Textbook of Fluid Mechanics and Hydraulic Machines, S. Chand & Company.
- D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S.K. Kataria & Sons.
- S. Balani and R.K. Basal, Hydraulics and Fluid Mechanics, Khanna Publishers.
- H. Lamb, An Introduction to Fluid Dynamics, Cambridge University Press.

Reference Books:

- S.K. Som and G. Biswas, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill.
- Frank M. White, Fluid Mechanics, McGraw-Hill.

Class: **S. Y. B. Tech**	Semester: **III**
Course Code: **ME245**	Course Name: **Metrology and Quality Control Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This laboratory course provides hands-on training in the use of precision measuring instruments and quality control techniques used in manufacturing industries. The course includes experiments on linear and angular measurements, geometrical measurements, surface finish evaluation, gauges, comparators, and Coordinate Measuring Machine (CMM). Students will also perform statistical quality control analysis using control charts and quality control tools. The practical course develops skills in inspection, measurement accuracy, data analysis, and industrial quality assurance practices.

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

1. Demonstrate the use of precision measuring instruments for dimensional, angular, geometric, and surface measurements.
2. Measure and evaluate dimensional accuracy, surface characteristics, and quality of engineering components using appropriate inspection techniques.
3. Analyze quality data using statistical quality control tools for process monitoring and improvement.
4. Interpret control charts and quality analysis results for evaluating manufacturing process performance.

Prerequisite:

1. Basic knowledge of Engineering Drawing and Manufacturing Processes
2. Familiarity with workshop practices and measuring instruments
3. Basic concepts of production and mechanical engineering systems

Course Content

Unit No	Description	Hrs
1.	Use of Vernier Caliper and Micrometer for linear measurements	02
2.	Measurement of angle using slip gauges and sine bar.	02
3.	Measurement of angles using Bevel Protractor.	02
4.	Measurement of flatness of engineering components	02
5.	Measurement of surface roughness using surface roughness measuring instruments	02
6.	Use of Plug Gauge, Ring Gauge and Snap Gauge	02
7.	Measurement using Tool Maker's Microscope	02
8.	Application of Statistical Quality Control tools such as Histogram, Pareto Chart, Cause-and-Effect Diagram and Scatter Diagram.	02
9.	Preparation and analysis of X-chart, R-chart, using sample quality data.	02
10.	Preparation and analysis of p-chart and c-chart using sample quality	02

	data.	

References:

Text Books:

- R. K. Jain, Engineering Metrology, Khanna Publishers.
- N. V. Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press.
- I. C. Gupta, A Textbook of Engineering Metrology, Dhanpat Rai Publications.
- E. L. Grant and R. S. Leavenworth, Statistical Quality Control, McGraw Hill.
- Dale H. Besterfield, Total Quality Management, Pearson Education.

Reference Books:

- R. K. Rajput, Mechanical Measurements and Metrology, S. Chand Publications.
- Acheson J. Duncan, Quality Control and Industrial Statistics, Irwin Publications.
- Connie L. Dotson, Fundamentals of Dimensional Metrology, Cengage Learning.
- Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley India.
- Mahajan, Engineering Metrology, Dhanpat Rai Publications.

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Class: **S. Y. B. Tech**	Semester: **III**
Course Code: **ME2354**	Course Name: **Workshop Practice -I**

L	T	P	Credits
--	--	2	1

Course Description:
This course provides practical exposure to basic machining and advanced welding processes used in manufacturing industries. Students develop hands-on skills in lathe operations, tool grinding, threading, and welding processes such as TIG, MIG, submerged arc welding, and plasma arc cutting.
The course also emphasizes understanding the influence of machining parameters on surface finish, dimensional accuracy, and tool wear, thereby strengthening practical manufacturing and fabrication competencies.

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

1. Perform tool grinding and sharpening and apply them to improve tool performance.
2. Perform different operations to produce "A" part of job on lathe machine such as turning, facing, step turning, knurling, threading operations on MS workpiece, ensuring flatness, smooth surface finish with accuracy and precision.
3. Operate TIG, MIG and submerged arc welding setup with proficiency.
4. Analyze the factors affecting machining responses such as surface roughness and tool wear.

Course Content

Unit No	Description	Hrs.
1.	**Lathe Operations:** Job Involving Tool Grinding, Facing, Step Turning, Taper Turning, Knurling, 'V' Threading Operations, Analyzing Machining response during these operations e.g., Surface roughness and Tool wear	12
2.	**Advance Welding Shop:** Job on TIG Welding, Job on MIG Welding, Demonstration of Stainless Steel & Aluminum Welding, Job on Plasma Arc Cutting, Job on Submerged Arc Welding, Comparison of strength of various weld joints	12

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References:

Text Books:

- Hajra Choudhary, Element of Workshop Technology vol. II, Media Promoters and Publications.
- Hajra Choudhary, Element of Workshop Technology vol. I, Media Promoters and Publications.

Reference Books:

- Raghuvansrii, Workshop Technology, vol. II, Dhanpat Rai.
- W A. J. Chapman, Workshop Technology, Part II, Oxford and IBH Publishing Co.

Choice Based Professional Skills Development and Foreign Languages Program
for
Second Year B. Tech.
(Sem. III and IV)

Professional Skills Development and Foreign Languages Courses

1. Professional Leadership Skills (SH2635)
2. Interpersonal Skills (SH2615)
3. Innovation Tools and Methods for Entrepreneurs (SH2695)
4. Personal Effectiveness and Body Language (SH2595)
5. German Language - Level III (SH2735)
6. German Language - Level IV (SH2645)
7. Japanese Language - Level III (SH2715)
8. Japanese Language - Level IV (SH2625)

***An Important Notes:**

A student has to complete any two courses out of six choices offered under Choice Based Professional Skills Development Programme. A course in each semester will be allocated without any repetition.

Foreign language course selected in F.Y. Sem-I will remain the same with next levels in Sem-III and IV. (No new entries in S.Y.B.Tech Sem.-III)

Class: **S. Y. B. Tech.**	Semester-**III/IV**
Course Code: **SH2635**	Course Name: **Professional Leadership Skills**

L	T	P	Credits
-	-	2	1

Course Description:
This course is one of various courses offered under Choice Based Professional Skills Development programme. This course guides those special students who want to be entrepreneurs and professional leaders. This course covers various aspects of Leadership which includes Team formation, conflict management, motivation, and presentation skills.

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

1. Demonstrate self-management skills through co-curricular activities.
2. Explain the traits of a leadership through real life examples.
3. Exhibit the ability to work effectively in team.
4. Apply decision making techniques in formal meetings.
5. Prepare a presentation as per the audience and context requirements.

Prerequisite: A Student, who is going to enroll for this course should have -

1. Adequate knowledge of basic grammar of English language.
2. Intermediate level vocabulary of English language.
3. Ability to communicate moderately in English.

Course Content (Minimum 12 sessions will be conducted from the following list.)

Experiment No	Description	Hrs
1.	**SMART Goal Setting, SWOT/C Analysis and Action Plan:** Discussion on Dos and Don'ts, Advantages, and Generation of the Document by Students and its Assessment.	02
2.	**Assertiveness and Positive Thinking:** Types of Behaviour, Benefits of Being Assertive and Positive Thinking, Developing Positive Attitude, Case Studies and Presentations	02
3.	**Self Management:** Need of Self Management, Developing Self Acceptance, Steps of Self Management, Individual Classroom Activity and its Assessment	02
4.	**Leadership Styles and Change Management:** Introduction to Different Types of Leaderships, Effective Organizational Change Management, Individual Classroom Activity and its Assessment	02
5.	**Team Formation and Leading a Team-I:** Why Teams? Roles and Responsibilities in Teams, Strategies for Team Development, Barriers to Teams, Steps of Team Development	02
6.	**Team Formation and Leading a Team – II:** Case Studies of Teams and Student Presentations	02
7.	**Business Meetings and Decision Making – I:** Preparing for the	02

	Meeting, Role of Chairperson and Participants in Meetings	
8.	**Business Meetings and Decision Making – II:** Mock Meetings, Decision Making Case Studies and Feedback	**02**
9.	**Conflict Management:** Types of Personalities, Possible Reasons of Conflicts at Work Place, Conflict Resolution Strategies, Conflict Management Case Studies and Feedback	**02**
10.	**Time Management:** Time Management Techniques, Introduction to Time Management Tools, Benefits of Time Management, Case Studies and Presentations	**02**
11.	**Presentation Skills – I:** Preparation, Types of Presentations - Informative, Instructional, Arousing, Persuasive, Decision-making, Presentation Tools	**02**
12.	**Presentation Skills – II:** Body Language, Managing Questions and Student Presentations Student Presentations and Feedback, Student Presentations and Feedback	**02**
13.	**Creative and Critical Thinking:** Approaches to Creative Thinking, Strategies for Creative Thinking, Characteristics and Strategies of Critical Thinking	**02**
14.	**Motivating People:** Types of Motivation, Components of Motivation, Steps in Keeping Motivation Level High	**02**

References:

- Krishna Mohan and Meera Banerji; *Developing Communication Skills*, Macmillan India Ltd., New Delhi.
- Masters, L. Ann et al. *Personal Development for Life and Work*, New Delhi: Cengage Learning.
- Jeff Butterfield, *Soft Skills for Everyone*, Cengage Learning India Private Limited.
- John Seely, *Oxford Guide to Effective Writing and Speaking*; Oxford University Press.
- UNLESH the power within... Soft Skills – Infosys Training Manual Module 1 to 5 (Infosys Campus Connect Programme).

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)
Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

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Class: **S. Y. B. Tech.**	Semester-**III/IV**
Course Code: **SH2615**	Course Name: **Interpersonal Skills**

L	T	P	Credits
-	-	2	1

Course Description:
This course offers the tips and techniques to lead a life full of success, prosperity and happiness by changing the current mind set to that of positive and harmonious thinking. It further teaches upon important aspects such as priorities in life, how to manage stress, teamwork, laws of nature, human body as a divine computer, power of mind etc.

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

1. Exhibit interpersonal communication skills.
2. Analyze self for SWOT to achieve the goal stated.
3. Demonstrate decision-making skills.
4. Apply conflict resolution styles appropriate in different situations.
5. Demonstrate skills to manage balance in work and life.

Prerequisite: A Student, who is going to enroll for this course, should have following English language abilities:

1. Adequate knowledge of basic grammar of English language.
2. Intermediate level vocabulary of English language.
3. Communicate moderately using English language.

Course Content

Experiment No	Description	Hrs
1.	**Importance of Universal Laws of Nature in Human Life:** Overview, scientific, universal, secular, usefulness in every walk and phase of life, overview of Universal Laws of Nature, determining factor in human life, important laws of nature and its influence on life of individual, family, society and world at large. wisdom, living life in tune with laws of nature	02
2.	**'You are the Architect of your Destiny':** This unit will make you aware that none else but you alone are responsible and accountable for what you achieve in your life, freedom of decisions, choices to make up your future, guiding powers to make the choices in your life, achieving life full of health, wealth, success, peace and happiness for yourself and all	02
3.	**Setting and Achieving Goals:** Defining your own goals in life, Concept of power of mind, concepts of interaction of conscious and subconscious levels of mind, tips and techniques to harness the	02

	amazing power of subconscious mind to achieve goals, Visualization and auto-suggestion techniques, real life examples	
4.	**Work-life Balance:** What is means by work-life balance, priorities in life, time management, its importance, practical tips that enable to achieve work-life balance	**02**
5.	**Art of Harmonious Thinking:** Importance, concept of harmonious thinking, Wishful Thinking, Positive Thinking, difference between Harmonious Thinking and Positive Thinking, powerful techniques to inculcate the habit of Harmonious Thinking, concept of Spiritual Thinking, Divine Universal Prayer – the life changer, Bless All technique, benefits of chanting the prayer	**02**
6.	**Spirituality in Day-to-day Life:** Concept of Love Work, 7 dimensions of Love Work, benefits us as individual, family, society and entire human race, important to be a good human being, usefulness to become successful, tools to apply the different 'Life skills' in day-to-day life, simple but powerful and useful techniques such as attitude of gratitude, attitude of win-all	**02**
7.	**Human Values:** Ethics and Human values, difference in ethics and values, Qualities of human values	**02**
8.	**Communication Skills:** Ability to commendably read, write, speak and listen by conforming knowledge and presenting in a structured, cohesive fashion, Understanding and demonstrating workplace communication in the context of organization's business, understanding one's core skills for job	**02**
9.	**Interpersonal Skills:** Presenting interpersonal skills by amiable and respecting individuals, effective listening to stakeholders, bonding and developing rapport, Team success	**02**
10.	**Decision Making**: Importance of correct decision making, Analytical thinking / mind, Information processing ability, Making sound judgment and confident decision	**02**
11.	**Cross cultured sensitizations & Adaptability:** Adapting multinational & multicultural environment, embracing diversity, culturally sensitive and bonding to colleagues and stakeholders, sense of belongings and promotion of unity at work place	**02**
12.	Evaluation of Students for their Understanding of Various Concepts Discussed.	**02**

References:

- Spiritual Wisdom in Day-to-day life – Blogs by Mr. Pralhad Wamanrao Pai.
- Towards the goal of beautiful life – Book by Satguru Shri Wamanrao G. Pai.
- Power of your subconscious mind – Dr. Murphy.
- Seven people of highly effective people – Stephen Covey.
- How to win friends and influence people – Dale Carnegie.

- S. Hariharan, et al; *Soft Skills*, MJP Publishers, Chennai (2010).
- Gopalaswamy Ramesh et al. The ACE of Soft Skills: Attitude, Communication and Etiquette for Success, New Delhi: Pearson Education, 2012. Print.
- Masters, L. Ann et al. Personal Development for Life and Work, New Delhi: Cengage Learning, 2012. Print.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)
Evaluation Method: In every session student will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

Class: **S. Y. B. Tech.**	Semester-**III/IV**
Course Code: **SH2695**	Course Name: **Innovation Tools and Methods for Entrepreneurs**

L	T	P	Credits
-	-	2	1

Course Description:
This course helps students to identify different tools for developing the solution that student has already learned to ideate in the previous course "Creativity and Design Thinking". Further, students get information about various tools to carry out competitor analysis and user journey map. It would help him to come up with detailed specifications and USP of the product based on the competitor survey.

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

1. Define complex problems, predict emerging trends, and model trade-offs and contradictions to generate innovative solutions.
2. Analyze real-world problems using systematic innovation techniques, TRIZ, functional analysis, and creative problem-solving tools to identify contradictions and generate innovative solutions.
3. Evaluate business opportunities through frugal and disruptive innovation approaches, business model canvas, and institutional support mechanisms for entrepreneurship development.
4. Apply design thinking methodologies, user journey mapping, competitor analysis, and product/software design specifications to develop user-centric and value-driven products or services.
5. Develop a comprehensive entrepreneurial project report incorporating technical, financial, economic, production, and managerial aspects, and prepare an effective investor pitch to communicate business ideas professionally.

Prerequisite: A Student who is going to enroll for this course should have following abilities:

1. Creativity and Innovativeness
2. Problem identification
3. Apply design thinking approach to develop working prototype
4. Structured approach to problem solving

Course Content

Experiment No	Description	Hrs
1.	**Systematic Innovation:** Define the problem in depth with all details, Trend prediction, Modeling the problem to identify tradeoffs and contradictions	02
2.	**TRIZ:** Theory of Inventive problem solving (TRIZ), HIT Matrix, Scamper, Algorithms of brain storming and innovation, Functional analysis	02

3.	**Frugal and Disruptive Innovation:** Biomimicry and frugal innovation for prototyping, Disruptive innovation.	**02**
4.	**User Journey Map:** Map showing user interaction at every stage of product/service. Step-by step process of UJM creation	**02**
5.	**Competitor analysis:** Analysis of competitor and users for similar products, effectiveness of existing solutions and identifications of gaps	**02**
6.	**Product/Software Design Specifications:** Detailed specifications for better product design, detailed UI for software for clarity on user interaction, specify USPs of the product in comparison to the competitors	**02**
7.	**Business Canvas:** Definition of a Business Model The 9 Building Blocks: 1. Customer 2. Value Propositions 3. Channels, distribution, 4. Customer relationships 5. Revenue 6. Key Resources 7. Key Activities 8. Key Partnerships 9. Cost Structure	**02**
8.	**Design Thinking (Part I):** Customer Insights, Ideation, Visual Thinking.	**02**
9.	**Design Thinking (Part II):** Prototyping. Storytelling. Scenarios	**02**
10.	**Institutional arrangement for Entrepreneurship Development:** Institutional arrangement for Entrepreneurship Development – DIC, ITCOT, SIDCO, NSIC, SISI, TIIC, SIDBI, Commercial Banks	**02**
11.	**Project Report:** a) Economic Aspects b) Technical Aspects c) Financial Aspects d) Production Aspects e) Managerial Aspects	**02**
12.	**Investor Pitch Tool:** a) Introduction b) Helpful Tips about preparation, pitching and content sharing c) Does and Don'ts d) Introduction e) Problem f) Solution/Product/Service g) Traction h) Market Opportunities/ Size i) Competition j) Go To Market Strategies k) Financials l) Team	**02**

References:

- J. Knapp. Design Sprint, Simon & Schuster Publisher.
- Silverstein. The Innovator's Toolkit, Wiley Publishing House.

- M. A. Orloff. ABC-TRIZ: Introduction to creative design thinking with modern TRIZ modeling, Springer Publication.
- M. Laverty. Entrepreneurship, OpenStax Publication.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)
Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

Class: **S. Y. B. Tech.**	Semester-**III/IV**
Course Code: **SH2595**	Course Name: **Personal Effectiveness and Body Language**

L	T	P	Credits
-	-	2	1

Course Description:
This course is one of various courses offered under Choice Based Professional Skills Development programme. The course with its interactive and need based sessions helps students in knowing and managing self, set and pursue meaningful goals, and develop positive personal qualities for sustainability in today's global world.

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

1. Develop skills to build self-esteem and positive attitude.
2. Develop interpersonal skills characterized by effective communication
3. Define nonverbal clues during interpersonal dialogue.
4. Demonstrate responsiveness towards time, stress, and health issues.
5. Interpret the non-verbal behaviour of a person.

Prerequisite: A Student, who is going to enroll for this course, should have following English language abilities:

1. Adequate knowledge of basic grammar of English language.
2. Intermediate level vocabulary of English language.
3. Communicate moderately using English language.

Course Content (Minimum 12 sessions will be conducted from the following list.)

Experiment No	Description	Hrs
1.	**Self-awareness and Self Esteem:** Meaning, Factors influencing self-esteem- environmental and social factors Developing self-esteem- strategies for building self-esteem	02
2.	**Goal Setting:** Long term and short-term goals, Steps in goal setting (SMART)- - identify strategies - consider possible blocks and ways to deal with them - outline the steps - set deadlines	02
3.	**Self-Analysis:** SWOT Analysis, who am I, Attributes, Importance of Self Confidence	02
4.	**Personality Typing**: Extraversion, Introversion, Sensing, Intuition, Thinking, Feeling, Judging Perceiving	02
5.	**Life Skills for Personal Effectiveness:** Values: Punctuality, Honesty, Loyalty, Dependability, Reliability-	02

	Application of Life Skills in day - to- day life - Life Skills for Adolescents and Youth	
6.	**Time Management:** Strategies for effective time management (Principles, Planning, Identify & Control time stealers, Prioritize, Problems and Solutions, learn to say NO	**02**
7.	**Stress Management:** Sources of stress, types, signs and symptoms of stress - positive aspects of stress - negative aspects of stress	**02**
8.	**Stress Management Techniques:** Coping mechanisms, Deep Breathing Exercise, Meditation and Visual Imagery techniques, Muscle Relaxation, Peer Sharing, Emotional Intelligence	**02**
9.	**Decision-making:** Definition, Informed Decision Making, Consequences of Decision Making and Models of Decision Making	**02**
10.	**Creative Thinking:** Out-of-the box thinking, Stages of Creative Thinking, Factors hindering creative thinking, Characteristics of Creative thinkers	**02**
11.	**Interpersonal skills:** Meaning, need to develop interpersonal skills, components of interpersonal skills, techniques to improve skills, benefits with real life examples/case studies	**02**
12.	**Art of Communication:** Verbal & Non-Verbal Communication, 7'Cs of Effective Communication Importance of Effective Communication	**02**
13.	**Body Language – I:** Non-verbal codes: Kinesics, Proxemics	**02**
14.	**Body Language – II:** Vocalics, Haptics, Appearance	**02**

References -

- S. Hariharan, *Soft Skills*, MJP Publishers, Chennai.
- Gopalaswamy Ramesh, *The ACE of Soft Skills: Attitude, Communication and Etiquette for Success*, New Delhi: Pearson Education.
- Jeff Butterfield, *Soft Skills for Everyone*, cengage Learning India Private Limited.
- UNLESH the power within... Soft Skills – Infosys Training Manual *Module 1 to 5* (Infosys Campus Connect Programme)
- Masters, L. Ann, *Personal Development for Life and Work*, New Delhi: Cengage Learning.

- Covey, Stephen R., *Seven Habits of Highly Effective People*: *Powerful Lessons in Personal Change*
- Barun K. Mitra, *Personality Development & Soft Skills*, Oxford Publishers, Third impression.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)
Evaluation Method: In every session student will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **SH 2735**	Course Name: **German Language - Level III**

L	T	P	Credits
-	-	2	1

Course Description:
This course meets the requirements of student's overall personality development. The course helps the student in learning German as a foreign language. Vocabulary building activities, grammar, reading skills and basic conversational skills are addressed in this course.

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

1. Demonstrate the ability to use German vocabulary and expressions related to professions and everyday communication.
2. Interpret and respond to simple German texts and dialogues to comprehend information in familiar real-life contexts.
3. Apply German grammatical structures in spoken and written communication.
4. Communicate effectively in German through role-plays, conversations, and presentations.
5. Develop confidence in using German language skills for practical situations by integrating listening, speaking, reading, and writing abilities.

Prerequisite: A Student, who is going to enroll for this course, should have following German language abilities:

1. Adequate knowledge of basic grammar of German language.
2. Intermediate level vocabulary of German language.
3. Communicate moderately using German language.

Course Content

Experiment No	Description	Hrs
1.	Professions and their workplace Getting acquainted with different professions, usual tasks in particular profession, likes, dislikes etc.	02
2.	Job advertisements reading and understanding. To express oneself about his preferences for part time jobs. his likes and dislikes	02
3.	Short texts about finding jobs(for understanding the short paragraphs) & telephonic conversation Grammar- conjunctions and ,or, but (und ,oder ,aber)	02
4.	Grammar-Present Perfect Tense Exercises based on present perfect tense	02

5.	Present perfect tense with helping verb haben and sein. Difference between these two verbs and related exercises	**02**
6.	Vocabulary of clothes and conversation while buying the clothes	**02**
7.	Grammar- 'W' questions related to clothes(welche und diese) Exercises related to welche und diese in nominative and accusativ	**02**
8.	Grammar- present perfect tense of separable and non-separable verbs	**02**
9.	Dativ verbs Exercises related to dativ verbs	**02**
10.	Dialog between shopkeeper and customer Personal Pronomen in Dativ	**02**
11.	Orientation in the shopping mall. Understanding the floors and information on notice boards.	**02**
12.	Revision of the grammar and doubts clearing	**02**
13.	Test and presentations assigned to students during semester	**02**

References:

- Studio D – A 1, Cornelsen Verlag, Goyal Publishing House, New Delhi.
- Tangram Aktuell – A 1, Goyal Publishing House, New Delhi.
- Language A 1, Goyal Publishing House, New Delhi.
- Network A 1, Goyal Publishing House, New Delhi.

The extra notes will be provided to the students to complete the required syllabus.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)
Evaluation Method: In every session student will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

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Class: **S. Y. B. Tech.**	Semester- **III**
Course Code: **SH2715**	Course Name: **Japanese Language - Level III**

L	T	P	Credits
-	-	2	1

Course Description:
This course is designed to introduce students to the everyday language of Japan. Lessons are organized around natural conversational topics, leading students from fundamental aspects of grammar to readings in simple texts.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Make use of basic conversations in various situations.
2. Apply Japanese grammatical structures accurately in spoken and written communication.
3. Identify the sentence patterns.
4. Explain insights about the communication required for living in Japan.
5. Interpret Japanese work ethics required in their professional career.

Prerequisite: A Student, who is going to enroll for this course, should have following Japanese language abilities:
1) Knowledge of basic grammar of Japanese Language.
2) Communicate moderately using Japanese Language.

Course Content

Experiment No	Description	Hrs
1	Polite way of request for something, using て forms of the verbs.	02
2	Expressions used for offering to do something.	02
3	To ask for permission to do something.	02
4	Pattern used to express prohibition.	02
5	Use of て forms of the verbs to express sequence in action.	02
6	How to join two or more than two sentences together.	02
7	How to express something done after something.	02
8	Introduction of interrogative pronouns used to specify one item out of list of 2 or more than 2 things.	02
9	Rules for adjective – adjective combinations in one sentence.	02
10	How to make ない forms of the verbs.	02

11	Use of ない forms of the verbs to ask or to tell someone not to do something.	**02**
12	Must do pattern using なければ なりません。	**02**
13	How to make dictionary forms of the verbs.	**02**
14	Uses Potential form できる	**02**
15	How to express the hobby.	**02**

***Note**: Words written phonetically using the Latin alphabet (*romaji*) will be only used in the very initial stage to aid learning pronunciations.

References -

- Minna No Nihongo I (3A Corporation, Japan), Publications: Goyal publishers.
- Nihongo shouhou, Publication: JALTAP.

Other reference material, practice papers & CDs for listening practice.
The extra notes will be provided to the students as per the requirement of the syllabus.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)
Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

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Class: **S. Y. B. Tech.**	Semester: **IV**
Course Code: **ME236**	Course Name: **Kinematics of Machines**

L	T	P	Credits
3	--	--	3

Course Description:
Basically, Kinematics of machines course deals with study of machines & mechanisms with and without consideration of forces causing the motions in these (kinetics & kinematics). The subject under consideration, i.e. Kinematics of Machines is concerned with kinematics part i.e. study of machines & mechanisms without considering the forces causing motions in these. The major focus is on determination of displacement, velocity & acceleration of different links of the mechanisms using different methods like Graphical method, analytical methods etc. This is required further for kinetic analysis of the mechanisms. Apart from above, generation of cam profile, study of synthesis & governors, toothed wheels and gear train are the major contents of the syllabus.

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

1. Select appropriate mechanisms for specific engineering applications.
2. Analyze the velocity and acceleration characteristics of mechanisms using kinematic principles.
3. Design cams and follower systems for specified motion requirements and operating conditions.
4. Select and apply suitable power transmission systems for mechanical applications.
5. Analyze the kinematic performance of flywheels and governors.
6. Analyze the kinematic behavior and motion characteristics of gear systems.

Prerequisite:
The prerequisite for study of this course is that students should have complete course of Applied Mechanics. In addition, the students should have adequate knowledge about graphical skills and analytical skills.

Course Content

Unit No	Description	Hrs.
1.	**Fundamentals of kinematics and Mechanisms:** Kinematic links, pairs, chains etc. Classification of kinematic pairs, Kinematic Chains, Types of joints, Types of constrained motion, Difference between Machine & Structure, Degree of freedom, Kutzbach criteria, Grublers criteria, Inversion : definition , types Inversions of four bar chain, Slider crank chain, double slider crank chain and its inversion, Geneva mechanism ,Crank & slotted lever mechanism, Oscillating cylinder engine mechanism, Elliptical trammel, Oldham's coupling, Steering gear mechanism –Ackermann and Devis, Condition for correct steering	06

2.	**Analysis of Mechanism:** Relative velocity method, Relative Acceleration Method, Coriolis component of acceleration. Velocity analysis by Instantaneous centre method, Velocity and acceleration analysis by Klein's Construction Method.	**06**
3.	**Cams:** Types of cams and followers, Analysis of standard motions to the follower, Determination of cam profiles for given follower motion, Analysis of cams with specified contours cams and circular arc cam, Tangent cam, jumping of follower.	**06**
4.	**Mechanical Power Transmission:** **Belts Drive:** Types of belts & rope drives, calculation of length & power transmitted, Belt tension ratio, sleep & creep of belt. **Chain drive:** Classification, length, angular speed ratio, classification of chains. **Gear Drive:** Geometry of motion, Gear geometry, Types of profiles Involute & Cycloidal, theory of spur, Helical and Spiral gears,	**06**
5.	**Flywheel and Governor:** **Flywheel:** Introduction, turning moment diagram for different engines, fluctuation of energy, determination of maximum fluctuation of energy, coefficient of fluctuation of energy, coefficient of fluctuation of speed, Energy stored in flywheel, Dimensions of the flywheel rim. **Governor:** Types, Porter and Hartnell governor, Controlling force and stability of Governor, hunting, sensitivity, isochronisms, Governor effect and power insensitiveness of Governor	**06**
6.	**Toothed Gears and Gear Trains:** **Toothed Gears:** Interference in involute tooth gears and methods for its prevention, path of contact, arc of contact, contact ratio. Gear trains. **Gear Trains:** Types, Tabular method for finding speeds of elements in epicyclic gear train, Differential gear box.	**06**

References:

Text Books:

- Charles E. Wilson and J. Peter Sadler, Kinematics and Dynamics of Machinery, Pearson Education Inc.
- Ratan S.S, Theory of Machines, Tata McGraw Hill New Delhi.
- P. L. Ballany, Theory of Machines & Mechanism, Khanna Publication, New Delhi.
- V.P. Singh, Theory of Machines, Dhanpat Rai and Sons.
- Phakatkar,Theory of Machines I and II, Nirali Publication, Pune.
- Dr. R.K.Bansal, Theory of machines, Laxmi Publication.

Reference Books:

- Thomas Bevan, Theory of Machines, CBS Publishers, New Delhi.
- Shigley, Theory of Machines and Mechanism, McGraw Hill, New York.
- J.S. Rao and R.V. Dukipatti, Theory of Machines and Mechanism, New Age Int. Publications Ltd. New Delhi.
- Shah and Jadhawani, Theory of Machines, Dhanpat Rai& Sons.

- Abdullah Shariff, Theory of Machines, McGraw Hill, New Delhi.

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Class: **S. Y. B. Tech**	Semester: **IV**
Course Code: **ME248**	Course Name: **Design of Machine Elements**

L	T	P	Credits
3	--	--	3

Course Description:
The course on Design of Machine Elements provides a systematic approach to the design of mechanical components with emphasis on safety, reliability, and functional efficiency. It covers essential design principles, including material selection, standard codes, and considerations of aesthetics and ergonomics. A strong focus is placed on failure analysis under static loading conditions, incorporating appropriate theories of elastic failure for safe design. The course includes the design of key machine elements such as welded and bolted joints, shafts, keys, couplings, springs, and power screws. By integrating theoretical concepts with practical applications and established standards, the course equips learners with the ability to design and optimize machine components for real-world engineering applications.

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

1. Apply fundamental design procedures standards, material selection, to specify machine components.
2. Evaluate machine elements under static loading using appropriate theories of elastic failure.
3. Design temporary and permanent joints for diverse loading conditions.
4. Design solid and hollow shafts, keys, and splines based on strength, rigidity, and ASME codes.
5. Design helical springs and mechanical couplings for effective power transmission.
6. Analyze torque, efficiency, and self-locking parameters to design power screws.

Prerequisite:
Strength of Material, Engineering Mechanics, Engineering Materials, and Engineering Mathematics

Course Content

Unit No	Description	Hrs
1.	**Fundamental aspects of design:** Engineering design and classification, basic design procedure, requirement of machine element, standards and codes, selection of preferred sizes, aesthetic and ergonomic considerations in design, engineering materials and classification	06
2.	**Design against static load:** Modes of failure, stresses due to bending and torsional load, Theories of elastic failure: maximum principal stress theory, maximum shear stress theory, distortion-energy theory, selection and use of failure theories, design of lever, design of cotter and knuckle joints.	06

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3.	**Design of temporary and permanent Joints:** **Design of bolted joint:** forms of screw threads, terminology of screw threads, bolted joint simple analysis, eccentrically loaded bolted joint in shear, eccentric load perpendicular to axis of bolt **Design of welded joint:** types of welded joints, strength of butt welds, strength of parallel fillet weld, strength of transverse fillet weld, eccentric load in plane of welds, weld subject to bending moment and torsional moment.	**06**
4.	**Design of shaft and keys:** **Shaft:** types of shafts, design of solid & hollow shafts on strength and rigidity basis, A.S.M.E code for shaft design **Keys:** types of keys, design of square and flat keys, splines	**06**
5.	**Design of spring and couplings:** **Spring:** types of springs, terminology, stress and deflection equation, spring material, design of helical Spring, **Couplings:** design of muff coupling, clamp coupling and rigid flange coupling	**06**
6.	**Design of power screw:** Forms of thread, torque requirement – lifting load and lowering load, self-locking screw, efficiency of square threaded screw, design of power screw & nuts	**06**

References:

Text Books:

- V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publication.
- S. P. Patil, Mechanical System Design, Jaico Publication House, New Delhi.
- S. K. Basu and D. K. Pal, Design of Machine Tools, Oxford and IBH Publication.
- N. K. Mehta, Machine Tool Design, Tata McGraw Hill Publication.

Reference Books:

- Shigley and C. R. Miscke, Mechanical Engineering Design, Tata McGraw Hill Publication.
- R. L. Norton, Machine Design – An Integrated Approach, Pearson Education.
- Juvinall R. C. and Marshek K. M., Fundamentals of Machine Component Design, Wiley India.

Class: **S. Y. B. Tech**	Semester: **IV**
Course Code: **ME250**	Course Name: **Engineering Thermodynamics**

L	T	P	Credits
3	--	--	3

Course Description:
The aim of this course is to provide students the basic concepts of thermodynamic systems and their applications. It also covers the basic properties of gases, liquids and vapors (specific heat capacities), energy, entropy, enthalpy, exergy, energy, laws of thermodynamics, vapor power cycles; ideal gas mixtures; and efficiencies of energy conversion systems, such as boilers, turbines, condensers, pump and the use of steam tables to gather energy properties of the steam at different conditions. The effective moving the heat energy generated in the various processes in the steam power plant is computed.

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

1. Apply thermodynamics principles to mechanical engineering applications.
2. Describe entropy, change in entropy and increase of entropy principle.
3. Differentiate between available and unavailable energy with examples.
4. Recognize the properties of pure substances and use thermodynamic property tables charts.
5. Apply mathematical fundamental to study the properties of steam gas and gas mixtures.
6. Explain the air and vapor power cycles and calculate cycle performance.

Prerequisite: Concept of energy, work, heat and conversion between them.

Course Content

Unit No	Description	Hrs.
1.	**Basic Concepts:** Thermodynamics system, Microscopic & macroscopic point of view, thermodynamic system and control volume, thermodynamic properties, processes and cycles, Thermodynamic equilibrium, Quasi-Static process, Zeroth law of thermodynamics **First law of Thermodynamics:** First law for a closed system undergoing a cycle and change of state, energy, PMM1, first law of thermodynamics for steady flow process, steady flow energy equation applied to nozzle, diffuser, boiler, turbine, compressor, pump. (Numerical Treatment)	06
2.	**Second law of thermodynamics:** Limitations of first law of thermodynamics, Kelvin Planck and Clausius statements and their equivalence, PMM2, causes of irreversibility, Carnot theorem, corollary of Carnot theorem, thermodynamic temperature scale.	06

3.	**Entropy:** Clausius theorem, property of entropy, inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, entropy change for non-flow and flow processes, third law of thermodynamics (Numerical Treatment)	
4.	**Availability:** Energy of a heat input in a cycle, exergy destruction in heat transfer process, exergy of finite heat capacity body, exergy of closed and steady flow system, irreversibility, second law efficiency (Numerical Treatment).	**06**
5.	**Properties of gases and gas mixtures:** Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibb's function. Avogadro's law, equation of state, ideal gas equation, Vander Waal's equation, reduced properties, law of corresponding states, compressibility chart, Gibbs Dalton law, internal energy; enthalpy and specific heat of a gas mixtures, Simple Calculations (Numerical Treatment).	**06**
6.	**Properties of Pure Substances:** Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of 1st and 2nd law for pure substances (Numerical Treatment).	**06**
7.	**Air and Vapor Power Cycles:** Air standard cycles, Carnot, Otto and Diesel, Carnot cycle using steam, limitations of Carnot cycle, Rankine cycle, representation on T-s and h-s planes, thermal efficiency, specific steam consumption. Work ratio, effect of steam supply pressure and temperature, condenser pressure on the performance. (Numerical Treatment).	**06**

References:

Text Books:

- P.K. Nag, Engineering Thermodynamics, Tata McGraw Hill, New Delhi.
- Ballaney P.L., Thermal Engineering, Khanna Publishers, New Delhi.
- Kumar and Vasandani, Thermal Engineering, Metropolitan Book Co, Delhi.
- R. Yadav, Steam & Gas Turbines, CPH Allahabad.
- B. K. Sarkar, Thermal Engineering, Tata McGraw Hill.
- R. K. Rajput, Thermal Engineering, Laxmi Publications, New Delhi.
- Mahesh M Rathore, Thermal Engineering, McGraw Hill Education, New Delhi.

Reference Books:

- J P Holman, Thermodynamics, McGraw Hill, London.
- Wylen Van, G. J. & Sonntag R. E., Fundamentals of Classical Thermodynamics, John Wiley & Son.
- Yunus A. Cengel, Thermodynamics an Engineering Approach, Tata McGraw Hill.
- S. C. Jain, Steam Tables, Birla Publications Pvt. Ltd. Delhi.

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Class: **S. Y. B. Tech**	Semester: **IV**
Course Code: **ME2144**	Course Name: **Material Science & Metallurgy**

L	T	P	Credits
3	–	–	3

Course Description:
Material Science & Metallurgy is offered as the course at the Fourth semester of Mechanical Engineering undergraduate programme. It focuses on fundamentals in Material Science as preparation of equilibrium diagrams from cooling curves, determination of mechanical properties from crystal structures, macrostructures and microstructures. It covers the important part of material testing i.e. Destructive and Non-destructive testing which is important in evaluation of mechanical properties and determination of flaws in materials. In this course students are introduced to important equilibrium diagrams of Ferrous and Nonferrous families, different alloys on the diagrams with their properties and applications. The course also covers fundamentals of heat treatment processes of steel and the improvement in mechanical properties by various heat treatment processes. The whole notion of this course is selection of materials for various engineering applications.

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

1. Explain different alloys, their properties and applications by referring equilibrium diagrams.
2. Determine mechanical properties by destructive testing methods.
3. Detect flaws in components by non-destructive testing methods.
4. Select suitable heat treatment to achieve desired changes in mechanical properties of steels.
5. Select suitable material for given engineering applications.
6. Explain manufacturing of a component by using powder metallurgy

Prerequisite:

1. Atomic structures in metals.
2. Types of bonds in metals.

Course Content

Unit No	Description	Hrs.
1.	**Metals and Alloy Systems:** Crystal structure in metals (BCC, FCC, HCP), Imperfection in crystals, nucleation, solidification and growth, cooling curves, Solid solutions and intermediate phases, Construction of equilibrium diagrams from cooling curves, components of different solubility in liquid and solid state, Lever arm principles, dendritic structure and coring.	06

2.	**Phase diagrams for Ferrous alloys:** Fe-Fe3C Diagram, Plain carbon steels, Steel specifications, Alloy steels- Free cutting steels, HSLA, Maraging steels, creep resisting steels, Different types of Stainless steels, tooling materials such as hot work, cold work tool steels, high speed steel, cast iron.	**06**
3.	**Principles of Metallurgical Testing:** **Destructive Testing methods:** Tensile, Compressive, Impact, Fatigue, Creep, Hardness. **Non- Destructive Testing:** Dye Penetrant, magnetic, ultrasonic, Radiography, Eddy Current testing.	**06**
4.	**Non-ferrous alloys, Non-metallic and Advanced materials:** Alloys of Copper, Aluminum, Magnesium, Titanium, Other alloys of lead, tin, zinc, nickel, manganese, white metals and bearing alloys, Polymers, ceramics, Composites, smart materials, Nano materials, Bio materials.	**06**
5.	**Heat Treatment Processes:** Transformation products in steel upon cooling and heating, TTT Diagram and CCT Diagram, Effect of alloying dements on TTT diagram and its significance, Annealing, Normalizing, Hardening and tempering, Mechanism of quenching Surface hardening, Flame hardening and other heat treatment processes, Heat treatment defects and remedies.	**06**
6.	**Powder Metallurgy & Material Selection:** Introduction to Powder Metallurgy and its applications. Relationship between material selection, material properties and material processing, Criteria for selection of engineering materials, Selection of materials for strength, toughness, fatigue and creep, Case studies in material selection.	**06**

References:

Text Books:

- V.D. Kodgire, Material Science and Metallurgy, Everest Publishers Pune.
- T.V. Rajan & C.P. Sharma, Heat Treatments Principles and Practices, PHI Publications.

Reference Books:

- William D. Callister, Materials Science and Engineering an Introduction, John Wiley & Sons.
- Vijendra Singh, Engg. Physical Metallurgy, Standard Publishers Delhi.
- Prabhudev, Heat treatment of Steels, HMT Handbook.
- S. H. Avner, Physical Metallurgy, Tata McGraw-Hill publication.
- F.A.A. Cranes & J.A. Charles, Selection and Uses of Engineering Materials, Butterworth & Com.Ltd., London.

Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **ME2381**	Course Name: **Object Oriented Language with C++**

L	T	P	Credits
2	-	-	2

Course Description:
Object-Oriented Programming (OOP) is a well-established and widely adopted programming paradigm known for its effectiveness in managing software complexity and promoting code reusability and modularity.
This course introduces students to the core principles of OOP, such as: Classes and Objects, Inheritance, Polymorphism, Encapsulation Emphasis is placed on developing secure and efficient programs applicable to mechanical engineering contexts, including handling file-based data storage and generating basic geometric visualizations.

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

1. Explain object-oriented programming concepts, class structure, and inheritance mechanisms in C++.
2. Develop C++ programs using functions, constructors, operator overloading, arrays of objects, and file handling.
3. Analyze and debug C++ programs involving object-oriented features, inheritance structures, and basic graphics applications.

Prerequisite:
Prior knowledge of C Programing is essential

Course Content

Unit No	Description	Hrs
1.	**OOPs Concepts:** POP concept and characteristics, Limitations of POP, need for OOP Introduction to OOP: Definition, features, benefits Class and Object: concept, structure, examples Data members, member functions, visibility modes	04
2.	**Functions in C++:** Overview of Functions in C++, Inline functions, Function Overloading, Friend Function, Arrays of objects and Arrays inside objects	04
3.	**Constructors, Destructors:** Need; Types: Default Constructor, Parameterized Constructor, Copy Constructor; Constructor overloading; Destructor	04
4.	**Operator Overloading:** concept and need, Unary and Binary operator overloading, Member and Friend operator overloading	04
5.	**Inheritance:** Inheritance concept and advantages Modes of inheritance: public, private,	04

	protected Single and multilevel inheritance Multiple and hierarchical inheritance Hybrid inheritance Virtual base class and ambiguity	
6.	**File Handling & C++ Graphics:** **File handling:** file creation and opening File read, write, append operations File closing and file modes Introduction to C++ Graphics **Graphics functions:** line, circle, rectangle initgraph(), closegraph(), applications	**04**

References:

Text Books:

- E. Balagurusamy, Object-Oriented Programming with C++, McGraw Hill Education (India) Pvt. Ltd.
- Yashavant P. Kanetkar, Let Us C++, BPB Publications.
- D. Ravichandran, Programming with C++, McGraw-Hill Education (India) Pvt. Ltd.

Reference Books:

- Herbert Schildt, The Complete Reference C++, McGraw-Hill Education.
- Robert Lafore, Object-Oriented Programming in Turbo C++, Galgotia Publications Pvt. Ltd.
- Bjarne Stroustrup, An Overview of the C++ Programming Language, Addison-Wesley Professional.
- T. J. Henricson and E. Nyquist, Programming in C++: Rules and Recommendations, Ellemtel Telecommunication Systems Laboratories.

Multidisciplinary Minor- II

Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **CEMD2021**	Course Name: **Building Estimation and Valuation**

L	T	P	Credits
3	-	-	3

Course Description:
The Building Estimation and Valuation course is designed to develop students' proficiency and confidence in preparing estimates for various civil engineering structures. The course enables students to analyze the rates of different building items and understand the principles of cost estimation. By studying this course, students will become capable of preparing estimates, rate analyses, and various construction bills required at construction sites with greater accuracy and efficiency.

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

1. Explain the types of estimates and their basic requirements in construction projects.
2. Describe measurement sheets, abstract sheets, and detailed specifications for various construction items.
3. Prepare detailed estimates for load-bearing structures and framed structures.
4. Perform rate analysis for different construction activities.
5. Explain the concepts of tenders and contracts used in construction practice.
6. Describe the fundamental terms and principles of valuation in civil engineering.

Prerequisite: Unit conversions and the fundamental knowledge of different construction materials with their rates.

Course Content

Unit No	Description	Hrs
1.	**Introduction:** General introduction to Quantity surveying, Purpose of estimates, Types of Estimates- Approximate and Detailed, Various items to be included in estimates of building, road and culvert with their modes of measurement, I.S. 1200, Prime cost, Provisional sums, Provisional quantities, administrative approval and technical sanction to estimates. Introduction to SSR., General notes and guide lines of SSR.	06
2.	**Specifications:** Specifications- purpose and types, General specifications for different class of buildings, Detailed specifications of building items like PCC, RCC, brick and stone masonry, plastering, flooring.	06
3.	**Detailed estimate of buildings:** Measurement sheet, Abstract sheet, long wall-short wall and center line method for finding quantities. Detailed estimate of load bearing and RCC buildings.	07

4.	**Rate Analysis and Schedule of Reinforcement:** Importance of rate analysis, Factors affecting the cost of materials, labour, Task work, Transports, Overhead charges, market rates of various materials, labours. Rate analysis preparation of PCC, RCC, brick and stone masonry, plastering, pointing, flooring.	**06**
5.	**Introduction of Tender and Contracts:** Tender- Notice, Documents, Procedure and Types, Contract- Types, Conditions, Earnest money, Security deposit, Validity period, Defect liability period, Liquidated and unliquidated damages, Arbitration, Escalation of cost, Daily reports maintained on site.	**05**
6.	**Valuation:** Definition, Necessity, Cost, Price, Value, Types of values, Depreciation and obsolescence, sinking fund, Methods of calculating depreciation, Annuity, Year purchase, Land valuation, Methods of land and building valuation, Freehold and leasehold property, Mortgage, Mortgage deed and Precautions.	**06**

References:

Reference Books

- B. N. Dutta, Estimating and Costing in Civil Engineering, UBS Publishers & Distributors Pvt. Ltd.
- M. Chakraborty, Estimating, Costing, Specification and Valuation in Civil Engineering, UBS Publishers & Distributors Pvt. Ltd.
- B. S. Patil, Civil Engineering Contracts and Estimates, Universities Press Pvt. Ltd.
- S. C. Rangwala, Elements of Estimating and Costing, Charotar Publishing House.

I. S. Codes:

- Updated I. S. 1200
- Updated S. S. R.

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Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **CSMD204**	Course Name: **Fundamentals of Database Systems**

L	T	P	Credits
3	-	-	3

Course Description:
A database is an organized collection of data. A relational database, more restrictively, is a collection of schemas, tables, queries, views, and other elements. It defines data models, relational models, constraints that can be used in design of the relational database, also it focuses on file structure, transaction management and recovery of databases. The course also provides an overview of SQL which is used for implementation of relational databases. data. A general-purpose DBMS is a software system designed to allow the definition, creation, querying, update and administration of databases.

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

1. Describe the fundamental elements of relational database management systems.
2. Design ER-models to represent simple database application scenarios.
3. Write SQL query to perform various operations on the database.
4. Analyze principle of integrity constraints, Hashing and Indexing on databases.
5. Illustrate the transaction management, concurrency control and crash recovery.

Prerequisite: A basic understanding of programming concepts (using languages such as Python, Java, or C++) and foundational knowledge of data structures and algorithms.

Course Content

Unit No	Description	Hrs
1.	**Introduction to Database Concepts:** Purpose of Database Systems, Data abstraction, Data Models, Entities and Entity sets, Mapping Constraints, E-R Diagram, Reducing E-R Diagrams to Tables, Generalization and Aggregation.	06
2.	**Relational Model:** Structure of Relational Databases, Structured Query Language (SQL): Data Definition Language, Data Manipulation Language, Aggregate functions, Set Operations.	06
3.	**Integrity Constraints and Database Design:** Domain Constraints, Referential Integrity, Functional Dependencies, Decomposition, Normalization: 1NF, 2NF, 3NF	06
4.	**Data Storage and Indexes:** File Organization, Data Dictionary Storage, Indexing: B+ tree indexing and B tree indexing, Hashing: Static and Dynamic.	06
5.	**Basic of Transactions:** Concepts of transaction processing, ACID properties, Transaction states, Serializability, Testing for serializability.	06
6.	**Concurrency Control and Recovery System:**	06

	Lock-based protocols, Timestamp - based Protocols. Crash Recovery: Failure Classification, Log-Based Recovery, Checkpoints.	

References:

Text Books:

- Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, Database System Concepts, Tata McGraw Hill.
- C. J. Date, A. Kannan, and S. Swamynathan, An Introduction to Database Systems, Pearson Education.

Reference Books:

- Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education.

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Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **EEMD2021**	Course Name: **Power System**

L	T	P	Credits
3	-	-	3

Course Description:
The power system comprises of generation, transmission and distribution of electric power This course covers economics of power generation using different types of generating sources. Different types of loads in power system, Moreover, this course covers importance of power factor in power system and different types of tariffs. Overview of transmission and distribution systems.

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

1. Write the basic working principles of different generating sources.
2. Analyze different types of loads
3. Explain importance of power factor and tariffs in power system.
4. Identify various components in power transmission and distribution system.
5. Select substation equipment as per requirement.
6. Describe the role of AI in substation automation.

Prerequisite: Basic Electrical Engineering, Basic Mathematics and Physics.

Course Content

Unit No	Description	Hrs
1.	**Power Generation:** Structure of power system, generating stations – operation and working of conventional and nonconventional energy sources. Comparison between them.	06
2.	**Variable load on power stations:** Load curves and types of loads – base and peak loads, cost of electrical energy, depreciation and its methods.	06
3.	**Power factor and Electric Tariff:** Power triangle, power factor and causes of low power factor and methods of power factor improvement. Tariff and its characteristics.	06
4.	**Electrical and Mechanical Design of Transmission lines:** Construction of transmission lines and its components, line resistance, inductance and capacitance. Sag and its calculation, String efficiency	06
5.	**Supply systems:** AC and DC transmission systems and comparison. Overhead and underground system, Construction of cables and types.	06
6.	**Substation and AI Applications:** Classification of substations, outdoor and indoor substations. Symbols for equipment's in substations and their functions Introduction to AI in	06

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	substations for fault detection, predictive maintenance, load forecasting, and smart monitoring using intelligent control systems.	

References:

Text Books:

- V. K. Mehta, Principles of Power System, S. Chand Publishing.
- Ashfaq Husain, Electrical Power Systems, CBS Publishers & Distributors.

Reference Books:

- S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Education.
- W. D. Stevenson Jr., Elements of Power System Analysis, McGraw Hill International.

Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **ECMD2021**	Course Name: **Electronics Communication Systems**

L	T	P	Credits
3	-	-	3

Course Description:
Analog and Digital Communication are the fundamental and core subjects in Electronics and Telecommunication Engineering. The course provides knowledge of basic principles of communication, modulation and demodulation techniques, transmission and reception methods in analog as well as digital communication.

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

1. Describe different communication systems.
2. Explain applications of analog and digital modulation techniques.
3. Analyze different modulation and demodulation techniques.
4. Explain the use of satellite communication.

Prerequisite: Fundamental concepts of engineering and Mathematics.

Course Content

Unit No	Description	Hrs
1.	**Amplitude Modulation & Demodulation** Electromagnetic spectrum, Introduction to communication system, Need for modulation. Amplitude Modulation, Definition, Time domain and frequency domain description, power relations in AM waves. Generation of AM waves, Detection of AM Waves.	06
2.	**Frequency Modulation & Demodulation** Introduction of FM, Description of systems, Mathematical representation of FM, Frequency Spectrum of FM wave, Phase modulation, Intersystem comparisons, pre-emphasis and de-emphasis, Generation of Frequency Modulation and Demodulation methods, Angle Modulation.	06
3.	**Radio Receivers** Function of AM receiver, receiver parameters: Sensitivity, Selectivity, Dynamic Range, Tracking, Fidelity, Receiver Types- Tuned Radio Frequency (TRF) receiver, AM Receiver- RF section, Mixer, IF Frequencies and Amplifiers, FM Receivers- Common circuits, Comparison with AM receivers, Amplitude Limiting.	06
4.	**Digital Modulation Techniques** And Data Formats Data Formats, ASK, FSK, PSK, coherent and non-coherent reception, BPSK, DPSK, QPSK, 16-QAM, MSK, Waveforms and Comparison of digital modulation.	06
5.	**Satellite Communication:** Basic concepts of Satellite Communications, Satellite subsystems, Satellite Link design, Orbital Mechanics.	06

6.	**Satellite Application:** DBS, VSAT, GPS, Case Studies – Mars Mission, Chandrayan.	**06**

References:

Text Books:

- K. Sam Shanmugan, Digital and Analog Communication Systems, Wiley India.
- R. P. Singh and S. D. Sapre, Communication Systems: Analog and Digital, Tata McGraw Hill.
- George Kennedy and Bernard Davis, Electronic Communication Systems, Tata McGraw Hill.

Reference Books:

- Bernard Sklar, Digital Communications: Fundamentals and Applications, Pearson Education.
- Wayne Tomasi, Electronic Communication Systems, Pearson Education.
- Herbert Taub and Donald L. Schilling, Principles of Communication Systems, Tata McGraw Hill.
- Louis E. Frenzel Jr., Communication Electronics: Principles and Applications, Tata McGraw Hill.

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Class: **S. Y. B. Tech**	Semester-**IV**
Course Code: **CIMD202**	Course Name: **Computer Algorithms**

L	T	P	Credits
3	--	--	3

Course Description:
This course introduces students to the design of computer algorithms, as well as analysis of sophisticated algorithms. It contains design and analysis of algorithms to solve wide variety of problems including searching, sorting and graph algorithms. It covers various techniques that can be used to solve new problems you face, like divide and conquer, greedy algorithms, dynamic programming etc.

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

1. Analysing asymptotically the performance of algorithms.
2. Compare and analyse searching and sorting algorithms.
3. Apply different algorithm design techniques to solve problems like job sequencing, knapsack, TSP, finding shortest path etc.
4. Apply backtracking method to solve problems like N-queens, graph coloring, sum of subsets etc.
5. Describe computational complexity theory to classify computational problems according to their inherent difficulty.

Prerequisite: Basic knowledge of Mathematics.

Course Content

Unit No	Description	Hrs
1.	**Introduction:** Introduction, Characteristics of algorithm, Pseudocode conventions, Recursive algorithms, Performance analysis – time and Space complexity, asymptotic notations.	05
2.	**Searching and Sorting Methods:** Linear Search, Binary Search, Bubble sort, Quick Sort, Merge Sort, Selection Sort, Insertion sort, Radix Sort, Bucket Sort. Divide and Conquer- General method, Finding the maximum and minimum, Strassen's matrix multiplication.	07
3.	**Greedy Method:** General method, Knapsack problem, Job sequencing with deadlines, Minimum-cost spanning trees – Prim's and Kruskal's algorithms, Optimal storage on tapes, Single source shortest paths.	05
4.	**Dynamic Programming:** General method, Multistage graphs, all pair shortest paths, 0/1 Knapsack problem, Reliability design, Traveling sales person problem.	07

5.	**Backtracking:** General method, n-Queens problem, Subset sum problem, Graph coloring problem, Travelling sales person problem.	**06**
6.	**Introduction to Complexity Theory:** The P and NP Classes, Polynomial, time reductions, NP- Hard and NP-Complete classes. NP-Hard graph problems- Clique decision problem, Vertex cover problem, Travelling sales person decision problem, Randomized algorithms.	**06**

References:

Text Books:

- Ellis Horowitz, Satraj Sahani, Saguthevar Rajasejaran, "Fundamentals of Computer Algorithms", Universities Press.
- Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms".

Reference Books:

- Sara Baase & Allen VanGelder, "Computer Algorithms: Introduction to Design & Analysis", Addision Wesley.
- Alfred V. Aho , The design and analysis of computer algorithms, Addison-Wesley Pub

Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **MEMD2041**	Course Name: **Behavioral Engineering and Design**

L	T	P	Credits
3	-	-	3

Course Description:
This course delves into the principles and practices of behavioral engineering and design as applied to the creation of new products, encompassing physical consumer goods as well as software and mobile applications. Through theoretical exploration and hands-on projects, students will learn how to design products that effectively influence user behavior and enhance user experience.

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

1. Analyze the fundamental concepts, theories and ethical considerations of behavioral engineering in product design.
2. Apply psychological principles and behavioral insights to analyze user behavior and product design scenarios.
3. Analyze the role of persuasive design techniques in influencing user engagement, adoption and behavior change in consumer products.
4. Incorporate aesthetic appeal into product designs, assessed through objective criteria such as visual appeal ratings.
5. Incorporate ergonomic considerations into product designs assessed through objective criteria such as user comfort.

Prerequisite:
Course on Design Thinking.

Course Content

Unit No	Description	Hrs
1.	**Behavioral Engineering and Design for Product Innovation:** Overview of behavioral engineering and its relevance in product design, Key concepts and theoretical frameworks, Understanding the role of psychology in product development, Ethical considerations in designing products for behavior change.	06
2.	**Human Behavior and Product Design:** Psychological principles influencing user behavior, Factors affecting consumer decision-making, User experience (UX) design principles for physical and digital products, Designing for emotional engagement and user satisfaction.	06
3.	**Applying Behavioral Insights in New Product Development:** Integrating behavioral research into the product design process, Behavioral design techniques for enhancing product adoption and usage, Case studies of successful products leveraging behavioral engineering	06

	principles, Hands-on exercises in applying behavioral insights to product ideation and prototyping.	
4.	**Persuasive Design for Consumer Products:** Principles of persuasive design in consumer product development, creating compelling product experiences through persuasive techniques, Designing for habit formation and behavior change, Ethical considerations in persuasive product design.	**06**
5.	**Aesthetics:** Principles of aesthetic design and its impact on user perception, Integrating aesthetics with functional design requirements	**06**
6.	**Ergonomics in Product Design:** Understanding anthropometrics and ergonomics in product design, Case studies of products exemplifying successful integration of aesthetics and ergonomics	**06**

References:

- Nir Eyal, Hooked: How to Build Habit-Forming Products, Penguin Books.
- Don Norman, The Design of Everyday Things, Basic Books.
- Stephen Anderson, Seductive Interaction Design: Creating Playful, Fun, and Effective User Experiences, New Riders.
- William Lidwell, Kritina Holden, and Jill Butler, Universal Principles of Design, Rockport Publishers.
- Mark S. Sanders and Ernest J. McCormick, Human Factors in Engineering and Design, McGraw-Hill.

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Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **MEMD206**	Course Name: **Automotive Drivetrain**

L	T	P	Credits
3	-	-	3

Course Description:
This course introduces the fundamentals of automotive drivetrain systems and their role in transmitting engine power to the wheels. The course covers the construction, working principles, performance characteristics, and applications of clutches, gearboxes, propeller shafts, universal joints, differentials, and final drive systems. It also introduces modern transmission technologies such as Automated Manual Transmission (AMT), Continuously Variable Transmission (CVT), Dual Clutch Transmission (DCT), hybrid drivetrains, and electric vehicle drivetrain architectures. Emphasis is given to drivetrain efficiency, torque transmission, vehicle performance, and emerging trends in mobility systems.

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

1. Explain the layout, components, and working principles of automotive drivetrain systems.
2. Analyse the construction, operation, and performance characteristics of different clutch systems.
3. Analyse various automotive transmission systems including manual, automatic, CVT, AMT, and DCT with respect to their construction, operation, and performance characteristics.
4. Examine the function and performance of propeller shafts, universal joints, and constant velocity joints in power transmission.
5. Evaluate the construction and working of differential and final drive systems for vehicle performance.
6. Assess hybrid and electric vehicle drivetrain technologies with respect to efficiency, energy management, and future mobility trends.

Prerequisite: Nil.

Course Content

Unit No	Description	Hrs
1.	**Introduction to Automotive Drivetrain:** Layout of automobile power transmission system, Types of drivetrains: FWD, RWD, AWD, 4WD, Requirements of a good drivetrain, Torque, power flow, and losses in drivetrain	06
2.	**Clutches:** Functions and requirements of a clutch, Single plate, multi-plate, cone, and centrifugal clutches, Clutch materials and wear characteristics, Hydraulic and electronic clutch actuation.	06

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3.	**Gearboxes and Transmission Systems:** Manual transmission: sliding mesh, constant mesh, synchromesh, Automatic transmission: torque converter and planetary gear sets, Introduction to Continuously Variable Transmission (CVT), Dual Clutch Transmission (DCT) and Automated Manual Transmission (AMT)	**06**
4.	**Propeller Shafts and Universal Joints**: Construction and function of propeller shafts, universal joints and constant velocity (CV) joints, slip joints, driveline vibration issues, torque transmission characteristics of shaft systems.	**06**
5.	**Differential and Final Drive Systems**: Construction and working of differential systems, open differential, limited slip differential, locking differential, axle arrangements, final drive ratios, effect of differential action during vehicle cornering and traction conditions.	**06**
6.	**Modern and Electric Vehicle Drivetrains**: Hybrid electric drivetrain configurations – series, parallel, and power-split systems; electric vehicle drivetrain architecture, regenerative braking systems, drivetrain efficiency and energy management, future trends in automotive drivetrain technology.	**06**

References:

Text Books:

- Kripal Singh, Automobile Engineering (Vol. I), Standard Publishers Distributors.
- N. K. Giri, Automobile Engineering, Khanna Publishers.
- S. Srinivasan, Automotive Mechanics, Tata McGraw Hill.
- K. K. Ramalingam, Automobile Engineering, SciTech Publications.
- R. K. Rajput, Automobile Engineering, Laxmi Publications.
- G. B. S. Narang, Automobile Engineering, Khanna Publishers.

Reference Books:

- Heinz Heisler, Advanced Vehicle Technology, Elsevier.
- N. S. Chhikara, Automobile Engineering (Vol. II), Satya Prakashan.
- K. Newton, W. Steeds, and T. K. Garrett, The Motor Vehicle, Society of Automotive Engineers (SAE).
- William H. Crouse and Donald L. Anglin, Automotive Mechanics, Tata McGraw Hill Education.
- P. W. A. Kett, Motor Vehicle Science (Vol. I), Longman.
- James D. Halderman and Chase D. Mitchell, Automotive Engines: Theory and Servicing, Pearson Education.

Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **MCMD2021**	Course Name: **Industrial Fluid Power**

L	T	P	Credits
3	-	-	3

Course Description:
Fluid power has the highest power density of all conventional power-transmission technologies. Learn the benefits and limitations of fluid power, how to analyse fluid power components and circuits, and how to design and simulate fluid power circuits using Automation Studio for applications.
In this course, you will be introduced to the fundamental principles and analytical modelling of fluid power components, circuits, and systems. You will learn the benefits and limitations of fluid power compared with other power transmission technologies; the operation, use, and symbols of common hydraulic & pneumatic components; how to formulate and analyse models of hydraulic & pneumatic components and circuits; and how to design and predict the performance of fluid power circuits.

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

1. Describe the structure and function of common hydraulic and pneumatic components such as cylinders, valves, pumps, and motors etc.
2. Model and analyze common hydraulic and pneumatic components such as cylinders, valves, pumps, and motors.
3. Create & simulate basic hydraulic and pneumatic circuit diagrams for different applications.
4. Design, develop & analyze simple hydraulic and pneumatic systems for given task.

Prerequisite: Fundamental concepts of fluid mechanics, basic electrical engineering, and engineering mechanics.

Course Content

Unit No	Description	Hrs
1.	**Fluid Power Systems and Fundamentals:** Introduction to fluid power, Advantages of fluid power, Application of fluid power system, Types of fluid power systems, Properties of hydraulic fluids, General types of fluids, Fluid power symbols. (ISO/JIC), Use of Automation studio to draw circuits.	06
2.	**Hydraulic System and Components (Pumps and Actuators):** Pumping theory, Pump classification, Gear pump, Vane Pump, construction and working of pumps, pump performance, piston pump, Variable displacement pumps, Linear hydraulic actuators, Types of hydraulic cylinders, Single acting, Double acting cylinders, Special cylinders like tandem, Rod less, Telescopic - Construction and application, cushioning mechanism, Mounting of actuators, Rotary actuators - Gear,	06

	Vane and Piston motors.	
3.	**Hydraulic Valves, Accumulators and Circuits:** Directional control valve .4/2, 4/3, 5/3-way valves, Shuttle valve check valve, Pressure control valve, Flow control valve (Fixed and adjustable), Electrical control solenoid valves, Types of accumulators, Accumulators circuits, Intensifier Circuit and Application, Speed control circuits, synchronizing circuit and industrial application circuits copying circuit and press circuit, regenerative circuit.	**06**
4.	**Pneumatic Systems, Components and Circuits:** Properties of air Compressors, Filter, Regulator, and Lubricator Unit, Air control valves, Quick exhaust valves and pneumatic actuators, Pneumo-hydraulic circuit, Time delay circuits, Sequential circuit design for simple applications using cascade method.	**06**
5.	**Fluid Logic Control System:** Hydro Mechanical servo systems, Electro-hydraulic and Electro-pneumatic systems and proportional valves, Introduction to fluidic devices, simple circuits, PLC applications in fluid power control, Failure and troubleshooting in fluid power systems, Pneumatic positioning and servo systems, air hydro boosters.	**06**
6.	**Hydraulic/Pneumatic Circuit Design:** Steps in hydraulic circuit design, and simulation using Automation Studio. Steps in pneumatic circuit design, and simulation using Automation Studio.	**06**

References:

Text Books:

- Anthony Esposito, Fluid Power with Applications, Prentice Hall.
- Andrew Parr, Industrial Hydraulic and Pneumatic Systems, Butterworth-Heinemann. (This is the standard text; if your syllabus specifically intends another author named Stewart, please verify the details.)
- H. P. Garg, Industrial Hydraulics and Pneumatics, Dhanpat Rai Publications.
- S. R. Majumdar, Oil Hydraulic Systems: Principles and Maintenance, Tata McGraw Hill.

Reference Books:

- Vickers Inc., Industrial Hydraulics Manual, Vickers.
- FESTO Didactic, Hydraulics – Basic Level (TP501 Handbook), FESTO Didactic.

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Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **AIMD2021**	Course Name: **Data Structures and Algorithms**

L	T	P	Credits
3	-	-	3

Course Description:
The Data Structures and Algorithms course is a comprehensive study of fundamental concepts and techniques essential for efficient problem-solving in computer science. Students will explore various data structures, including arrays, linked lists, stacks, queues, trees, graphs, and hash tables, and learn how to analyze their time and space complexity. The course extensively explores the design and analysis of algorithms, encompassing various topics such as sorting, searching, and graph traversal. Emphasis is placed on understanding algorithmic paradigms and their applications. Through programming assignments and theoretical exercises, students will gain practical experience in implementing algorithms and solving real-world problems. This course serves as a foundation for algorithmic thinking and prepares students for advanced computer science topics.

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

1. Compare between linear and nonlinear data structures.
2. Describe the characteristics of various data structure such as stacks, queues, trees, graphs and Hash tables.
3. Analyse various searching and sorting algorithms and apply it to solve particular problem.
4. Determine a suitable data structure and algorithm to solve a real-world problem.

Prerequisite:

- Basic knowledge of C programming and basic mathematical concepts

Course Content

Unit No	Description	Hrs
1.	**Introduction to Data Structures:** Primitive and non-primitive data structures, Operations on data structures, Algorithms, Abstract Data Types, Complexity Analysis	05
2.	**Linear Data Structures:** **Stack:** Definition, Representation and Applications of Stack. **Queue:** Definitions, Representation and Applications of Linear Queue, Circular Queue, and Priority Queue.	06
3.	**Linked Lists:** Definition, Representation, Operations and Applications of singly linked list, doubly linked list, circular linked list, Application of linked list-Stack & queue, Introduction to Sparse matrix, representation of sparse matrix using linked list.	07
4.	**Searching, Sorting and Hashing Techniques:**	07

	Linear search, Binary search, Bubble sort, insertion sort, Merge sort, Quick sort, Selection sort, Radix sort, Heap sort, Complexity of algorithms **Hashing**: Definition, Hash functions, Overflow, Collision, Open Hashing, closed hashing, Rehashing Techniques.	
5.	**Trees:** Basic Technology, Binary Tree, Traversal methods, Binary search tree, AVL Tree, B tree, B+ tree, Heaps - operations and their applications.	**06**
6.	**Graphs:** Basic concepts of graph theory, Storage representation, Operations on graphs, Traversing a graph, Shortest path algorithm.	**05**

References:

Text Books:

- Seymour Lipschutz, Data Structures, McGraw-Hill (Schaum's Outlines Series).

Reference Books:

- Alfred V. Aho, John E. Hopcroft, and J. D. Ullman, Data Structures and Algorithms, Addison-Wesley.
- Ashok N. Kamthane, Introduction to Data Structures in C, Pearson Education.

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Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **RAMD2021**	Course Name: **Sensors and Actuators**

L	T	P	Credits
3	-	-	3

Course Description:
The goal of this course is to give senior and graduate students in engineering a hands-on introduction to the fundamental technology and practical applications of sensors. Various sensors, including capacitive, inductive, ultrasonic, accelerometers, image sensors and others will be covered in the course. Instrumentation techniques incorporating computer control, sampling, and data collection and analysis are reviewed in the context of real-world scenarios. There will be weekly laboratory assignments where students will have hands on experience with various sensors.
The course is based around a custom board equipped with various sensors, such as a high-speed camera, touch sensor, humidity sensor, temperature sensor, pressure sensor, accelerometer and position sensor. Additional peripheral sensors using the PMOD interface standard can also be attached to the sensor board. The board interfaces with these sensors via an FPGA device and it can also communicate with a PC via USB 3.0 interface. Students will use Verilog language to program the FPGA and communicate with various sensors and PC.

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

1. Explore the functions, characteristics, and operating principles of different sensors, transducers, and actuators.
2. Examine the process and techniques involved in calibrating sensors and transducers for optimal performance.
3. Evaluate and justify the choice of material and manufacturing methods used in the design of specific sensors.
4. Select the most appropriate sensors, transducers, and actuators based on the requirements of a given application.

Prerequisite:
A basic course on Automotive engineering and Electrical machines is recommended as pre-requisites for this course.

Course Content

Unit No	Description	Hrs
1.	**Sensors:** Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signals: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle	06

	of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.	
2.	**Inductive & Capacitive Transducer:** Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers – different types & signal conditioning- Applications: - capacitor microphone, capacitive pressure sensor, proximity sensor	**06**
3.	**Intelligent Sensors:** General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.	**06**
4.	**Micro Sensors and Micro Actuators:** Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators-Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles	**06**
5.	**Sensor Materials and Processing Techniques:** Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process	**06**
6.	**Actuators:** Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria. Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.	**06**

References:

Text Books:

- D. V. S. Murthy, Transducers and Instrumentation, PHI.
- D. Patranabis, Sensors and Transducers, PHI.
- S. Gupta and J. P. Gupta, PC Interfacing for Data Acquisition and Process Control, Instrument Society of America.

- Gary Johnson, LabVIEW Graphical Programming, McGraw Hill.
- D. Patranabis, Sensors and Transducers, Wheeler Publishing.
- Sergej Fatikow and Ulrich Rembold, Microsystem Technology and Microbotics, Springer-Verlag.
- Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, Springer.

Reference Books:

- Arun K. Ghosh, Introduction to Measurements and Instrumentation, PHI.
- A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI.
- Hermann K. P. Neubert, Instrument Transducers, Oxford University Press.

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Class: **S. Y. B. Tech**	Semester-**IV**
Course Code: **SH2175**	Course Name: **Environmental Science**

L	T	P	Credits
1	-	2	2

Course Description:
The syllabus of Environmental Science provides an integrated, quantitative and interdisciplinary approach to the study of environmental systems. The students of Engineering undergoing this course would develop a better understanding of human relationships, perceptions and policies towards the environment and focus on design and technology for improving environmental quality. Project has been incorporated to enhance high potential in the student and built research and positive attitude towards environment related issues, which will help them in their social and technical life ahead. The project is designed to make them apply practical knowledge with relevant tools and techniques to solve real life problems related to the environment and industry. This course will help students in developing eco-friendly approach to achieve sustainable development.

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

1. Apply interdisciplinary knowledge from various fields of science and engineering to address environmental issues.
2. Evaluate environmental impacts of human activities on the environment.
3. Use scientific approach to identify and solve environment related problems.
4. Design suitable solutions to address environmental challenges.
5. Participate in group work to become acquainted with the importance of teamwork collaboration.
6. Develop presentation and report writing skills.

Prerequisite: Nil.

Course Content

Unit No	Description	Hrs
1.	**Natural Resources and Ecosystem:** Renewable and non-renewable resources, Forest resources, water resources, Mineral resources, food resources, Energy resources, alternative energy resources Land resources, Structure and Functions of ecosystem, biotic and abiotic components, food chains, food web, Biodiversity, types of biodiversity, conservation of biodiversity.	04
2.	**Environmental Pollution and Health:** Environmental Pollution, types of pollution, Air pollution, Water Pollution, Noise Pollution, Soil Pollution, Marine Pollution, Radioactive Pollution, Thermal Pollution (Causes, sources and effects, abatement methods),	04

	Pollution Case studies-Bhopal Gas Tragedy, Chernobyl Accident: A nuclear Disaster, Ganga Water Pollution. Solid Waste management (Causes, sources, effects & control measures), Hazardous waste management, Plastic waste management, E-waste management. Disaster management and risk analysis.	
3.	**Climate change and Sustainable development:** From unsustainable to sustainable development, Urban problems related to energy, Water conservation: Rainwater harvesting, Watershed management, Climate change, Global Warming, Ozone layer depletion, Acid Rain, Consumerism & waste Products, Concepts of Eco-labeled products, Eco-mark, Awareness of Environmental Legislation.	**04**

Guidelines for Project:

1. The distribution of project group will be done by project coordinator and respective head of the department to the faculty.
2. Project will be the team work consisting min 3 to max 5 students.
3. Project topic should be application oriented and with consideration to Environmental science problems in their respective stream. Selection and finalization will be through project guide.
4. Prepare project report as per guidelines.
5. Project group must provide complete solution to the selected problem with conceptual clarity.
6. The project will be evaluated by respective branch HOD and project guide and senior faculty.
7. The project should be presented before the committee, which shall evaluate for 50 marks.

References:

Text Books:

- D.K. Asthana, Meera Asthana, A Textbook of Environmental Studies, S. Chand Publication Revised edition, 2006.
- S. Deswal & A. Deswal, Basic course in environmental Studies, Dhanpat Rai & Co ltd., Delhi, Second revised edition, 2009.

Reference Books:

- Eldon D Enger, Bradley F. Smith, Environmental science – a study of inter-relationships Wm C Brown Publishers 1989
- Francois Ramade Ecology of Natural resources, John wiley & Sons
- Robert Leo Smith, Ecology and field biology, Harper Collins Publishers
- Gilbert M. Masters, Introduction to Environmental Engineering & Science, Prentice Hall International Inc. Second Edition

Class: **S. Y. B. Tech**	Semester: **IV**
Course Code: **ME2224**	Course Name: **CAD Modelling Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This course equips students with the knowledge and skills to create detailed 2D and 3D models, perform assemblies, generate bill of material (BOM), and produce technical drafts for mechanical components. Students will learn to use SolidWorks CAD software, focusing on essential commands for sketching, modeling, and assembly processes. The curriculum includes setting drawing units, applying geometric and dimensional constraints, and integrating components into functional assemblies. Additionally, students will develop proficiency in creating and analyzing BOM and generating comprehensive 2D drafts in various projection views.

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

1. Construct accurate sketches of machine parts using CAD software.
2. Develop 3D models of machine parts by applying essential modeling commands.
3. Assemble multiple machine components into functional assemblies using advanced CAD tools.
4. Evaluate detailed drawing views, including various projections and annotations, for technical accuracy and completeness.

Course Content

Expt. No	Description	Hrs
1.	Introduction and Overview of SolidWorks, CAD/CAM/CAE Product Cycle, Environment of SolidWorks, Introduction to Menu Bars, Features, and Modules.	02
2.	Overview of SolidWorks User Interface: Command Manager, Feature Tree, and Property Manager. Understanding File Management and Templates.	02
3.	Constraints: Geometric and Dimensional Constraints, Sketch Tools, Sketch Solving Status, Sketch Relations, Standard Options, and Reference Geometry.	02
4.	3D Features: Extruded Boss/Base, Extruded Cut, Revolve, Sweep, Loft, Rib, Hole Wizard, and Slot Creation.	02
5.	Advanced Features: Fillet, Chamfer, Draft, Shell, Thread/Tap, Patterning (Linear, Circular, and Mirror), and Scaling Transformations.	02
6.	Creating and Managing Reference Geometry: Planes, Axes, Coordinate Systems, and Measurements.	02
7.	Assemblies: Inserting Components, Mating Features, Exploded Views, Smart Mates, Manipulating Parts, and Interference Detection.	02
8.	Advanced Assembly Operations: Coincidence, Contact, Offset, Angle Mates, Fixing Components, Quick Constraints, and Checking Interference/Clash.	02
9.	Drafting and Detailing: Front View, Auxiliary View, Section Views, Broken Views, Clipping Views, and Balloon Generation. Adding Dimensions,	02

	Tolerances, and Annotations. Generating Bill of Materials (BOM).	
10.	Case Study: Application of all modules for the assembly and drafting of a screw jack or other mechanical components.	**02**

References:

Text Books:

- Sham T. Solid Works for Designers. Softcover, CADCIM Technologies.
- Planchard, D., & Planchard, M. Engineering Design with SolidWorks. SDC Publications.
- Shih, R. SolidWorks: A Step-by-Step Project-Based Approach. SDC Publications.
- Zeid, I. Mastering SolidWorks. McGraw-Hill Education.

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Class: **S. Y. B. Tech**	Semester: **IV**
Course Code: **ME2401**	Course Name: **Object Oriented Language with C++ Lab**

L	T	P	Credits
-	-	2	1

Course Description:
Object-Oriented Programming (OOP) is a well-established and widely adopted programming paradigm known for its effectiveness in managing software complexity and promoting code reusability and modularity. This course introduces students to the core principles of OOP, such as classes, objects, inheritance, polymorphism, and encapsulation. Emphasis is placed on developing secure and efficient programs applicable to mechanical engineering contexts, including handling file-based data storage and generating basic geometric visualizations.

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

1. Implement C++ programs using object-oriented concepts such as classes, functions, constructors, operator overloading, and inheritance.
2. Debug C++ programs involving arrays of objects, file handling operations, and object lifecycle management.
3. Design C++ applications integrating object-oriented features, file handling, and basic graphics.

Prerequisite: Knowledge of C Programming.

Course Content

Expt. No	Description	Hrs
1.	Programs on Functions in C++.	02
2.	Programs on Classes & Objects - I.	02
3.	Programs on Classes & Objects - II.	02
4.	Programs on arrays of objects and arrays in objects.	02
5.	Programs on inline function & friend function.	02
6.	Programs on function overloading & operator overloading.	02
7.	Programs on constructor and destructor.	02
8.	Programs on Inheritance (single, multilevel, multiple).	02
9.	Programs on Inheritance (hierarchical, hybrid, virtual base class).	02
10.	Programs on file operations.	02
11.	Programs on graphics and line simulation - I.	04

References:

Text Books:

• E. Balagurusamy, Object-Oriented Programming with C++, 8th Edition, McGraw

Hill Education (India) Pvt. Ltd., New Delhi
- Yashavant P. Kanetkar, Let Us C++, 3rd Edition, BPB Publications, New Delhi.
- D. Ravichandran, Programming with C++, 3rd Edition, McGraw-Hill Education (India) Private Limited

Reference Books:
- Herbert Schildt, The Complete Reference C++, 4th Edition, McGraw-Hill Education,
- Robert Lafore, Object-Oriented Programming in Turbo C++, 1st Edition, Galgotia Publications Pvt. Ltd., New Delhi
- Bjarne Stroustrup, An Overview of the C++ Programming Language, 4th Edition, Addison-Wesley Professional,
- T. J. Henricson and E. Nyquist, Programming in C++: Rules and Recommendations, Ellemtel Telecommunication Systems Laboratories

Class: **S. Y. B. Tech**	Semester: **IV**
Course Code: **ME2244**	Course Name: **Material Science & Metallurgy Lab**

L	T	P	Credits
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Course Description:

This lab covers the important part of material testing i.e. Destructive and Non-destructive testing which is important in evaluation of mechanical properties and determination of flaws in materials. This lab also covers preparation of specimen for micro structural examinations, correlation of structures with mechanical properties. Students will be familiarized with selection of suitable heat treatment process for modification of mechanical properties.

Course Learning Outcomes:

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

1. Evaluate various mechanical properties using various destructive tests.
2. Use various Non-Destructive Testing methods to determine defects in components
3. Correlate mechanical properties with microstructures of steel and cast iron
4. To estimate composition of various ferrous and non-ferrous metals using emission spectrometer
5. Heat treats given steel specimens to modify mechanical properties.

Course Content

Expt. No.	Description	Hrs.
1.	Tensile test on Mild steel.	02
2.	Rockwell and Brinell hardness test on various metals.	02
3.	Micro-Vickers Hardness of delicate samples.	02
4.	Impact test on various metals.	02
5.	Demonstration of non-destructive testing methods.	02
6.	Examination of microstructures of steel.	02
7.	Examination of microstructures of Cast Iron.	02
8.	Heat treatments of steel.	02
9.	Compositional analysis by using Optical emission spectrometer.	02

10.	Jominy end quench test for Hardenability.	**02**

References:

Text Books:

- V.D. Kodgire, Material science and metallurgy, Everest Publishers Pune.
- William D. Callister, Materials Science and Engineering an Introduction, John Wiley & Sons.

References Books:

- Vijendra Singh, Physical Metallurgy, Standard Publishers Delhi.
- Prabhudev, Heat treatment of Steels, HMT Handbook.
- S. H. Avner, Physical Metallurgy, Tata McGraw-Hill publication.

Class: **S. Y. B. Tech**	Semester: **IV**
Course Code: **ME246**	Course Name **Workshop Practice -II**

L	T	P	Credits
--	--	2	1

Course Description:
This course focuses on advanced machining and assembly practices through hands-on training on lathe, milling, shaping, drilling, turret lathe, and grinding machines. Students perform precision machining operations including boring, taper turning, threading, milling, and grinding, followed by assembly with close dimensional tolerances.

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

1. Perform various lathe operations to fabricate composite parts (by performing boring, taper turning, threading etc.) and to assemble them with close dimensional tolerance, ensuring proper alignment and fit.
2. Perform cylindrical grinding and surface grinding process to achieve better surface quality.
3. Analyze material removal and profile generation during milling operations and enhance surface finish and material removal efficiency.
4. Analyze Surface contouring during shaping operations, demonstrating the ability to create complex shapes and profiles.
5. Perform operations on Turret lathe and drilling machine for engineering applications.

	Course Content	
Expt. No.	**Description**	**Hrs.**
1.	**Lathe Operations-** Fabricate parts (B, C and D) and assemble them together with part "A" with close dimensional tolerance. Job involving Boring machining process, internal taper operation, internal and external threading operations, 'V' and square threading, cylindrical grinding process, Surface grinding process, milling operations, drilling operations, Turret lathe operations. Analyzing Machining response during these operations e.g., Surface roughness and Tool wear	**24**

References:

Reference Books:

- Hajra Choudhary, Element of Workshop Technology vol. II, Media promoters and Publications.
- Hajra Choudhary, Element of Workshop Technology vol. I, Media promoters and Publications.
- Raghuvansrii, Workshop Technology, vol. II, Dhanpat Rai.
- W A. J. Chapman, Workshop Technology, Part II, Oxford and IBH publishing Co.

Class: **S. Y. B. Tech Mech**	Semester: **IV**
Course Code: **ME244**	Course Name: **Massive Open Online Course-I (MOOCS-I)**

L	T	P	Credits
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Course Description:
Online courses offered through platforms like NPTEL, SWAYAM, and NASSCOM provide opportunities to deepen the understanding of advanced mechanical engineering concepts and technologies to Mechanical Engineering students. These courses focus on critical domains such as Design, manufacturing, thermal engineering, CAD/CAM/CAE, robotics & automation, materials engineering, and emerging fields like renewable energy and Industry 4.0. They blend theoretical foundations with practical applications, enabling students to strengthen problem-solving skills, engage with modern engineering tools, and prepare for industry-oriented challenges, enabling lifelong learning. The objective of this course is to emphasize the development of skills and attitudes that enable continuous learning & adaptation to new situations.

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

1. Explain advanced principles, methods, and technologies in various areas of mechanical engineering.
2. Analyze mechanical engineering problems using mathematical, computational, and engineering fundamentals.
3. Design solutions for mechanical systems using modern engineering tools, software, and simulation platforms.
4. Apply programming, simulation, and analysis techniques (such as FEA, CFD, CAD/CAM) to develop and test mechanical systems and processes.
5. Demonstrate the ability to engage in independent and self-directed learning.

Note:

1. Student will get the credits of respective course in following conditions,
   a. In case of course selected from NPTEL/SWAYAM/NASSCOM platforms, students have to complete the timely assignments, pass the exam and secure the certificate.

2. While selecting online course, following points must be taken care of,
   a. Selected course must be approved by Departmental Programme Committee (DPC).
   b. Duration of each online course must be of at least FOUR weeks for NPTEL/SWAYAM & minimum 12 to 20 hours for NASSCOM.

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References:

- NPTEL (National Programme on Technology Enhanced Learning) https://nptel.ac.in
- SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) https://swayam.gov.in
- MOOCs on NASSCOM www.nasscom.in

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Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **SH 2645**	Course Name: **German Language - Level IV**

L	T	P	Credits
-	-	2	1

Course Description:
This course exposes a learner to LSRW skills of German language. The course takes a student's German language skills to advanced level with situational conversations. The course helps learners in creating cross-cultural sensitization and adaptability skills. Here, a student prepares himself for German language examination.

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

1. Demonstrate the ability to use German vocabulary and expressions in daily life familiar communicative situations.
2. Apply German grammatical structures, including the imperative, modal verbs (dürfen and sollen), the pronoun man, and W-questions accurately in spoken and written communication.
3. Interpret and respond to simple German conversations, reading passages, and audio texts of everyday situations to extract relevant information.
4. Communicate effectively in German by writing short texts using appropriate vocabulary and grammar.
5. Demonstrate integrated German language proficiency by applying listening, speaking, reading, and writing skills to successfully perform in real-life contexts.

Prerequisite: A Student, who is going to enroll for this course, should have following German language abilities:

1. Adequate knowledge of basic grammar of German language.
2. Intermediate level vocabulary of German language.
3. Communicate moderately using German language.

Course Content

Experiment No	Description	Hrs
1.	Body parts and Krankheiten(diseases) and home remedies	02
2.	Grammar- Imperative for du ,ihr, Sie	02
3.	Health tips and conversation at clinic Modal verbs - dürfen & sollen	02
4.	Professions related to health	02
5.	Vocabulary of vacation and activities in vacation	02
6.	Writing a postcard	02

	Grammar- Pronoun - man	
7.	Topic- Weather Reading texts related to vacation and formation of "W" questions	**02**
8.	Grammar revision for the entire book	**02**
9.	Explaining the pattern of the exam and explanation of each skill's exam requirement	**02**
10.	Practice for Skill "Writing" and " Speaking"	**02**
11.	Practice for skill "Reading" and "Listening"	**02**
12.	Solving exam set 1 Speaking practice	**02**
13.	Solving exam set 2 speaking practice	**02**

References:

- Studio D – A 1, Cornelsen Verlag, Goyal Publishing House, New Delhi.
- Tangram aktuell A 1, Goyal Publishing House, New Delhi.
- Lagune A 1, Goyal Publishing House, New Delhi.
- Netzwerk A 1, Goyal Publishing House, New Delhi.

The extra notes will be provided to the students to complete the required syllabus.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)
Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

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Class: **S. Y. B. Tech.**	Semester- **IV**
Course Code: **SH2625**	Course Name: **Japanese Language - Level IV**

L	T	P	Credits
-	-	2	1

Course Description:
This course is designed to introduce students to the everyday language of Japan. Lessons are organized around natural conversational topics, leading students from fundamental to advanced aspects of grammar to readings in simple texts.

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

1. Make basic conversations in various situations.
2. Recognize the sentence patterns.
3. Improve Japanese Language proficiency.
4. Give students insights about the communication required for living in Japan.
5. Expose students to the Japanese work ethics required in their professional careers.

Prerequisite: A Student, who is going to enroll for this course, should have following Japanese language abilities:

1) Knowledge of basic grammar of Japanese Language.
2) Communicate moderately using Japanese Language.

Course Content

Experiment No	Description	Hrs
1	How to make た forms of the verbs.	02
2	To express "have the experience of " using た forms of the verbs.	02
3	To express two or more than two actions in one list using た forms of the verbs.	02
4	Polite forms & plain forms (Style of speech)	02
5	Conversation in plain forms & polite forms.	02
6	To express ideas or judgements.	02
7	Report speech.	02
8	To express recommendation, suggestion.	02
9	How to seek agreement or confirmation from the listener.	02
10	Noun modification.	02
11	Describing an appointment, errand.	02

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12	Rules while using とき	**02**
13	Verbs used for giving & receiving of things (polite & plain forms)	**02**
14	Conditional forms of verbs, adjectives & nouns.	**02**
15	Subject of subordinate clause.	**02**

***Note**: Words written phonetically using the Latin alphabet (*romaji*) will be only used in the very initial stage to aid learning pronunciations.

References -
1. Minna No Nihongo I (3A Corporation, Japan), Publications: Goyal publishers.
2. Nihongo shouhou, Publication: JALTAP
Other reference material, practice papers & CDs for listening practice.
The extra notes will be provided to the students as per the requirement of the syllabus.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)
Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.