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 to T.Y. B.Tech. from 2025-26 (2023-27 Batch)
Department of Automobile Engineering

Rev: MA/RIT/01/2022-26

Class: S.Y. B.Tech. Mechanical Engineering Automobile **Semester:** III

Course Code	Course	Teaching Scheme				Evaluation Scheme				
							Theory (Marks)		Practical (Marks)	
		L	T	P	Credits	Scheme	Max	Min. for passing (%)	Max.	Min. for passing (%)
SH2032	Engineering Mathematics – III	3	1	-	4	ISE	20	40 40	----	----
						UT1	15		----	----
						ESE	50	40	----	----
MA201	Applied Thermodynamics	3	-	-	3	ISE	20	40 40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
MA203	Engineering Mechanics	3	-	-	3	ISE	20	40 40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
MA205	Manufacturing Technology	3	-	-	3	ISE	20	40 40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
MA207	Material Science & Metallurgy	3	-	-	3	ISE	20	40 40	----	----
						UT1	15		----	----
						UT2	15		---	----
						ESE	50	40	----	----
SH2173	Environmental Science	1*	-	-	1	ISE	50	40	----	----
						ESE	50	40	----	----
MA209	Workshop Practice – I	-	-	2	1	ISE	-----	----	100	50
MA211	Engineering Mechanics Lab.	-	-	2	1	ISE	----	----	50	50
						ESE	----	----	50	50
MA213	Machine Drawing Lab.	-	-	2	1	ISE	----	----	100	50
MA215	Technical Aptitude – I	-	-	2*	1	ISE	----	----	50	50
						ESE	----	----	50	50
SH2603	Environmental Science Project	-	-	2	1	ISE	----	----	100	50
	Open Elective – II Professional Skills Development and Foreign Languages - I	-	-	2	1	ISE	----	----	60	50
						ESE	----	----	40	50
	TOTAL	**16**	**1**	**12**	**23**					
	TOTAL CONTACT HOURS	**29**								

ISE = In Semester Evaluation, UT1 = Unit Test 1, UT2 = Unit Test 2, ESE = End Semester Examination

Total Contact Hours/week: 29
Total Credits : 23

Note*: One-hour extra lecture to be allotted in the time-table.

Technical Aptitude-I: Engineering Mathematics-III, Applied Thermodynamics, Engineering Mechanics

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Open Elective – II:

Sr. No.	Subject Name		Course Code
1.	Professional Skills Development and Foreign Languages - I	Professional Leadership Skills	SH2633
2.		Interpersonal Skills ['Jeevanvidya' for Work Life Balance]	SH2613
3.		Innovation Tools and Methods for Entrepreneurs	SH2693
4.		Personal Effectiveness and Body Language	SH2593
5.		German Language - Basic Level	SH2733
6.		Japanese Language - Level III	SH2713

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

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Department of Automobile Engineering

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Class: S.Y. B.Tech. Mechanical Engineering Automobile **Semester:** IV

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory (Marks)			Practical (Marks)	
		L	T	P	Credits	Scheme	Max	Min. for passing (%)		Max	Min. for passing (%)
MA202	Kinematics of Machines	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
MA204	Fluid Mechanics & Machinery	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
MA206	Electric Drives and Controls	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			--	---
						UT2	15			---	---
						ESE	50	40		---	---
MA208	Mechanics of Materials	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			--	---
						ESE	50	40		---	---
MA210	Industrial Organisation and Management	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
MA212	Metrology & Measurement Lab.	-	-	2	1	ISE	---	----		100	50
MA214	Fluid Mechanics & Machines Lab.	-	-	2	1	ISE	---	----		50	50
						ESE	---	----		50	50
MA216	Solid Modeling Lab.	-	-	2	1	ISE	---	---		100	50
MA218	Workshop Practice - II	-	-	2	1	ISE	---	----		100	50
MA220	Object-Oriented Programming Lab.	-	-	2	1	ISE	----	----		50	50
						ESE	----	----		50	50
MA222	Technical Aptitude - II	-	-	2*	1	ISE	---	----		50	50
						ESE	---	----		50	50
	Open Elective – III Professional Skills Development and Foreign Languages - II	-	-	2	1	ISE	-	-	--	60	50
						ESE	-	-		40	50
	TOTAL	**14**	**-**	**14**	**21**						
	TOTAL CONTACT HOURS	**28**									

ISE = In Semester Evaluation, UT1 = Unit Test 1, UT2 = Unit Test 2, ESE = End Semester Examination.

Total Contact Hours/week : 28
Total Credits : 21

Note: Students are requested to undergo industrial / field training of a minimum of four weeks in the vacation of Semester-IV and its evaluation will be carried out in the Semester-V.

Note*: One hour extra lecture to be allotted in the timetable.

Technical Aptitude-II: Kinematics of Machines, Mechanics of Materials, Fluid Mechanics & Fluid Machinery

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Open Elective – III:

Sr. No.	Subject Name		Course Code
1.	Professional Skills Development and Foreign Languages - II	Professional Leadership Skills	SH2633
2.		Interpersonal Skills ['Jeevanvidya' for Work Life Balance]	SH2613
3.		Innovation Tools and Methods for Entrepreneurs	SH2693
4.		Personal Effectiveness and Body Language	SH2593
5.		German Language - Advanced Level	SH2643
6.		Japanese Language - Level IV	SH2623

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

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Class: T.Y. B.Tech. Mechanical Engineering Automobile **Semester:** V

Course Code	Course	Teaching Scheme				Evaluation Scheme				
							Theory (Marks %)		Practical (Marks %)	
		L	T	P	Credits	Scheme	Max.	Min. for Passing	Max.	Min. for Passing
MA3351	Automotive Systems	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
	Program Elective - I	2	-	-	2	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
	Open Elective - I	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
	Multidisciplinary Minor - I	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
	Multidisciplinary Minor - III	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
SH3034	Scholastic Aptitude - I	1	-	2	Audit	ISE	100	50 (P/NP)	---	----
	Multidisciplinary Minor - IV	-	-	4	2	ISE	---	---	50	50
						ESE	---	---	50	50
MA3431	Heat Transfer Lab.	-	-	2	1	ISE	---	---	100	50
MA345	Solid Modeling Lab.	-	-	2	1	ISE	---	---	50	50
						ESE	---	---	50	50
MA347	Automotive Systems Lab.	-	-	2	1	ISE	---	---	100	50
MA3511	Massive Open Online Courses (MOOC)	-	-	-	1	ESE	---	---	100	50
MA349	Summer Internship	-	-	-	1	ISE	---	----	100	50
	TOTAL	**15**	**-**	**12**	**21**					
	TOTAL CONTACT HOURS	**27**								

ISE = In Semester Evaluation, UT-1 = Unit Test-1, UT-2 = Unit Test-2, ESE = End Semester Exam.

Total Contact Hours/week : **27**
Total Credits : **21**
Technical Aptitude Courses : Theory of Machines, Material Science, Mechanical Measurement & Metrology

- **# End Semester Examination of Multidisciplinary Minor - IV will be based on practical oral examination only.**
- **Note: Students are required undergo scholastic aptitude training of minimum two weeks in the vacation of Semester-V and it's evaluation will be carried out in the Semester-VI as an audit course.**
- *** Contact hours of scholastic aptitude are not accounted in teaching load during semester.**

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Program Elective – I:

Sr. No.	Course Code	Discipline	Course
1	MA3091	Automotive Design	Automotive Product Design and Development
2	MA3371		Hydraulics & Pneumatics
3	MA3391	Automotive Service & Management	Transport Management
4	MA3411		Automotive Maintenance

Open Elective I

Sr. No.	Course Code	Open Elective Subject Name	Offered by the department
1	OE3044	Renewable Energy Sources	Robotics & Automation
2	OE3064	Environmental Impact Assessment	Civil Engineering
3	OE3104	Network Administration	Computer Science and Engineering
4	OE3381	Disaster Management	Civil Engineering
5	OE341	Energy Audit and Management	Electrical Engineering
6	OE343	Data Science	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
7	OE365	Distributed Systems	Computer Science and Information Technology
8	OE347	New Product Design & Development	Mechanical Engineering
9	OE349	Non-Conventional Energy Sources	Mechanical Engineering
10	OE351	Hydrogen & Fuel Cell Technology	Mechanical Engineering
11	OE353	Factory Automation	Mechatronics Engineering Dept.
12	OE355	Cyber Physical System	Mechatronics Engineering Dept.
13	OE357	Internet of things	Electronics & Telecommunication Engineering
14	OE359	Drone technology	Electronics & Telecommunication Engineering
15	OE361	Object Oriented Modeling and Design	Computer Science and Information Technology
16	OE363	Robotics Engineering & Applications	Robotics & Automation

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Class: T.Y. B.Tech. Mechanical Engineering Automobile **Semester:** VI

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks %) Max.	Theory (Marks %) Min. for Passing		Practical (Marks %) Max.	Practical (Marks %) Min. for Passing
MA3281	Automotive Power Plant	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
MA332	Research Methodology	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Program Elective - II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Open Elective - II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Multidisciplinary Minor - II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Multidisciplinary Minor - V	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
SH3064	Scholastic Aptitude - II	1	-	2	Audit	ISE	100	50 (P/NP)		---	---
MA3411	Automotive Power Plant & Vehicle Testing Lab.	-	-	4	2	ISE	---	---		50	50
						ESE	---	---		50	50
MA3431	Automotive Electrical and Electronics Lab.			4	1	ISE	---	---		100	50
MA3262	Capstone Project Phase - I	-	-	2	1	ISE	---	---		100	50
	TOTAL	**18**	**-**	**12**	**21**						
	TOTAL CONTACT HOURS	**30**									

ISE = In Semester Evaluation, UT-1 = Unit Test-1, UT-2 = Unit Test-2, ESE = End Semester Exam.

Total Contact Hours/week : 30
Total Credits : 21
Technical Aptitude Courses: Design of Machine Elements, Power Plant Engg., Industrial Engg.

*** Contact hours of scholastic aptitude are not accounted in teaching load during semester.**

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Program Elective – II:

Sr. No.	Course Code	Discipline	Course
1	MA334	Automotive Design	Mechanics of Composite Materials
2	MA336		Sensors and Actuators
3	MA3381	Automotive Service & Management	Vehicle Body Repair
4	MA340		Automotive Dealership Management

Open Elective II

Sr. No.	Course Code	Open Elective Subject Name	Offered by the department
1	OE3024	Reliability Engineering	Robotics & Automation
2	OE3084	Materials Management	Civil Engineering
3	OE3182	Industrial Drives	Electrical Engineering
4	OE3284	Supply Chain Management	Mechanical Engineering
5	OE3324	Entrepreneurship Development	Mechanical Engineering
6	OE3401	Cyber Security	Computer Science and Information Technology
7	OE342	Data Mining	CSE(AI&ML)
8	OE344	Supply Chain Analytics	Mechatronics Engineering Dept.
9	OE346	Mobile Robotics	Mechatronics Engineering Dept.
10	OE348	Information Technology Foundation Program	Computer Science and Engineering
11	OE350	Operations Research	Civil Engineering
12	OE352	Image Processing	Electronics & Telecommunication Engineering
13	OE354	Fuzzy logic and Neural Network	Electronics & Telecommunication Engineering
14	OE356	Project Management	Mechanical Engineering
15	OE358	Plumbing (Water and Sanitation)	Civil Engineering
16	OE362	Flexible Manufacturing System	Robotics & Automation
17	OE364	AI for Manufacturing	Computer Science and Information Technology
18	OE366	AI for Cybersecurity	Computer Science and Engineering
19	OE368	AI for Agriculture	CSE(AI&ML)
20	OE370	AI for Sustainability	Electronics & Telecommunication Engineering
21	OE3242	Marketing for Engineers	MBA

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Class: Final Year B.Tech. Mechanical Engineering Automobile **Semester:** VII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory (Marks %)			Practical (Marks %)	
		L	T	P	Credits	Scheme	Max.	Min. for Passing		Max.	Min. for Passing
MA459	Electric and Hybrid Electric Vehicles	2	-	-	2	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
MA461	Automotive System Design	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
MA4032	Vehicle Dynamics	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
	Program Elective – III	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
	Program Elective - IV	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
	Program Elective – III Lab.	-	-	2	1	ISE	--	---		50	50
						ESE	--	---		50	50
MA475	Automotive System Design Lab.	-	-	2	1	ISE	--	---		50	50
						ESE	--	---		50	50
MA477	Automotive Simulation Lab.	-	-	2	1	ISE	--	---		100	50
MA479	Automotive Diagnostics Lab.	-	-	2	1	ISE	--	---		50	50
						ESE	--	---		50	50
MA481	Capstone Project Phase - II	-	-	6	3	ISE	--	---		50	50
						ESE	--	---		50	50
	TOTAL	**14**	**-**	**14**	**21**						
	TOTAL CONTACT HOURS	**28**									

ISE = In Semester Evaluation, MSE = Mid Semester Exam, ESE = End Semester Exam.

Total Contact Hours/week : 28
Total Credits : 21

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Program Elective – III:

Sr. No.	Course Code	Discipline	Course
1	MA463	Automotive Design	Finite Element Methods
2	MA4191		Automotive NVH
3	MA4351	Automotive Service & Management	Automotive Air Conditioning
4	MA465		Motor Insurance Practices

Program Elective – IV:

Sr. No.	Course Code	Discipline	Course
1	MA4071	Automotive Design	Automotive Aerodynamics
2	MA4171		Computational Fluid Dynamics
3	MA4151	Automotive Service & Management	Industrial Engineering
4	MA467		Special Purpose Vehicles

Program Elective – III Lab.:

Sr. No.	Course Code	Discipline	Course
1	MA469	Automotive Design	Finite Element Methods Lab.
2	MA4451		Automotive NVH Lab.
3	MA4711	Automotive Service & Management	Automotive Air Conditioning Lab.
4	MA473		Motor Insurance Practices Lab.

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

Class: Final Year B.Tech. Mechanical Engineering Automobile **Semester:** VIII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for Passing		Max.	Min. for Passing
OE4382	Finance for Engineers (Online Course)	2	-	-	2	ISE	25	40	40	---	---
						ESE	75	40		---	---
OE4362	Engineering Management & Economics (Online Course)	2	-	-	2	ISE	25	40	40	---	---
						ESE	75	40		---	---
IP4024	Industry Internship & Project	-	-	-	12	ISE	---	----		50	50
						ESE	---	---		50	50
	TOTAL	-	-	-	16						

ISE: In Semester Evaluation, ESE: End Semester Exam

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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Model II: Research Internship (RI)

Class: Final Year B.Tech. Mechanical Engineering Automobile **Semester:** VIII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for Passing		Max.	Min. for Passing
OE4382	Finance for Engineers (Online Course)	2	-	-	2	ISE	25	40	40	---	---
						ESE	75	40		---	---
OE4362	Engineering Management & Economics (Online Course)	2	-	-	2	ISE	25	40	40	---	---
						ESE	75	40		---	---
RE4044	Research Internship	-	-	-	12	ISE	---	---		50	50
						ESE	---	---		50	50
	TOTAL	-	-	-	**16**						

ISE: In Semester Evaluation, ESE: End Semester Exam

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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Model III: Entrepreneurial Internship (EI)

Class: Final Year B.Tech. Mechanical Engineering Automobile **Semester:** VIII

Course Code	Course	Teaching Scheme			Credits	Evaluation Scheme					
		L	T	P		Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for Passing		Max.	Min. for Passing
ED4104	Project Management (Online Course)	-	-	-	2	ISE	25	40	40	-	-
						ESE	75	40		-	-
ED4044	Commercial Aspects of the Project (Online Course)	-	-	-	2	ISE	25	40	40	-	-
						ESE	75	40		-	-
ED4064	Entrepreneurship Development Program (EDP)	-	-	-	1	ISE	---	--		100	50
ED4084	Entrepreneurial Internship	-	-	-	11	ISE	--	--		50	50
						ESE	--	--		50	50
	TOTAL	-	-	-	**16**						

ISE: In Semester Evaluation, ESE: End Semester Exam

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 an entrepreneurial internship need to undergo a one-month internship at an outside reputed organization or firm
Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.
4] A one-week Entrepreneurship Development Program (EDP) will be conducted after completion of 7th semester and before start of 8th semester.

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Multidisciplinary Minor

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

Multidisciplinary Minor Baskets					
MDM Basket Name	**Sr. No.**	**Course Code**	**Course Name**	**Semester**	**Offered by Department**
Automobile Engineering	1	MAMD201	Automobile Systems	III	Automobile Engineering
	2	MAMD202	I. C. Engines	IV	
	3	MAMD301	Automotive Safety & Ergonomics	V	
	4	MAMD303	Automotive Engineering Lab.	V	
	5	MAMD302	Electric Vehicles	VI	
Construction Engineering	1	CEMD201	Building Construction and Planning	III	Civil Engineering
	2	CEMD202	Building Estimation and Valuation	IV	
	3	CEMD301	Infrastructure Engineering	V	
	4	CEMD303	Smart Cities and Sustainable Development	V	
	5	CEMD302	Public Health Engineering	VI	
Software Programming	1	CSMD201	Introduction to Data Structures	III	Computer Science & Engineering
	2	CSMD202	Problem solving using JAVA	IV	
	3	CSMD301	Fundamentals of Database Systems	V	
	4	CSMD303	Object-oriented Programming in Python	V	
	5	CSMD302	Artificial Intelligence	VI	
Electrical Power System	1	EEMD201	Electrical Power Generation	III	Electrical Engineering
	2	EEMD202	Power System	IV	
	3	EEMD301	Electrical Machines	V	
	4	EEMD303	Electrical Technology Lab	V	
	5	EEMD302	Smart Grid	VI	

Electronics System Design	1	ECMD201	Electronics Devices and Applications	III	Electronics &Telecommunication Engineering
	2	ECMD202	Electronics Communication Systems	IV	
	3	ECMD301	Advanced Communication Systems	V	
	4	ECMD303	Industrial Electronics	V	
	5	ECMD302	Electronic Product Design	VI	
Software Development	1	CIMD201	Data Structures	III	Computer Science & Information Technology
	2	CIMD202	Computer Algorithms	IV	
	3	CIMD301	Introduction to DBMS	V	
	4	CIMD303	OOP using Java	V	
	5	CIMD302	Software Engineering	VI	
Elements of Mechanical Engineering	1	MEMD201	Materials and Applications	III	Mechanical Engineering
	2	MEMD202	Design and Drawing of Machine Components	IV	
	3	MEMD301	Manufacturing and Assembly Process	V	
	4	MEMD303	Refrigeration and Air Conditioning	V	
	5	MEMD302	Power Plant Engineering	VI	
Mechatronics Engineering	1	MCMD201	Fundamentals of Mechatronics	III	Mechatronics Engineering
	2	MCMD202	Industrial Fluid Power	IV	
	3	MCMD301	Sensor and Instrumentation	V	
	4	MCMD303	Industrial Automation	V	
	5	MCMD302	Industrial Robotics	VI	
Artificial Intelligence	1	AIMD201	Object Oriented Programming	III	Computer Science & Engineering (AI-ML)
	2	AIMD202	Data Structures and Algorithms	IV	
	3	AIMD301	Machine Learning	V	
	4	AIMD303	Business Intelligence	V	
	5	AIMD302	Principles of AI	VI	

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

B. Tech. in Mechanical Engineering Automobile with Double Minor degree

- To get B. Tech. in Mechanical Engineering Automobile with Double Minor degree student need to earn extra 18 credits by completing 6 minor courses (One minor course / semester)
- Minor courses can be completed through online platforms
- Student can choose any one specialization given by the department and complete all the six courses under the specialization to earn total 188 Credits which consist 170 credits of regular Multidisciplinary Minor courses and 18 Credits of Double Minor courses.
- Following are the baskets of Minor courses

Double Minor Baskets					
Double Minor Basket Name	**Sr. No.**	**Course Code**	**Course Name**	**Semester**	**Offered by Department**
Electric Vehicle	1	MADM201	Powertrain for EV	III	Automobile Engineering
	2	MADM202	Battery Management Systems for Electric Vehicles	IV	
	3	MADM301	Hybrid Vehicles	V	
	4	MADM302	Fuel Cell Technology	VI	
	5	MADM401	Charging Infrastructure	VII	
	6	MADM402	Autonomous Vehicle	VIII	
Water Resource Management	1	CEDM201	Water Economics and Governance	III	Civil Engineering
	2	CEDM202	Availability and Management of Groundwater Resources	IV	
	3	CEDM301	Pollutants and Water Supply	V	
	4	CEDM302	Integrated Waste Management For A Smart City	VI	
	5	CEDM401	Advanced Geomatics Engineering	VII	
	6	CEDM402	Optimization Methods for Civil Engineering	VIII	

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Data Science	1	CSDM201	Principles of Data Science	III	Computer Science & Engineering
	2	CSDM202	Data Wrangling with Python	IV	
	3	CSDM301	Data management and representation	V	
	4	CSDM302	Exploratory Data Analysis	VI	
	5	CSDM401	Business Analytics	VII	
	6	CSDM402	NPTEL/SWAYAM	VIII	
Electric Vehicle and Renewable Energy Systems	1	EEDM201	Technologies for Clean And Renewable Energy Production	III	Electrical Engineering
	2	EEDM202	Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems	IV	
	3	EEDM301	Solar Photovoltaics Fundamentals, Technology and Applications	V	
	4	EEDM302	Introduction to Hybrid and Electric Vehicles	VI	
	5	EEDM401	Fundamentals of Electric vehicles: Technology and Economics	VII	
	6	EEDM402	Electric vehicles and Renewable energy	VIII	
Internet of Things	1	ECDM201	Sensors and Actuators	III	Electronics & Telecommunication
	2	ECDM202	Wireless Sensor Networks	IV	
	3	ECDM301	IoT protocols and Security	V	
	4	ECDM302	Embedded System Design for IoT	VI	
	5	ECDM401	Android Application Design	VII	
	6	ECDM402	Cloud Integration using AWS	VIII	
Artificial Intelligence and Data Science	1	CIDM201	Artificial Intelligence	III	Computer Science & Information Technology
	2	CIDM202	Data Science with R programming	IV	
	3	CIDM301	Machine Learning	V	
	4	CIDM302	Business Intelligence	VI	
	5	CIDM401	Deep learning	VII	
	6	CIDM402	Data Ethics and Privacy	VIII	

AI Based Condition Monitoring	1	MEDM201	Fundamentals of Structural Dynamics	III	Mechanical Engineering
	2	MEDM202	Principles of Vibration control	IV	
	3	MEDM301	Machinery Fault Diagnosis	V	
	4	MEDM302	Instrumentation and Data Recording	VI	
	5	MEDM304	Double Minor IV Lab	VI	
	6	MEDM401	AI Tools and Signal Processing	VII	
	7	MEDM402	AI Based Condition Monitoring	VIII	
Autotronics	1	MCDM201	Fundamentals of Automotive Systems	III	Mechatronics Engineering
	2	MCDM202	Automotive Electrical and Electronics	IV	
	3	MCDM301	Automotive Communication System	V	
	4	MCDM302	Automotive Driver Assistant System	VI	
	5	MCDM401	Engine Control System	VII	
	6	MCDM402	Automotive Diagnostics	VIII	
Artificial Internet of Things - AIOT	1	AIDM201	Introduction to Internet of Things	III	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
	2	AIDM202	IoT Protocols	IV	
	3	AIDM301	IoT System Design	V	
	4	AIDM302	Industry 4.0 and IIoT	VI	
	5	AIDM401	Internet of Things Technology and Applications	VII	
	6	AIDM402	NPTEL/SWAYAM	VIII	

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

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

- To get B. Tech. in Mechanical Engineering Automobile with Honor and Multidisciplinary Minor degree student need to earn extra 18 credits by completing 6 Honor courses (One course / semester)
- Honor course can be completed through online platforms
- Student can choose any one specialization given by the department and complete all the six courses under the specialization to earn total 188 Credits which consist 170 credits of regular Multidisciplinary Minor courses and 18 Credits of Honor courses.
- Following are the baskets of Honor courses

Specialization: Vehicle Design & Development			
Sr. No.	**Course Code**	**Course Name**	**Offered in Semester**
1	MAHO201	Automotive Styling and Ergonomics	III
2	MAHO202	Automotive Body & Structure Design	IV
3	MAHO301	Engine Design	V
4	MAHO302	Vehicle Testing and Certification	VI
5	MAHO401	Automotive Safety	VII
6	MAHO402	Design of Electric Vehicles	VIII

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

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 Automobile-Honors with Research and Multidisciplinary Minor degree Student need to earn total 206 Credits which consist 170 credits of regular Multidisciplinary Minor courses, 18 Credits of Honor courses and 18 credits of Research courses.

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

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for passing		Max.	Min. for passing
REH401	Intellectual Property Rights	-	-	-	2	ISE	50	40	40	---	---
						ESE	50	40		---	---
REH403	Research Project (Synopsis) Phase - I	-	-	-	2	ISE	--	--	--	50	50
						ESE	--	--		50	50
REH405	Research Specific Core Course - I (Online NPTEL course)	-	-	-	3	ISE	50	40	40	--	--
						ESE	50	40		--	--
	TOTAL	-	-	-	7						

ISE: In Semester Evaluation, ESE: End Semester Exam.

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

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

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for passing		Max.	Min. for passing
REH402	Research Project Phase - II	-	-	-	11	ISE	--	--	--	50	50
						ESE	--	--		50	

K.E. Society's

Rajarambapu Institute of Technology, Sakharale

(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Syllabus of T.Y. B. Tech. Mechanical Engineering Automobile

To be Implemented to T.Y. B. Tech. from 2025-26 (2023-27 Batch)

Department of Automobile Engineering

Class: **T. Y. B. Tech.**	Semester: **V**
Course Code: **MA3351**	Course: **Automotive Systems**

L	T	P	Credits
3	-	-	3

Course Description:

Automotive systems are a one of the core courses of Automotive Engineering and lays foundation for the advanced courses like vehicle dynamics and automotive design. The course introduces the major automotive chassis systems like steering, brakes and suspensions. It also covers the drivetrain elements like clutches, gearbox and differential. The course emphasizes on fundamental principles of operation, functional system equations, various system configurations and advancements. Successful completion of this course is very much essential for further learning and industry carrier.

Course Outcomes:

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

1. Explain constructional details and operation of the automotive systems.
2. Interpret the influence of various technical parameters on the behavior of the automotive systems.
3. Configure the systems and its elements for integrating into drivetrain/chassis systems appropriate for given automotive application.
4. Present the advanced versions of automotive systems.

Prerequisite: A basic course on Mechanical elements is recommended as pre-requisites for this course

Course Content

Unit No.	Description	Hrs.
1	**Introduction and Automotive clutches** Classification of automobiles, transmission layouts eg. front engine-front wheel drive etc., chassis and body materials, frames Requirements, analytical equation for torque transmission, types, clutch assembly, diaphragm clutch, centrifugal clutch, fluid flywheel, torque converter	**06**
2	**Gearbox** Need of gearbox, manual gearbox, gear selector mechanism, heavy vehicle gear boxes, lubrication, torque convertors, overdrive, automatic transmissions, AMT, DCT, CVT	**06**
3	**Propeller shaft, differential and axles**	**06**

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	Propeller shaft/drive shafts, Universal joints, Constant velocity joints differential, differential lock, final drive, axle arrangements, 4WD arrangement	
4	**Steering system** Steering geometry, Ackermann steering, steering ratio, layouts, power steering, active steering, steer-by-wire system, 4W steering	**06**
5	**Suspension system, Wheels and Tyres** Principles, elements, quarter car model, types of suspension systems, damper, roll centers, adaptive suspensions	**06**
6	**Braking system** Principles and equations, drum and disc brake arrangements, hydraulic brake system, air and vacuum brakes, ABS and ESP	**06**

References:

Text Books-

1. Newton, Steed & Garret, Motor Vehicles, Butterworth Heinemann
2. Henz Heisler, Advanced Vehicle Technology, SAE International

Reference Books-

1. Henz Heisler, Vehicle and Engine Technology, SAE International
2. J. Reimpell, H. Stoll, J. W. Betzler, The Automotive Chassis, Butterworth Heinemann
3. Giles J. G., Steering, Suspension & Tyres, Illiffe Book Ltd. London
4. William Crouse, Donald Anglin, Automotive Mechanics, McGraw-Hill
5. N. K. Giri, Automotive Mechanics, Khanna Publishers

Department of Automobile Engineering

Class: **T.Y. B. Tech.**	Semester-V
Course Code: **MA3091**	Course Name: **Automotive Product Design and Development**

L	T	P	Credits
2	-	--	2

Course Description:
The course has practical significance as the students shall be responsible for automotive/industrial product development as a part of the industry. The content of the course includes important aspects of product design and development such as need identification, specification setting, conceptualization, product architecture, product development techniques like DFx, industrial design considerations, product development economics and Intellectual Property Right (IPR). The course outcomes shall ensure that the graduates are capable of converting an idea into a commercial product or a physical prototype ready for commercialization. They shall be well equipped with theoretical background and understanding of the details of product design and development process.

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

1. Develop the specifications for the proposed product.
2. Generate, screen and test concepts for proposed product.
3. Choose product appropriate product architecture and integrate various development concepts while developing the product.
4. Analyse commercial aspects of a typical product development project.

Prerequisite: The students preferably should have been exposure to vehicle systems and vehicle as a product.

Course Content

Unit No	Description	Hrs
1.	**Product planning and specifications** Introduction and generic product development process, Characteristics and challenges of PD, opportunity identification, product planning, identifying customer needs, product specifications-establishing target specifications, setting the final specifications	06
2.	**Concept generation, selection and evaluation** Concept generation process, tools for concept generations, concept selection, Pugh matrix for concept selection, concept evaluation, measuring customer response	06
3.	**Product architecture and development methodologies**	06

	Types of product architectures, choosing product architecture, types of modularities, DFx concept, Industrial design – aesthetics, ergonomics and styling, Design for manufacturing and assembly, Design for environment – concept and process	
4.	**Product development economics** Product development cash flow, NPV, economic analysis – base-case model, sensitivity analysis and its use for determining trade-off, influence of qualitative factors, IPR – Patents	**06**

References -

Text Books:

1. Karl T Ulrich, Steven D Eppinger, Product Design and Development, Tata McGrawhill New Delhi
2. Bhise V D, Automotive product development: A systems engineering implementation. CRC Press; 2017 May 8.

Reference Books:

1. George E. Dieter, Linda C. Schmidt, Engineering Design, McGraw-Hill International Edition, ISBN 978-007-127189-9
2. Kevin, Otto and Wood, Product Design, Pearson Education
3. Yousef Haik, T. M. M. Shahin, Engineering Design Process, Cengage Learning, 2010, ISBN 0495668141
4. Boothroy J.G., Assembly Automation and Product Design, Marcel Dekker
5. Burdek B.E., Design, History, Theory and Practice of Product Design, Birkhauser Publisher for Architecture, Boston
6. Chitale A.K., Product Design and Manufacturing, PHI Learning, New Delhi

Class: **T. Y. B. Tech.**	Semester: **V**
Course Code: **MA3371**	Course: **Hydraulics and Pneumatics**

L	T	P	Credits
2	-	-	2

Course Description:
The course aims at introduction of hydraulic and pneumatic fluid power applications in engineering. The course contents include elements of hydraulic and pneumatic system to enable the students to select the components of hydraulic and pneumatic systems. The design and selection of hydraulic circuits and pneumatic circuits for various applications is also covered in the syllabus.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Describe the fundamentals of hydraulics and pneumatics.
2. Explain different components of fluid power system.
3. Design hydraulic and pneumatic circuits for specific applications.

Prerequisite: Fluid Mechanics and Machinery

Course Content:

Unit No.	Description	Hrs.
1	**Elements of Hydraulic System** Introduction, Properties of fluids, Hydraulic and Pneumatic symbols, Application of hydraulics in various fields of engineering, elements of hydraulic systems – Types and applications of Hydraulic Pumps, Cylinders, Motors, Accumulators, Strainer, Filters.	06
2	**Hydraulic Circuits** Types of control valves, applications of control valves, Hydraulic circuits and their applications - Pressure-regulating circuit, speed control circuit, accumulator circuit, booster and intensifier circuit, motion synchronizing circuit.	06
3	**Elements of Pneumatic System** Application of pneumatics in engineering, elements of pneumatic system, comparison between hydraulic and pneumatic systems, Primary and secondary air treatment - Filters, regulators, lubricators, mufflers and dryers Air compressors, their types and selection criteria.	06
4	**Pneumatics Circuits** Pneumatic control valves and their applications - Direction control valves, Pressure control valves, speed regulators, Cylinders and their mountings, hoses and connections, Air motors, Pneumatic circuits and their applications - Basic pneumatic circuit, impulse operation, speed control, pneumatic motor circuit, sequencing circuits and time delay circuit.	06

References-

Text Books:

1. J. J. Pippenger, Industrial Hydraulic, Tata McGraw-Hill McGraw Hill Book Co. Ltd.
2. S. R. Majumdar, Pneumatics systems - Principles and Maintenance, Tata McGraw Hill Book Co.

Reference Books:

1. V. Thanikacha, Hydraulics and Hydraulic Machinery, Tata McGraw Hill Book Co.
2. A Esposito, Fluid Power with Application, Prentice Hall of India.

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Class:- **T. Y. B. Tech.**	Semester: **V**
Course Code: **MA3391**	Course: **Transport Management**

L	T	P	Credits
2	--	--	2

Course Description:
Amongst various transport modes, motor transport has dominant position within the transport sector. This growing importance of motor transport is also reflected in the steady increase in the modal share of motor transport in the movement of freight and passengers. The emergence of road transport as the dominant transport mode is attributable to some of its unique qualities such as easy accessibility, flexibility of operation, door-to-door service and reliability. Industrial development is also largely dependent on the transport sector. The subject covers the motor vehicle act covering the control of automobiles on the road, taxation structure, vehicle insurances, safety factors, bus & goods transport operations and advanced traffic management systems in brief.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Describe the motor vehicle act & central motor vehicle rules.
2. Illustrate motor vehicle insurance & taxation.
3. Analyze the passenger & goods transport operations.
4. Identify advanced techniques in traffic management

Prerequisite: Nil

Course Content

Unit No	Description	Hrs
1.	**Motor Vehicle Act** Motor Vehicle Act and Central Motor Vehicle Rules & amendments, Licensing of drivers & conductors, Registration of vehicle, Rules regarding construction of motor vehicles, State & interstate permits, Government administration structure, Offences, penalties & procedures.	04
2.	**Motor Vehicle Taxation** Objectives, Motor Vehicle Taxation Act, Structure & methods of laving taxation, One-time tax, Tax exemption & tax renewal.	04
3.	**Motor Vehicle Insurance** Significance & types, Comprehensive, Third party, Furnishing of particulars of vehicles involved in accident, MACT (Motor Accident Claims Tribunal), Accident claims procedure, Solactium Fund, Hit & Run case, Surveyor & Loss Assessor	04

4.	**Passenger Transport Operation** Structure of passenger transport organizations, Introduction to road corporation Act, Typical depot layouts, requirements, Bus & Crew Scheduling, passenger amenities, Theory of fares.	**04**
5.	**Goods Transport Operation** Structure of goods transport organizations, Scheduling of goods transport, Freight calculations, Storage & transportation of petroleum products	**04**
6.	**Advanced Techniques in Traffic Management** Vehicle & traffic navigation system, GPS, advanced traffic control devices, Intelligent Transport System, awareness on new road infra and their rules.	**04**

References -

Text Books:

1. Motor Vehicle Act, together with Central Motor Vehicle Rules, Eastern Book Company, Lucknow.
2. Gupte & Dighe, Motor Vehicle Laws in Maharashtra, Hind Law House Publications.

Reference Books:

1. H. Ananthakrishnan & V. A. Pai, Motor Insurance, Insurance Institute of India, Reprint Edition.
2. P. Sudarsanam, Passenger Amenities in State Transport Undertakings, C.I.R.T., Pune.
3. S. R. Tapade, Bus Depot Layout, C.I.R.T., Pune.
4. S. R. Tapade, Bus & Crew Scheduling, C.I.R.T., Pune.
5. Richard Iles, Public Transport in Developing Countries, Elsevier.
6. R. K. Mohanty, Automobile Engineering, Standard Book House, New Delhi.
7. Bob Williams, Intelligent Transport Systems Standards, ARTECH HOUSE, INC.

Class: **T.Y. B. Tech.**	Semester- V
Course Code: **MA3411**	Course Name: **Automotive Maintenance**

L	T	P	Credits
2	-	--	2

Course Description:
This course helps students to learn essentials & need of automotive diagnostic & maintenance, fundamentals of tribology, friction, wear and lubrication. This course will help students to plan a service station layout for business to prepare records and documentation required for vehicle maintenance. Troubleshoot and carry out maintenance of engine and automotive systems have also been included. The students will also be trained to use modern automotive diagnostic tools and equipment.

Course Outcomes:
At the end of the course the student should be able to:
1. Describe the importance and significance of automotive maintenance and records.
2. Select advanced equipment and machines used in automotive maintenance.
3. Troubleshoot and carry out basic maintenance of automotive systems.
4. Discuss the developments in automotive maintenance technology.

Prerequisite: Automotive Systems & I. C. Engine

Course Content

Unit No	Description	Hrs
1.	**Maintenance of Records and Schedules** Preventive (scheduled) and breakdown (Unscheduled) maintenance, requirements of maintenance, preparation of check Lists, Inspection schedule, maintenance of records, log sheets.	06
2.	**Engine Maintenance** Engine components maintenance and cleaning methods, Visual and Inspections, minor reconditioning of various components, Reconditioning methods, special tools used for maintenance	06
3.	**Chassis Maintenance** Maintenance of automobile chassis, alignment of chassis, suspension, brake and Steering systems.	06
4.	**Transmission and Driveline Maintenance** Maintenance of Automobile clutch, gear box, drivelines and rear axles	06
5.	**Electrical System Maintenance**	06

	Testing methods battery, starter motor, charging, Ignition and lighting Systems. Checking and servicing of dash board instruments	
6.	**Maintenance of Engine & Vehicle Management Systems** Vehicle On-board diagnosis system , Maintenance of engine management systems &Vehicle management systems.	**06**

References -

Text Books:

- John Doke, Fleet Management, McGraw Hill.
- Vehicle Service Manuals of reputed manufacturers.
- BOSCH, Automotive Handbook, Bentley publishers.

Reference Books:

- Ed May, Automotive Mechanics, McGraw Hill Publications.
- Robert Bosch, Diesel Engine Management, SAE Publications.
- Robert Bosch, Gasoline Engine Management, SAE Publications.

Class: **T.Y. B. Tech.**	Semester-V
Course Code: **OE3044**	Course Name: **Renewable Energy Sources**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides a comprehensive introduction to various renewable energy sources, including solar, wind, biomass, hydro, geothermal, and emerging technologies. It explores the fundamental principles, working mechanisms, and applications of these energy sources while emphasizing their role in sustainable development. Students will gain insights into energy storage solutions, smart grids, and the latest advancements in renewable energy integration. The course also covers environmental impacts, economic feasibility, and government policies promoting clean energy adoption. By the end of this course, students will be equipped with the knowledge to contribute to the development and implementation of renewable energy solutions in real-world scenarios.

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

1. Explain fundamental knowledge of various renewable energy sources and their importance.
2. Describe the working principles, technologies, and applications of renewable energy systems.
3. Analyze the environmental impact and economic feasibility of renewable energy solutions.
4. Investigate recent advancements and future trends in sustainable energy technologies.

Prerequisite: Engineering Physics, Engineering Chemistry, Basics of Mechanical Engineering

Course Content

Unit No.	Description	Hrs
1	**Introduction to Renewable Energy** Overview of global and national energy scenarios, Need for renewable energy and sustainability, Comparison of renewable and non-renewable energy sources, Government policies and incentives for renewable energy adoption.	06
2	**Solar Energy Systems** Basics of solar radiation and measurement, Photovoltaic (PV) systems: Types, working principles, and efficiency, Solar thermal systems: Collectors, solar water heaters, and solar concentrators, Applications of solar energy: Power generation, desalination, and space heating, solar energy prediction models.	06

3	**Wind Energy Systems** Fundamentals of wind energy and wind power generation, Wind turbine types, aerodynamics, and power extraction, Wind farm planning, site selection, and grid integration, Challenges and advancements in wind energy technology, efficiency, wind energy prediction models.	**06**
4	**Biomass and Bioenergy** Biomass resources and their classification, Conversion technologies: Combustion, gasification, and biogas production, Biofuels: Biodiesel, bioethanol, and their applications, Waste-to-energy technologies and environmental benefits.	**06**
5	**Hydropower and Geothermal Energy** Principles of hydroelectric power generation, Classification of hydro plants: Small, medium, and large-scale hydropower, Geothermal energy sources and power generation techniques, Direct-use applications of geothermal energy.	**06**
6	**Emerging Renewable Technologies and Energy Storage** Ocean energy: Tidal, wave, and ocean thermal energy conversion (OTEC), Hydrogen as a renewable fuel: Production, storage, and fuel cells, Energy storage technologies: Batteries, flywheels, and pumped hydro storage, compressed air, Smart grids and future trends in renewable energy integration.	**06**

References –

Text Books:

- Rai G. D. Non-Conventional Energy Sources, Khanna Publishers.
- Boyle G. Renewable Energy: Power for a Sustainable Future, Oxford University Press.
- Sukhatme, S. P., Nayak, J. K. – Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw-Hill.

Reference Books:

- Twidell, J., Weir, T. – Renewable Energy Resources, Taylor & Francis
- Duffie, J. A., Beckman, W. A. – Solar Engineering of Thermal Processes, Wiley
- Godfrey, B. – Wind Energy Handbook, Wiley
- Sorensen, B. – Renewable Energy: Physics, Engineering, Environmental Impacts, Economics & Planning.

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Class: **T. Y. B. Tech.**	Semester-V
Course Code: **OE3064**	Course Name: **Environmental Impact Assessment**

L	T	P	Credits
3	-	-	3

Course Description:
Environmental impact assessment (EIA) is offered as open Elective for Undergraduate course (B. Tech) semester V. It deals with definitions and concepts, rationale and historical development of EIA, EIA in Engineering, Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Apply EIA methods to prepare a report.
2. Analyse the all projects by using Environmental Impact assessment tool.
3. Provide solution for decision making in Industrial Development Problem.
4. Prepare EIA report for submission to concerned authority.

Prerequisite: Possess basic knowledge of Environmental Science

Course Content

Unit No	Description	Hrs
1	**Basic concepts of EIA**: Environmental Impact Assessment: Introduction, Stages of EIA, Origin of EIA, Establishments of Procedure: Legislative Option, Project Screening for EIA, Methods, Projects thresholds, Sensitive area criteria Matrices. Scope studies for Environmental Impact Studies (EIS). Preparation for EIS Planning, Public Participation and Review of EIS.	**06**
2	**Methods for impact assessment**: Background information, interaction matrix methodologies, network methodologies, mathematical modelling, environmental setting, environmental impact assessment methodology, documentation and selection process, environmental indices and indicators for describing affected environment, Life cycle assessment	06

3	**Prediction and assessment of impact for air and noise environment:** Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations.	06
4	**Prediction and assessment of impact for water and soil environment:** Basic information of water quality (Surface water and ground water), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and ground water standards, prediction and assessment of impact for ground water and soil, mitigations.	06
5	**Prediction and assessment of impact on cultural and socioeconomic environment:** Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socioeconomic environment, description of existing socioeconomic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation.	06
6	**AI applications Decision Methods for Evaluation of Alternative:** Categorization of Industries for seeking environmental clearance from concerned authorities, AI tools like Bayesian network, SCREENER, Calyx tm, ORBI, IMPACT, procedure for environmental clearance, procedure for conducting environmental impact assessment report, Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan, post environmental monitoring.	06

References -

Text Books:

- Canter R.L., Environmental Impact Assessment, McGraw Hill International Edition.
- John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.

Reference Books:

- R.R Barthwal, Environmental Impact Assessment, New Age International Publishers
- Abbasi, Environmental Impact Assessment, McGraw Hill International Edition.

Class: **T.Y.B. Tech.**	Semester-V
Course Code: **OE3104**	Course Name: **Network Administration**

L	T	P	Credits
3	-	-	3

Course Description:
This course is designed for the students from various academic backgrounds who wish to gain a fundamental understanding of network administration. The course covers essential network concepts and practical skills, with an emphasis on real world applications and everyday scenarios.

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

1. Recall and describe the different basic components of computer networks.
2. Explain the functions and interactions of each layer of the OSI model.
3. Distinguish various networking devices with their functions.
4. Analyze different web services and applications.
5. Synthesize the knowledge about cyber security related services and networking maintenance.

Prerequisite: Basic understanding of computer hardware and operating systems, Fundamental knowledge of networking concepts, Familiarity with the OSI model, Basic understanding of TCP/IP protocols

Course Content

Unit No	Description	Hrs
1	**Introduction to Computer Networks** Overview of computer networks (Components, Architecture),Importance of networking in various fields ,types of network (e.g. LAN,MAN,WAN),Common network terminologies (Topologies),Recent trends in network administration	06
2	**Basic Networking Protocols** Operating System installation process (e.g. windows, Linux),Introduction to OSI Model (Application layer, presentation layer, Session layer, Transport layer, network layer, data link layer, physical layer),Networking hardware's (Router , Switches , Hubs),IP Addressing Basics (network class, network, subnet, and device)	06

3	**Connecting Devices** Introduction to networking devices (e.g. NIC, Modems), Transmission media – Guided media, Unguided media (Wired and Wireless), Cabling and connectors (e.g. Coaxial and fiber optical Cables), Basics of Home Networking (A closer look at the Home Router, Components in a Home Router)	**06**
4	**Internet Services and Applications** Introduction to web services (HTTP, HTTP's), Email and messaging protocols (SMTP, IMAP), File Transfer Protocol (FTP)	**06**
5	**Network Security Basics** Introduction to cyber security (types of cybercrimes), Password Management (Generation of strong password, Enforces requirements), Firewalls and Antivirus software (Installation process of antivirus), Safe Internet Practices	**06**
6	**Troubleshooting and Basic Network Maintenance** Introduction to network monitoring tools (Configuration, performance, cloud infrastructure), Basic troubleshooting techniques (Tips for troubleshooting computers), Regular Network Maintenance Practices, Future trends – Role of network in future - Real world examples	**06**

References -

Text Books:

- Seffrey S. Beasley and PiyasatNilkaew "Network Essentials " Pearson Publishing
- William Stallings "Network Security Essentials" Pearson Publishing

Reference Books:

- Craig Hunt "Network Administration: The Complete Guide to Network Security and System Administration"

Class: **T. Y. B. Tech.**	Semester-V
Course Code: **OE3381**	Course Name: **Disaster Management**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides a holistic understanding of disaster management, covering both natural and manmade disasters. Students will delve into the meaning, nature, and various types of disasters, exploring their effects on individuals, communities, and the environment. The course encompasses a global perspective while focusing on the disaster profile of India, considering regional and seasonal variations.

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

1. Outline disaster and disaster management cycle.
2. Summarize disaster preparedness and response activities for various types of disaster.
3. Apply various advanced techniques for disaster management.
4. Examine role of various agencies in disaster management.
5. Analyze the disaster management scenario in India.

Prerequisite: Environmental Science

Course Content

Unit No	Description	Hrs
1	**Natural Disaster:** Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic, eruptions, Heat and cold Waves, Climatic Change: Global waning, Sea Level rise, Ozone Depletion.	06
2	**Manmade Disasters:** Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disasters -A Global View, Disaster Profile of India- Regional, and Seasonal.	06
3	**Disaster management cycle:** Introduction to Disaster Management Cycle: Mitigation, Preparedness, Response and Recovery. Disaster Mitigation, Hazard identification and vulnerability analysis, Mitigation strategies or measures	06

4	**Disaster Preparedness, Response and Recovery:** Introduction to Disaster Preparedness, Disaster Risk Reduction (DRR), The Emergency Operation Plan (EOP). Introduction to Disaster Response, Aims of disaster response, Disaster Response Activities, Modern and traditional responses to disasters, Modern methods of disaster response, Disaster Recovery, The Recovery Plan, Disasters as opportunities for development initiatives.	**06**
5	**Role of technology in Disaster management:** Geographic Information System (GIS) and Disaster Management. GIS applications. Global Positioning System (GPS) and Disaster Management, Applications of GPS to Disaster management. Remote Sensing and its significance in Disaster Management.	**06**
6	**Role of Multiple Stakeholders in Disaster management:** Role of NGO's, Community based organizations, media, Central, State, District and Local Administration, armed forces, Police and other organizations.	**06**

References -

Codes of Practice:

- National Disaster Management Authority (NDMA). National Disaster Management Plan 2019.
- National Disaster Management Authority (NDMA). National Disaster Management Act 2005.

Text Books:

- Coppola, D. P. "Introduction to International Disaster Management", Elsevier USA.
- Singh R. B., "Disaster Management", Rawat Publication.

Reference Books:

- Reiter L., "Earthquake Hazard Analysis: Issues and Insight", Colombia University Press.
- Mileti D. S. "Disaster by Design: A Reassessment of National Hazards in United States", The National Academic Press.

Department of Automobile Engineering

Class: **T.Y. B. Tech.**	Semester- **V**
Course Code: **OE341**	Course Name: **Energy Auditing and Management**

L	T	P	Credits
3	–	–	3

Course Description:
This course provides basic understanding of energy audit and management. Essential theoretical and practical knowledge about the concept of energy conservation, energy management, and different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit and measuring instruments in the commercial and industrial sector will be achieved through this course.

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

1. Identify the important of Energy Scenario.
2. Use energy audit knowledge to carry out energy audit of a given firm.
3. Examine different rolls in energy action planning
4. Apply project finance and management skills to carry out energy audit
5. Plan for energy monitoring and targeting.

Prerequisite: Electric Machines, Thermal Systems and Finance Management

Course Content

Unit No	Description	Hrs
1	**Energy Scenario :** Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy and Environment, Air Pollution, Climate Change, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features.	06
2	**Energy Management and Audit :** Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments, suitable case study for energy audit.	06
3	**Energy Action Planning** Key elements, Force field analysis, Energy policy purpose, perspective, Contents, Formulation, Ratification, Organizing –location of energy management, Top management support, Managerial function, Roles and responsibilities of energy manager, Accountability. Motivating-motivation	06

	of employees: Information system-designing barriers, Strategies; Marketing and communicating-training and planning.	
4	**Financial Management** Investment-need, Appraisal and criteria, financial analysis techniques-Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs	**06**
5	**Project Management** Definition and scope of project, technical design, Financing, Contracting, Implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification	**06**
6	**Energy Monitoring And Targeting** Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM). Suitable case study.	**06**

References -

Text Books:

- Amit Kumar Tyagi,Handbook on Energy Audits and Management, TERI Publication
- Wayne C. Turner, Energy Management Handbook, Wiley Inter Science Publication

Reference Books:

- P. O'Callaghan, Energy Management, McGraw - Hill Book Company
- Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I

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Class: **T. Y. B. Tech.**	Semester- V
Course Code: **OE343**	Course Name: **Data Science**

L	T	P	Credits
3	-	-	3

Course Description:
The course helps to learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration. The orientation of course is to understand the basic types of data and basic statistics. The organization of data inline to Vectors, Matrices and Frames are examined. The Conditionals and Control Flow of data over R programming is to be implemented. Additionally, it will assist in identifying the importance of data reduction and data visualization techniques.

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

1. Articulate basic terms what Statistical Inference means
2. Analyze the data using various statistical measures
3. Identify data organization techniques used as foundations for modelling data
4. Utilize R elements for data handling
5. Perform data reduction and apply visualization techniques

Prerequisite: Basic Mathematics, Descriptive statistical techniques

Course Content

Unit No	Description	Hrs
1	**Introduction** Definition of Data Science- Big Data and Data Science hype – and getting past the hype - Datafication - Current landscape of perspectives - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, Basics of R programming.	06
2	**Data Types** Types of Data: Attributes and Measurement, What is an Attribute? The Type of an Attribute, The Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes.	06

3	**Statistical Description of Data** Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range, Graphic Displays of Basic Statistical Descriptions of Data.	**06**
4	**Data Organization** Vectors: Creating and Naming Vectors, Vector Arithmetic, Matrices: Creating and Naming Matrices, Matrix Sub setting, Arrays, Factors and Data Frames: Introduction to Factors, Factor Levels, Summarizing a Factor, Introduction to Data Frame.	**06**
5	**Conditionals and Control Flow** Relational Operators, Relational Operators and Vectors, Logical Operators, Logical Operators and Vectors, Conditional Statements. Iterative Programming in R, Functions in R.	**06**
6	**Data Reduction and Visualization** Overview of Data Reduction Strategies, Principal Components Analysis, Attribute Subset Selection, Data Cube Aggregation. Data Visualization: Pixel - Oriented, Visualization Techniques.	**06**

References -

Text Books:

- Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk from The Frontline", O'Reilly
- Jiawei Han, Micheline Kamber and Jian Pei., "Data Mining: Concepts and Techniques", The Morgan Kaufmann Series in Data Management Systems
- K G Srinivas, G M Siddesh, "Statistical programming in R", Oxford Publications

Reference Books:

- Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", Pearson Education
- Brain S. Everitt, "A Handbook of Statistical Analysis Using R", 4 LLC
- Dalgaard, Peter, "Introductory statistics with R", Springer Science & Business Media
- Paul Teetor, "R Cookbook", O'Reilly

Class: **T.Y. B. Tech.**	Semester-V
Course Code: **OE365**	Course Name: **Distributed Systems**

L	T	P	Credits
3	--	--	3

Course Description:
This course provides elementary introduction to fundamental concepts and principles of distributed systems. It elaborates the architecture, design, and implementation of distributed systems, emphasizing resource sharing, coordination, and communication among networked computers. The course covers system models, networking principles, operating system support, web services, and distributed file systems. It makes students aware about the complexities and challenges involved in designing and managing distributed systems.

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

1. Describe the basic principles and characteristics of distributed systems.
2. Explain different models of distributed systems and understand their applications.
3. Apply fundamental networking principles and Analyze internet protocols.
4. Comprehend the role of operating systems in supporting distributed systems, including processes, threads, communication, and virtualization.
5. Develop and secure web services for distributed applications.
6. Analyze distributed file system architecture.

Prerequisite: Basics of Computer Networks.

Course Content

Unit No	Description	Hrs
1	**Characterization of Distributed Systems** Introduction to distributed system, Examples of distributed systems, Trends in distributed systems, Focus on resource sharing, Challenges.	04
2	**System Model** Introduction, Physical models, Architectural models – Client-Server model, Peer-to-Peer model, Layered Model, Micro-services Model, Fundamental models – Interaction Model, Remote Procedure Call, Security Model.	06
3	**Networking and Internetworking** Introduction, Types of networks, Network principles, Internet protocols, Case studies: Ethernet, WiFi and Bluetooth.	06
4	**Operating System Support**	07

	Introduction, Operating system layer, Protection, Processes and threads, Communication and invocation, Operating system architecture, Virtualization at the operating system level.	
5	**Web Services** Web services, Service descriptions and IDL for web services, A directory service for use with web services, XML security, Coordination of web services, Applications of web services.	**07**
6	**Distributed File System** Introduction, Features of DFS, File service architecture, Applications of DFS, Case study: Sun Network File System, Case study: The Andrew File System, Enhancements and further developments.	**06**

References -

Text Books:

- George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, "Distributed Systems Concepts and Design", Pearson)

Reference Books:

- Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems: Principles and Paradigms", Pearson

Class: **T.Y. B. Tech.**	Semester- **V**
Course Code: **OE347**	Course Name: **New Product Design and Development**

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 analyzing market opportunities and then focus on designing, testing, and introducing new products and services. This course will introduce the new product development process and cover the three main areas of focus:

- Discovery - opportunity identification
- Design - concept and product design, development and evaluation
- Delivery - innovative approaches to product launch and introduction.

Course Learning Outcomes:
After successful completion of the 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 the design process.
4. Apply the concepts and tools like DFMA, VE and QFD in design process
5. Assimilate the various product characteristics to design a novel product
6. Participate 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	**Description**	**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, creativity and innovation.	**06**

2	**Identifying Customer Needs:** Understanding customer needs, Voice of the customer, Gathering customer needs, Design Thinking (organizing and prioritizing needs), Product mission statement, Benchmarking and establishing product specifications	**06**
3	**Product Concept Generation, Selection and Testing:** Concept generation process and methods, Concept selection mechanism and techniques, Concept Testing-Purpose, process and methods. Product Architecture-types, establishing architecture, Modular design. Prototyping	**06**
4	**Product Design Tools and Techniques:** Design for manufacturing and assembly (DFMA), Product teardown and experimentation, Concurrent engineering, Quality function Deployment (QFD), Value engineering.	**06**
5	**Product Idealization:** Basic elements: Line, texture, color, form, symmetry, balance, scale, mass, unity and variety. Concept of visual language and visual design. Negative space. Use of symmetry. Generation of patterns and textures using simple elements. Color, color combinations and its dimensions: hue, value and Chroma. Color meanings in traditions and psychological use of colors. Ergonomic considerations, Anthropometry.	**06**
6	**Product Takeoff and Market Entry:** Economic analysis, life- cycle costing, sensitivity analysis Pricing, Packaging, Preparing a launch plan, Pricing and Marketing. Intellectual property rights (IPR)	**06**

References -

Text Books:

- Devdas Shetty, Design for product success, Society for Manufacturing Engineering.

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.

K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)
Syllabus of T.Y. B. Tech. Mechanical Engineering Automobile
To be Implemented to T.Y. B. Tech. from 2025-26 (2023-27 Batch)

Department of Automobile Engineering

Class: **T.Y. B. Tech**	Semester-**V**
Course Code: **OE349**	Course Name **Non-conventional Energy Sources**

L	T	P	Credits
3	--	--	3

Course Description:
This course provides a comprehensive understanding of non-conventional or renewable energy sources, exploring the principles, technologies, and applications associated with harnessing sustainable energy. The focus is on alternative sources that are environmentally friendly and contribute to reducing dependence on conventional fossil fuels. Students will delve into the latest advancements, challenges, and opportunities in the field of non-conventional energy.

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

1. Identify the need of requirement of renewable energy source
2. Summarize the various available energy sources.
3. Illustrate different technologies essential for conversion of renewable energy sources.
4. Evaluate the performance of energy conversion systems for maximum efficiency
5. Compare the various renewable energy technologies.
6. Select appropriate renewable energy technology for specific application

Prerequisite: Nil.

Course Content		
Unit No	**Description**	**Hrs**
1	**Basics of Energy Sources:** World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilization – Renewable Energy Scenario in India and around the World – Potentials - Achievements / Applications – Economics of renewable energy systems	**06**
2	**Solar Energy:** Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photovoltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications	**06**
3	**Bio - Energy:** Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Biodiesel – Cogeneration - Biomass Applications	**06**

4	**Wind Energy:** Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects	**06**
5	**Hydrogen Energy:** Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles. Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, and application of fuel cells	**06**
6	**Other Renewable Energy Sources:** Tidal energy, Wave Energy – Open and Closed OTEC Cycles , Small Hydro-Geothermal Energy , Stored hydro energy, Principles of hydro power technology	**06**

References -

Text Books:

- S P Sukhatme, Solar Energy, McGraw Hill Education.
- G.D. Rai, Non-conventional energy sources, Khanna Publishers, New Delhi.
- John Twidell , Renewable Energy Resources, Routledge.

Reference Books:

- Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, Oxford University Press, U.K.
- Freris. L.L., Wind Energy Conversion Systems, Prentice Hall, UK.
- David M. Mousdale, Introduction to Biofuels, CRC Press, Taylor & Francis Group, USA.
- B. H. Khan, Non-Conventional Energy, Tata McGraw-Hill, New Delhi.

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Class: **T.Y. B. Tech.**	Semester-V
Course Code: **OE351**	Course Name: **Hydrogen and Fuel Cell Technology**

L	T	P	Credits
3	--	--	3

Course Description:
The course is a learning about hydrogen and fuel cells – the cornerstones of hydrogen and fuel cell energy. The focus is on understanding the main driving forces of global changes and earning the basic knowledge of the key technologies leading to alternative energy sources.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Choose proper energy storage systems hydrogen and applications
2. Explain the different types of fuel cell technologies, fuels and membrane used in it
3. Design and Compare performance of fuel cell.

Prerequisite: Engineering Chemistry, Fluid Mechanics, Engineering Thermodynamics, Materials science.

Course Content

Unit No	Description	Hrs
1	**Hydrogen energy:** Introduction to hydrogen economy, production, storage and transportation systems, hydrogen from fossil fuels, electrolysis of water, thermo chemical cycles, transmission and infrastructure requirements, safety and environmental impacts, economics of transition to hydrogen systems	06
2	**Hydrogen production:** methods, types of electrolyzer: proton-exchange membrane, alkaline, solid oxide, alkaline, microbial, efficiency, open circuit voltage, and losses	06
3	**Hydrogen storage and transportation:** Methods of storage, solid, liquid, gaseous, Comparison between various methods, limitations, Transportation features, safety norms, methods, on boards and stationary applications	06
4	**Fuel cells:** Concept, key components, physical and chemical phenomena in fuel cells, advantages and disadvantages, different types of fuel cells and applications, characteristics, Nernst equation, relation of the fuel consumption versus current output	06
5	**Membranes &Fuels for Fuel Cells:** Membranes: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.	06

	Fuels: Hydrogen, methane, methanol – Sources and preparation, reformation processes for hydrogen – clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel.	
6	**Fuel cell design and performance:** Stoichiometric coefficients and utilization percentages of fuels and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and serial connection, over-potential and polarizations, DMFC operation scheme, general issues-water flooding and water management, polarization in PEMFC	**06**

References -

Text Books:

- J Larminie, A L Dicks, Fuel Cell Systems Explained, Wiley X Li, Principles of Fuel Cells, Taylor and Francis.
- Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry.
- M. AuliceScibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India.

Reference Books:

- F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA.
- G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL.
- O'Hayre, R.P.S. Cha, W. Colella, F.B.Prinz, Fuel Cell Fundamentals, Wiley, N
- Basu,S.(Ed) Fuel Cell Science and Technology, Springer, N.Y.
- Dincer, H Ishaq, Renewable Hydrogen Production, Elsevier.
- G Naterer, I Dincer, C Zamfirescu, Hydrogen Production from Nuclear Energy, Springer.
- B Sorensen, G Spazzafumo, Hydrogen and Fuel Cells: Emerging Technologies and Applications, Academic Press.

Class: - **T.Y. B. Tech.**	Semester-V
Course Code: **OE353**	Course Name: **Factory Automation**

L	T	P	Credits
3	-	-	3

Course Description:
To provide a clear view on factory automation types & to learn the various methods involved in automatic control and monitoring & to familiarize with factory automation systems in manufacturing and process industry.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Recognise various automation technologies in manufacturing and process industries.
2. Select various automation tools and methods in the manufacturing industry.
3. Implement various control and automation methods in process industries.
4. Analyse automation systems for manufacturing and process industries.

Prerequisite: Manufacturing systems, sensors and actuators,

Course Content

Unit No	Description	Hrs
1	**Introduction:** Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automation. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines.	06
2	**Material Handling and Identification Technologies:** Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.	06
3	**Automated Manufacturing Systems:** Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation. Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies.	06
4	**Control Technologies in Automation:** Industrial Control Systems, Process Industries versus Discrete Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms	06

5	**Computer Based Industrial Control:** Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems& RTU. Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems	**06**
6	**Case Study:** Factory automation in manufacturing industry and Process Industry.	**06**

References -

Reference Books:

- Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover, Pearson Education.
- Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition,2010
- An Introduction to Automated Process Planning Systems- Tiess Chiu Chang &Richard A.Wysk
- Webb, John W. Programmable Logic Controllers: Principles and Application, Fifth edition, Prentice Hall of India, New Delhi.
- Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, ISA Publication.
- Bolton , "Programmable Logic Controllers" Newnes.

Department of Automobile Engineering

Class: - T.Y. B. Tech.	Semester- V
Course Code: OE355	Course Name: Cyber Physical System

L	T	P	Credits
3	-	-	3

Course Description:
To study the basic concepts, requirements, principles, and techniques in emerging cyber-physical systems. Provide students hands-on experience in prototyping a cyber-physical system. Address real-world problems through Cyber Physical Systems. The objective of this course is to develop an exposition of the challenges in implementing a cyber-physical system from a computational perspective. The course also aims to provide students of different disciplinary background with necessary knowledge to understand the fundamentals of cyber physical systems.

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

1. Understand the need and purpose of the different components of CPS
2. Design physical system depends on its requirements
3. Develop the ability to interact with cyber-physical systems protocols
4. Analyze common methods used to secure cyber-physical systems

Prerequisite: -NA-

Course Content		
Unit No	**Description**	**Hrs**
1	**Computational foundation of Cyber Physical Systems:** Cyber Physical Systems in Real world, Basic Principle of Cyber Physical Systems, Industry 4.0, IIoT. Introduction Toward Industry 5.0: Cognitive Cyber-Physical System	06
2	**Cyber Physical System Design:** Cyber Physical Systems Design Recommendations, CPS system requirements, Cyber Physical System Application, Case study of Cyber Physical Systems.	06
3	**Cyber Physical System Platforms & Models:** Hardware platforms for Cyber Physical Systems (Sensors/Actuators, Microprocessor/Microcontrollers), Wireless Technologies for Cyber Physical Systems.	06
4	**Cyber Physical System – Models and Dynamics Behaviors:** Continuous Dynamics, Discrete dynamics, Hybrid Systems	06

5	**Concurrent Models of computation:** Structure of Models, Synchronous Reactive models, Dataflow models of computation, Timed models of computation	**06**
6	**Security and Privacy in Cyber Physical Systems:** Security and Privacy Issues in CPSs, Cyber Security Laws in India: IT Act(2000), IPC(1980), Companies Act (2013), Local Network Security for CPSs, Security and Privacy for Cloud-Interconnected CPSs, Case Study: Cyber security in Digital Manufacturing/Industry 4.0	**06**

References -

Text Books:

- Principles of Cyber Physical Systems, Rajeev Alur, MIT Press, 2015
- E. A. Lee, Sanjit Seshia , "Introduction to Embedded Systems – A Cyber–Physical Systems Approach", Second Edition, MIT Press, 2017, ISBN: 978-0-262-53381-2

Reference Books:

- Guido Dartmann, Houbing song, Anke schmeink, "Big data analytics for Cyber Physical System", Elsevier, 2019
- Houbing song, Danda B Rawat, Sabina Jeschke, Christian Brecher, "Cyber Physical Systems Foundations, Principles and Applications", Elsevier, 2017
- Chong Li, Meikang Qiu, "Reinforcement Learning for Cyber Physical Systems with Cyber Securities Case Studies", CRC press, 2019
- Houbing Song, Glenn A.Fink, Sabina Jesche, "Security and Privacy in Cyber-Physical Systems: Foundations, Principles and Solutions", IEEE Press.

Class: - **T. Y. B. Tech**	Semester-V
Course Code: **OE357**	Course Name: **Internet of Things**

L	T	P	Credits
3	-	-	3

Course Description:
The Internet of Things (IoT) course explores the interconnected world of smart devices, enabling students to grasp the fundamentals of IoT architecture, protocols, and applications. Through hands-on projects, students develop skills in device integration and data management. The course equips learners with a comprehensive understanding of IoT's transformative potential, preparing them to navigate the evolving landscape of connected technologies and contribute to the advancement of the digital era.

Course Learning Outcomes:
1. After completion of this course, students will be able to:
2. Explain the concepts of network connected embedded devices.
3. Identify and summarize different components required for IOT applications.
4. Analyse the system through Data Analytics tools.
5. Design suitable network architecture and use appropriate protocols for a given IOT application.

Prerequisite: Basic knowledge of microprocessor and microcontroller, communication

Course Content

Unit No	Description	Hrs
1	**Introduction & Basic of IoT** Definition, Characteristics, Physical and Logical Designs, IOT enabling technologies, IoT levels and deployment templates. Major Components of IoT System	06
2	**M2M and IOT management** Introduction, M2M comparison with IOT, M2M architecture, software and development tools IOT management, communication technologies, communication protocols, Web connectivity tools.	06
3	**IoT platform design methodology** Design methodology, IoT Device, IoT Platform Design Specification, Building blocks, Hardware and board approach, Useful Softwares and packages	06
4	**IOT data storage and Cloud** Data generation, local data storage and Purpose of Cloud, clouds used in IoT application, Cloud Storage Models, Communication APIs	06

5	**Iot Security** Vulnerabilities, security requirements, Threat analysis, IoT Security Tomography, Layered Attacker Model, Identity Management, Establishment, Access Control Secure Message Communication, Security Models	**06**
6	**Domain specific IOT** Home automation, Cities, Environment, Agriculture, Health and lifestyle.	**06**

References-

Text Books:

- Arshdeep Bahga, Vijay Madisetti.,"Internet of Things – A hands On Approach," 1st Edition, Universities Press.
- Raj Kamal," INTERNET OF THINGS -Architecture and Design Principles" McGraw Hill.

Reference Books:

- Simone Cirani," Internet of Things- Architectures, Protocols and Standards", WILEY,2018.
- Alessandro Bassi," Enabling Things to Talk- Designing IoT solutions with the IoT Architectural Reference Model", Springer.

Department of Automobile Engineering

Class: - **T. Y. B. Tech.**	Semester-V
Course Code: **OE359**	Course Name: **Drone Technology**

L	T	P	Credits
3	-	-	3

Course Description:
This course explores the revolutionary and riveting research in the ultramodern domain of drone technologies, drone-enabled applications. It explains the most recent developments in the field, challenges, and future scope of drone technologies. Beyond that, it discusses the importance of a wide range of design applications, drone/ Unmanned Aerial Vehicle (UAV) development.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Elaborate drone technology.
2. Explain fundamentals and design principles of UAV.
3. Discuss the wide range of applications of drone.
4. Classify various propulsion and controlling techniques for drone.

Prerequisite: Basic knowledge of electronics and control.

Course Content

Unit No	Description	Hrs
1	**Introduction** Definitions and Terminology, Types of Drone (based on wings), Physical Structure of Drone, Drone System Stack up of mechanical parts, Classification of UAVs, Military and Civilian Unmanned Aircraft	06
2	**UAV Design Principles** Introduction to UAV Design Principles, Computational and Experimental Design of a Fixed-Wing UAV, Payload Design of Small UAVs, Small UAV Design Development and Sizing, Systematic Design Methodology and Construction of Micro Aerial Quadrotor Vehicles.	06
3	**UAV Basic Components** Four basic components: propeller, engine, body, and flight board, Fixed wing drone, main structural elements of drone Kinematics and Dynamics, Dynamics and Control of Flapping Wing MAVs, Principles of Guidance, Navigation, and Control of UAVs.	06

4	**UAV Propulsion** UAV Propulsion: Introduction, Power Managements of a Hybrid Electric Propulsion System Powered by Solar Cells, Fuel Cells, and Batteries for UAVs.	**06**
5	**UAV Control** Linear Flight Control Techniques for UAV, Nonlinear Flight Control Techniques for UAV, Adaptive Control of UAV: Theory and Flight Tests, Robust and Adaptive Control Methods for Aerial Vehicles.	**06**
6	**UAV Applications** Drone Usage areas: Agriculture, Environment, Survey of UAVs for Traffic Monitoring, Cooperative Unmanned Aerial Systems for Fire Detection, Barriers to drone Technology: Power Source & Security.	**06**

References-

Text Books:

- Kimon P. Valavanis, George J. Vachtsevanos, Handbook of Unmanned Aerial Vehicles, Springer

Reference Books:

- Neeraj Kumar Singh, Porselvan Muthukrishnan, Industrial System Engineering for Drones, Apress
- Sachi Nandan Mohanty, J.V.R. Ravindra, Drone Technology: Future Trends and Practical Applications, Wiley

Department of Automobile Engineering

Class:- **T.Y. B. Tech.**	Semester-V
Course Code : **OE361**	Course Name : **Object Oriented Modeling & Design**

L	T	P	Credits
3	--	--	3

Course Description:
This course introduces students to the design of software models by the ways of expressing some sort of abstract language or diagrams are used to express the software design. Software analysis and design includes all activities, which help the transformation of requirement specification into implementation. Requirement specifications specify all functional and non-functional expectations from the software. These requirement specifications come in the shape of human readable and understandable diagrams. Object-oriented software design, an object modeling language such as UML is used to develop and express the software design. UML is a standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems.

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

1. Identify object classes and build the domain model using advanced concepts in object, dynamic and functional modeling.
2. Apply different object-oriented design techniques.
3. Design models using UML diagrams for software systems: use case, class, sequence, collaboration, activity, state chart diagrams, component and deployment.
4. Design software systems using open source and advanced modeling tools.
5. Evaluate designs of software systems in mini-projects, projects using Software Modeling & Design concepts

Prerequisite: Basics of Software Engineering and Object Oriented programming.

Course Content

Unit No	Description	Hrs
1	**Introduction to Object Modeling** Object Oriented development & themes, Modeling as a Design Technique, Objects, classes, links and associations, generalization and inheritance, Aggregation, abstract classes, generalization as extension and restriction, multiple inheritance, metadata, candidate keys and inheritance.	06
2	**Dynamic & Functional Modeling** Events, states, operations, concurrency, nested state diagrams, advanced dynamic modeling concepts, DFD, Case Study to draw nested state diagrams, Dynamic diagrams and DFD using UML tools.	06

3	**Design Methodology** Preview of OMT technology, Impact of an object oriented approach, Analysis, System design with examples, combining models, Designing models, Comparing Methodologies using structured analysis and design.	**06**
4	**Structural Modeling using UML** Classes, Relationships, Common mechanisms. Diagrams, Class Diagrams, Interfaces, Types and Roles, Packages, Instances and Object Diagram, Case Study on class and object diagrams.	**06**
5	**Behavioral Modeling using UML** Interactions, Use cases, Use case diagram, Interaction Diagrams and Activity diagrams, Events and signals, State Machines, Processes and Threads, Time and space, State chart diagrams, Case Study on use case, interaction, activity and state chart diagrams.	**06**
6	**Architectural Modeling using UML** Components, Deployment, Collaboration, Patterns and Frame works, Component diagrams and Deployment Diagrams, Case Study on Components, Deployment, Collaboration diagrams.	**06**

References -

Text Books:

- Michael Blaha, James R. Rumbaugh, William Premerlani, James Rumbaugh, "Object-Oriented Modeling and Design with UML" Pearson.
- Grady Booch, JeamsRambaugh, Ivar Jacotson, "The Unified Modeling Language User Guide", Pearson.

Reference Books:

- Andrew High, "Object Oriented Analysis and Design", McGraw Hill Education.
- Mark Priestley, "Practical Object Oriented Design with UML", McGraw-Hill Education.

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Rajaramnagar Autonomous 414 Dist. Sangli M.S.

Class: **T.Y. B.Tech.**	Semester-V
Course Code: **OE363**	Course Name: **Robotics Engineering & Applications**

L	T	P	Credits
3	-	-	3

Course Description:
This course explores the practical applications of robotics in various industries, including manufacturing, healthcare, agriculture, defense, and space exploration. It provides an understanding of robotic systems, sensors, actuators, and AI-driven automation. Students will learn about industrial robots, service robots, autonomous systems, and emerging trends in robotics. The course emphasizes real-world case studies, ethical considerations, and the impact of robotics on society, preparing students for careers in robotics and automation.

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

1. Explain various applications of robotics in industry and society.
2. Describe the concept of automation, robot integration, and their role in Industry 4.0.
3. Investigate the use of robots in healthcare, agriculture, defence, service, and space exploration.
4. Discuss ethical considerations and future trends in robotics applications.

Prerequisite: Basics of Mechanical Engineering, Basics of Robotics and automation, sensors and Actuators, Control System

Course Content

Unit No.	Description	Hrs
1	**Robotics in Agriculture** Introduction, historical development, Autonomous tractors, drones, and harvesting robots, impact and sustainability of agricultural robots, artificial intelligence and machine learning in agricultural robotics	6
2	**Industrial Robotics and Manufacturing Applications** Use of robots in manufacturing and assembly lines, Robotics in material handling, welding, painting, and packaging, Integration of robots with CNC machines and flexible manufacturing systems (FMS), Industry 4.0 and smart factories: Role of IoT, AI, and digital twins.	6
3	**Robotics in Healthcare and Medical Applications** Robotics in surgery, rehabilitation, and prosthetics, Assistive robots for elderly and disabled individuals, Role of AI in robotic healthcare applications, Case studies on robotic-assisted surgery (e.g., Da Vinci Surgical System).	6

4	**Robotics in Défense, and Space Exploration** Military robots: Unmanned ground vehicles (UGVs), aerial drones (UAVs), and bomb disposal robots, Robotics in space exploration: Rovers, robotic arms, and satellite servicing, Challenges and advancements in space robotics.	**6**
5	**Service, Autonomous, and Humanoid Robotics** Service robots: Household, hospitality, and customer service applications, Autonomous robots: Self-driving cars, warehouse automation, and logistics, Humanoid robots and their interaction with humans, Ethical concerns and the impact of robotics on employment, Case Study of Humanoid Robots (Rashmi, Sofiya, Yashnee etc)	**6**
6	**Future Trends, Challenges, and Ethical Considerations** Soft robotics and bio-inspired robots, AI and machine learning in robotics, cybersecurity risks and ethical considerations in robotics applications, robo grammer and robo romi, Future challenges and opportunities in robotics engineering.	**6**

References –

Text Books:

- Spong, M. W., Hutchinson, S., Vidyasagar, M. – Robot Modeling and Control,Wiley
- Mukherjee, S. – Robotics and Automation Engineering, Oxford University Press
- Mittal, R. K., Nagrath, I. J. – Robotics and Control, Tata McGraw-Hill
- Rajput, R. K. – Robotics and Industrial Automation, S. Chand Publishing

Reference Books:

- Groover, M. P. – Industrial Robotics: Technology, Programming, and Applications, McGraw-Hill.
- Siciliano, B., Khatib, O. – Springer Handbook of Robotics, Springer.
- Craig, J. J. – Introduction to Robotics: Mechanics and Control, Pearson.

Class: **T. Y. B. Tech.**	Semester: **V**
Course Code: **MAMD201**	Course: **Automobile Systems**

L	T	P	Credits
3	-	-	3

Course Description:
Automobile systems is a one of the core courses of Automotive Engineering and lays foundation for the advanced courses like vehicle dynamics and automotive design. The course introduces the major automotive chassis systems like steering, brakes and suspensions. It also covers the drivetrain elements like clutches, gearbox and differential. The course emphasizes on fundamental principles of operation, functional system equations, various system configurations and advancements. Successful completion of this course is very much essential for further learning and industry career.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Explain constructional details and operation of the automotive systems.
2. Interpret the influence of various technical parameters on the behaviour of the automotive systems.
3. Configure the systems and its elements for integrating into drivetrain/chassis systems appropriate for given automotive application.
4. Present in detail the technological advancements of the automotive systems.

Prerequisite: Basics of Mechanical Engineering.

Course Content

Unit No	Description	Hrs
1.	**Automotive clutches** Requirements, mathematical model, types, clutch assembly, diaphragm clutch, centrifugal clutch, fluid flywheel, torque converter.	06
2.	**Gearbox** Need of gearbox, manual gearbox, automatic transmissions, AMT, DCT, CVT	06
3.	**Propeller shaft, differential and axles** Propeller shaft/drive shafts, Universal joints, differential, differential lock, final drive, axle arrangements, 4WD arrangement.	06
4.	**Steering system** Steering geometry, Ackermann steering, steering ratio, layouts, power steering, active steering, steer-by-wire system, 4W steering.	07

5.	**Suspension system** Principles, elements, quarter car model, dampers, roll centers, adaptive suspensions	**05**
6.	**Braking system** Principles, drum and disc brake arrangements, hydraulic brake system, air and vacuum brakes, ABS and ESP	**06**

References-

Text Books:

1. Newton, Steed & Garret, *Motor Vehicles*, Butterworth Heinemann
2. Henz Heisler, *Advanced Vehicle Technology*, SAE International

Reference Books:

1. Henz Heisler, *Vehicle and Engine Technology*, SAE International
2. J. Reimpell, H. Stoll, J. W. Betzler, *The Automotive Chassis*, Butterworth Heinemann
3. Giles J. G., *Steering, Suspension & Tyres*, Iliffe Book Ltd., London
4. William Crouse, Donald Anglin, *Automotive Mechanics*, McGraw-Hill
5. Gillespie T. D., *Fundamentals of Vehicle Dynamics*, SAE International
6. N. K. Giri, *Automotive Mechanics*, Khanna Publishers

Class: **T.Y. B. Tech.**	Semester-**VI**
Course Code: **CEMD201**	Course Name: **Building Construction and Planning**

L	T	P	Credits
3	-	-	3

Course Description:
The content of the course 'Building Construction and Planning' provides an overview of properties and applications of various building materials. The course offers an insight into the functional design of building components. It enables the students in planning of the buildings. It also deals with various services and finishes employed in buildings.

Course Outcomes:
After successful completion of the course, student will be able to,
1. Suggest appropriate materials for building construction applications.
2. Prepare a functional design of components of the building.
3. Design and draw residential building using principles of planning and bye-laws.
4. Prepare plumbing and electrification plan for the building.
5. Explain properties of building finishing materials and application procedure.

Prerequisite:
- Basic knowledge of mathematics.

Course Content		
Unit No.	**Details of Content**	**Hrs.**
1.	**Construction Materials:** Properties and applications of Various materials viz. Stone, Aggregate, Brick, Steel, Aluminium, Timber, Glass, Flooring materials, Roofing materials, Cladding materials, Plumbing materials. Mortar, Plain Cement Concrete, Reinforced Cement Concrete and pre-stressed concrete.	**05**
2.	**Components of Building I:** Types of structures: Load Bearing Structure and Framed Structure, Preparation of sectional view drawing of load bearing and framed structure showing different building components, Concept of Soil Bearing Capacity, Substructure of a building, Components of Substructure of a building, Types of foundation and their suitability, Types of Masonry: Types of brick and stone masonry, bonds in brickwork and stone masonry.	**05**

3.	**Components of Building II:** Building components in superstructure: Column, Beam, Wall, Sill, Lintel, Chajja, Slab, Ventilator, Roofing, Parapet wall, Ramp, ladder, lift and escalator. Doors, Windows and Staircase: Technical terms, classification, functional design and drawing.	**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 Development permission/Building permission /Commencement permission, General land development requirements, General building requirements: Setback, Marginal distance, height and FSI as per Unified Development Control and Promotion Regulations 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. Preparation of building plans using principles of planning and bye-laws.	**07**
5.	**Building Services:** Concept of Plumbing & 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.	**07**
6.	**Building Finishes:** Plastering and pointing. Paints-Characteristics of ideal paints, constituents, classification, suitability, applying procedure and applications, defects. Varnishes- Characteristics of good varnish, ingredients, types, suitability, applying procedure and applications. Distemper- ingredients, applying procedure and applications. White washing and colour washing.	**06**

References-

Text Books:

- S. P. Arora, S. P. Bindra, "A Text Book of Building Construction", Dhanpat Rai Publications
- B. C. Punmia, "A Text Book of Building Construction", Laxmi Publications.

References Books: -

- V. B. Sikka, "A Course in Civil Engineering Drawing", S. K. Kataria and Sons.
- W.B Macay, "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, S.Y. Patki, "Building Drawing And Planning With An Integrated Approach To Built Environment", Tata McGraw-Hill Education Pvt. Ltd.

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: - **T.Y. B. Tech.**	Semester - **V**
Course Code: **CSMD201**	Course Name: **Introduction to Data Structures**

L	T	P	Credits
3	-	-	3

Course Description:
The Introduction to Data Structures 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, strudels 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.	**Description**	**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:

- Data structures, Seymour Lipschutz (MGH), Schaum's Outlines.
- Data Structures using C, A Practical Approach for Beginners by Amol M. Jagtap & Ajit S. Mali.

Reference Books:

- Data structures and Algorithms -- Alfred V. Aho, John E. Hopcroft, J. D. Ullman (Addision- Wesely Series).
- Data Structure using C -- ISRD Group (TMH) ACE series.
- Introduction to Data Structures in C – Ashok N. Kamthane, Pearson Education.

Class: - **T.Y. B. Tech.**	Semester- **V**
Course Code: **EEMD201**	Course Name: **Electrical Power Generation**

L	T	P	Credits
03	--	--	03

Course Description:
In this course provides fundamentals of energy sources. Energy is one of the most important components of economic infrastructure. Energy will be generated by conventional and non-conventional energy sources such as thermal, hydro, nuclear, solar energy, and wind energy etc. Processes to harness energy are therefore constantly becoming more technological and significant economically on a global scale. In electrical energy sources, students require theoretical knowledge in order to grasp the entire concept of conventional and non-conventional energy sources.

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

1. Explain the fundamental concepts of energy sources like conventional and non-conventional energy.
2. Describe various advantages and disadvantages of energy sources.
3. Illustrate different technology associate with thermal, hydro and nuclear power energy sources.
4. Illustrate different technology associate with solar, wind, biomass and other renewable energy sources.
5. Describe the working of micro/mini hydropower system.

Prerequisite:

- Basic Electrical Engineering
- Basic Mechanical Engineering
- Basic Civil Engineering
- Engineering Physics and Chemistry.

Course Content

Unit No	Description	Hrs
1	**Energy Scenario:** Present energy scenario worldwide and Indian perspective. concept of energy services, forms and characteristics of energy sources, energy classification, India's production, reserves of commercial energy sources, need for non-conventional energy sources, advantages and disadvantages.	06
2	**Thermal Power Plant:** Law of thermodynamics, Analysis of steal cycle-Carnot, Reheat cycle and Regenerative cycle, Layout of power plant and coal handling plant, selection	06

	of site, boiler, impulse turbine and reaction turbine, economizer, air preheater, super heater, condenser and cooling tower.	
3	**Hydro Power Plant:** Rainfall, run off and its measurement hydrograph, flow duration curve, reservoir storage capacity, layout of hydroelectric power plant, selection of site, classification of hydro plant, construction and working of turbine-Pelton, Kaplan and Francis.	**06**
4	**Nuclear Power:** Fundamentals of nuclear power, layout of nuclear power plant, selection of site, radioactivity & nuclear reactions, nuclear fission chain reaction in reactors, reactor thermal hydraulics, thermal reactors, breeder reactors, biological effects of radiation, reactor safety & security.	**06**
5	**Solar Energy:** Solar radiation, flat plate collectors, solar concentration, thermal applications of solar energy, photovoltaic technology and applications, energy storage.	**06**
6	**Wind Energy:** Wind characteristics, resource assessment, horizontal and vertical axis wind turbines, principle of wind energy conversion, wind energy economics, electricity generation and water pumping.	**06**

References -

Text Books:

- Rao, S. and Parulekar, B.B., Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers.
- Viorel Badescu, George Cristian Lazaroiu, Linda Barelli, Power Engineering Advances and Challenges, Part A: Thermal, Hydro and Nuclear Power, CRC Press.
- B. R. Gupta, Generation of Electrical Energy, S. Chand Publication.
- Rai, G.D., Non-Conventional Energy Sources, Khanna Publishers.

Reference Books:

- Twidell, J. and Tony W., Renewable Energy Resources, Taylor & Francis.
- Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction, Academic Press, Elsevier.
- Yasuo Koizumi, Tomio Okawa and Shoji Mori, Fundamentals of Thermal and Nuclear Power Generation, Elsevier, Publisher.

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Class: - **T.Y. B. Tech.**	Semester- **V**
Course Code: **ECMD201**	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 Learning Outcomes:
After successful completion of the 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.	**Description**	**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**	**06**

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	Number systems: Decimal, Binary, Octal, Hexadecimal, Binary coded decimal (BCD), Number system conversions, Binary Arithmetic, 1's and 2's complements, Logic gates.	
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:

- Boylestad, Robert & Louis, Nashelsky, "Electronics Devices and Circuit Theory", Pearson.
- Ramakant Gayakwad, Op-Amps and Linear Integrated Circuits, PHI
- 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.

Class: - **T.Y. B. Tech**	Semester-V
Course Code: **CIMD201**	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 Learning Outcomes:
After successful completion of the course, students will be able to,

1. Describe the basic terminologies of data structures.
2. Examine the linear data structure array with its types.
3. Demonstrate the working of stack, queue performed on data structures.
4. Illustrate the working of linked list.
5. Discuss Tree terminologies and their Applications.
6. Elaborate Graph terminologies with their types.

Prerequisite:

- Basics of C language

Course Content

Unit No	Description	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 array, 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**	07

	Definition, Terminologies, Representation, Operations, Singly linked list, Doubly linked list, Circular linked list, Stack using linked list, Queue using linked list.	
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, M. J. Augenstein, "Data Structure using C", (PHI).

Reference Books:

- Alfred V. Aho, John E. Hopcroft, J. D. Ullman, "Data structures and Algorithms", Addision, Welsely Series.
- 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: - T.Y. B. Tech	Semester-V
Course Code: **MEMD201**	Course Name: **Materials and Applications**

L	T	P	Credits
3	--	--	3

Course Description:
Materials and Applications is an advanced interdisciplinary course that delves into the fascinating world of materials science and engineering, with a special focus on topics such as Smart Materials, Magnetic Materials, and Electronic Materials. This course is designed to provide students with a comprehensive understanding of different ferrous, nonferrous, and advanced materials, their properties, and applications. The course also covers applications of the components made by Powder Metallurgy. The whole notion of this course is the selection of materials for various engineering applications.

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

1. Describe crystal structures and crystal imperfections.
2. Illustrate plotting of Equilibrium diagrams from Cooling Curves and its fundamentals.
3. Explain different Ferrous, Nonferrous alloys, their properties, and applications by referring to equilibrium diagrams.
4. Explain properties and applications of Smart Materials, Magnetic Materials, and Electronic Materials.
5. Explain properties and applications of Powder Metallurgy.
6. Select suitable material for given engineering applications.

Prerequisite:
The students should have knowledge of basic principles of physics, chemistry, and mathematics in XII standard.

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

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2.	**Ferrous Alloys:** Fe-Fe_3C 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.	**04**
3.	**Non Ferrous Alloys:** Alloys of Copper, Aluminium, Magnesium, Titanium, Other alloys of lead, tin, zinc, nickel, manganese, white metals and bearing alloys.	**07**
4.	**Smart Materials:** Piezoelectric materials, Shape memory alloys and shape memory polymers, Magneto-strictive materials, pH-sensitive polymers, Halochromic materials, Chromogenic-systems, Ferro fluid, Rheological fluid, Processing and applications of different smart materials viz; aerospace, robotics, electronics, and medical devices.	**07**
5.	**Magnetic Materials and Electronic materials:** Classification of Magnetic Materials, Magnetic Dipoles and Magnetic Moments, Magnetization, permeability and the magnetic field, Diamagnetic, paramagnetic, Ferromagnetic, Ferrimagnetic and Super magnetic Materials, Semiconductors and their applications.	**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.
- Ajit Behera, Advanced Materials, Springer.
- S. H. Avner, Physical Metallurgy, Tata McGraw-Hill publication.

Reference Books:

- William D. Callister, Materials Science and Engineering: An Introduction, John Wiley & Sons.
- WD. Callister, Materials Science and Engineering. Wiley India Pvt. Ltd.
- F.A.A. Cranes & J.A. Charles, Selection and Uses of Engineering Materials, Butterworth & Com. Ltd., London.
- James A. Jacobs & Thomas F. Kilduff, Engineering Material Technology Prentice Hall

- Smallman, A.H.W, R Physical Metallurgy and Advanced Materials Butterworth-Heinemann, Elsevier.
- Mark J. Hampden-Smith Wiley-VCH, Chemistry of Advanced Materials: An Overview, Wiley.

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Class: **T.Y. B. Tech**	Semester: **V**
Course Code: **MCMD201**	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 Learning Outcomes:
After successful completion of the 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.	**Description**	**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 programming	**08**
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 -

Textbooks:

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

Reference Books:

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

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Class: - **T.Y. B. Tech.**	Semester- **V**
Course Code: **AIMD201**	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 Learning Outcomes:
The course should enable the students 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	**Description**	**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:**	**06**

	Python introduction, Python syntax, Python comments, Python variables, Python data types, Python numbers, Python casting, Python strings, Python Booleans, Python operators.	
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, Osborne.
- Charles Dierbach, "Introduction to Computer Science Using Python", Wiley India
- ReemaThareja, "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

Class: **T. Y. B. Tech.**	Semester: V
Course Code: **MAMD301**	Course: **Automotive Safety & Ergonomics**

L	T	P	Credits
3	-	-	3

Course Description:
Automotive Safety & Ergonomics is offered as the course at the sixth semester of Mechanical Automobile Engineering undergraduate program. It consists of two modules – the first module focuses on the automotive safety & the second module constitutes automotive ergonomics. This course imparts understanding of role of safety systems in automobiles through technology and its use to protect occupants as well as pedestrians. The course also discusses use of ergonomics to design automobiles.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Discuss the basics of vehicle collision and its effects.
2. Summarize the various safety concepts used in passenger cars.
3. Explain use of ergonomics in automotive design.
4. Explain the human response to impact.
5. Explain the use of various systems used in automobiles for safety & ergonomic considerations.

Prerequisite: Automotive Systems

Course Content

Unit No	Description	Hrs
7.	**Introduction** Design of the body for safety, Driver assistance systems in automobiles, Definitions and terminology, Balance of stiffness and toughness characteristics and energy absorption characteristics of vehicle structures, Design of crash crumple zones, Modeling and simulation studies, Optimization of vehicle structures for crash worthiness, Types of impacts and Impact with rebound, movable barrier tests. Analysis and simulation of vehicle in barrier impacts, Roll over crash tests, Behavior of specific body structures in crash testing, Photographic analysis of impact tests, Regulatory requirements for crash testing.	06
8.	**Vehicle Safety Systems** Survival space requirements, Restraints systems used automobiles, Types of safety belts, Head restraints, Air bags used in automobiles, Use of energy absorbing systems in automobiles, Impact protection from steering controls,	06

	Design of seats for safety, types of seats used in automobiles. Importance of Bumpers in automobiles, Damageability criteria in bumper designs. Introduction to the types of safety glass and their requirements and rearward field of vision in automobiles, Types of rear view mirrors and their assessment. Warning devices, indicators, hinges, latches, wipers, & horns.	
9.	**Safety Concepts** Active Safety - Driving Safety, Conditional Safety, Perceptibility Safety, Operating Safety. Passive safety - Exterior & Interior Safety. Deformation Behavior Of Vehicle Body, Speed And Acceleration Characteristics Of Passenger Compartment On Impact, Pedestrian Safety - Human Impact Tolerance- Determination Of Injury Thresholds, Severity Index, Study Of Comparative Tolerance, Study Of Crash Dummies.	**06**
10.	**Vehicle Ergonomics** Introduction To Human Body - Anthropometrics And Its Application To Vehicle Ergonomics, Cockpit Design, Driver Comfort – Seating, Visibility, Man-Machine System- Psychological Factors – Stress, Attention, Passenger Comfort - Ingress And Egress, Spaciousness, Ventilation, Temperature Control, Dust And Fume Prevention And Vibration, Interior Features And Conveniences, Use Of Modern Technology For Automobile Ergonomics	**07**
11.	**Ergonomics and Human response to Impact** Importance of Ergonomics in Automotive safety, Human impact tolerance, Determination of Injury thresholds, Severity Index, Study of comparative tolerance, Application of Trauma for analysis of crash injuries. Injury criteria's and relation with crash and modeling and simulation studies in dummy.	**05**
12.	**Comfort and Convenience System** Cabin Comfort - In-Car Air Conditioning – Overall Energy Efficiency, Air Management, Central And Unitary Systems, Air Flow Circuits, Air Cleaning, Ventilation, Air Space Diffusion, Controls And Instrumentation, Steering And Mirror Adjustment, Central Locking System, Tire Pressure Control System, Rain Sensor System, Environment Information System, Automotive Lamps, Light Signaling Devices- Stop Lamp, Rear Position Lamp, Direction Indicator, Reverse Lamp, Reflex Reflector, Position Lamp, Gas Discharge Lamp, LED, Adoptive Front Lighting System (AFLS) And Daylight Running Lamps (DRL).	**06**

References-
Text Books:

1. Prasad, Priya & Belwafa Jamel, Vehicles Crashworthiness and Occupant Protection, American Iron and Steel Institute, USA.
2. Jullian Happian-Smith An Introduction to Modern Vehicle Design, SAE
3. Watts, A. J., Low speed Automobile Accidents Lawyers and Judges

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4. Johnson W. and Mamalis A.G., Crashworthiness of Vehicles, MEP, London

Reference Books:

1. Daniel J. Helt, Recent development in Automotive Safety Technology, SAE International Publication
2. Bosch - Automotive Handbook, SAE publication
3. Olson L. P, Forensic aspects of driver perception and response, Lawyers and Judges

Class: **T. Y. B. Tech.**	Semester: **V**
Course Code: **CEMD301**	Course Name: **Infrastructure Engineering**

L	T	P	Credits
3	-	-	3

Course Description:

This course provides an overview of infrastructure planning and design, covering roads, airports, railways, and harbors. Explore the history and present status of India's roads, delve into geometric design principles for highways, and learn about diverse pavement types. Gain insights into airport planning, runway layout, lighting, and markings. Conclude with a broad understanding of railway and harbor engineering for comprehensive insights into infrastructure development.

Course Learning Outcomes:

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

1. Apply the knowledge of geometric design in road construction.
2. Identify the quality parameters of pavement materials and various methods of road construction.
3. Discuss the various aspects of airport engineering.
4. Explain design parameters of railway engineering and it's component parts.
5. Summaries the different off shore structures for dock and harbors.

Prerequisite: Physics

Course Content

Unit No.	Description	Hrs
01	**Highway Planning** Introduction: Classification of roads, Brief history of road development in India, Present status of roads in India, NHA1, NHDP, PMGSY, MSRDC; Geometric Design of Highways: Terrain classification, Design speed. Highway cross-section elements, Sight distance, Overtaking sight distance, Intersection sight distance;	06
02	**Geometric Design of Roads** Design of Horizontal Alignment: Horizontal curves, Design of super elevation and its provision, Radius at horizontal curves, Widening of pavements at horizontal curves, Methods of extra widening; Design of vertical alignment: Different types of gradients, Grade compensation on curves, summit curves, valley curves	06

03	**Highway Construction** Types of Pavement (Flexible and Rigid); Types of Roads: WBM, WMM, DBM, SDBC, SMA, PQC, DLC; Highway Drainage: Necessity, sub surface and surace drainage; PPP in Transport Sector	**06**
04	**Airport Engineering** Introduction: Advantage and limitation of air transportation, Aircraft component parts and characteristics, Important terms in Airport planning, Airport layout: Imaginary surfaces, Zoning requirements Runway Location and orientation, Runway configuration, Characteristics of good layout, Basic runway length, Use of wind rose diagram. Airport Lighting and Markings.	**06**
05	**Railway Engineering:** History of Indian Railways; Recent development in railways specifically w.r.t. track structure; Permanent Way; Component parts of railway track; Railway lines classification based on speed; Geometric Design: Alignment, Gradient, Horizontal Curves, Superelevation; Points, Crossing and Turnouts; Signaling and Interlocking: Control of train movements and monitoring, Types of signals, Principal of interlocking; Modernization in Railway and Railway Tracks	**06**
06	**Dock and Harbor Engineering:** Introduction, Planning and layout of ports, Classification, Site Selection, Breakwater, Jetties, Locks, Shore protection works.	**06**

References:

Text Books:

- Khanna and Justo, "Highway Engineering", Nemchand Bros, Roorkee.
- L R Kadiyali, "Highway Engineering", Khanna Publisher.
- S.C. Saxena & S.P. Arora, "A textbook of Railway Engineering", Dhanpat Rai Publications.
- S. K. Khanna, M. G. Arora, "Airport Planning & Design", Nemchand Bros, Roorkee

Reference Books:

- Partha Chakraborty and Animesh Das, "Principles of Transportation Engineering", Prentice Hall of India Ltd., New Delhi.
- Satish Chandra, M. M. Agarwal, "Railway Engineering" Oxford University Press India.

Class: - **T.Y. B. Tech.**	Semester - **V**
Course Code: **CSMD301**	Course Name: **Fundamentals of Database Systems**

L	T	P	Credits
3	-	-	3

Course Description:
This course serves as an introduction to the fundamental principles and practices of database management. It is designed for individuals seeking to develop a solid foundation in organizing, storing, retrieving, and managing data efficiently. Participants will gain both theoretical knowledge and hands-on experience in working with databases, providing a comprehensive understanding of modern database management systems.

Course Learning Outcomes:
At the end of the course the student should be able to:

1. Describe the purpose and nature of the database system for storing and fast access to thedata
2. Identify various protocols, issues, and techniques related to transaction management for a consistent & and stable database
3. Draw E-R models to represent simple database application scenarios
4. Design the queries to manipulate and access data using procedural and non-procedural languages
5. Apply relational database design concepts to remove data redundancy and to retrieve data easily
6. Perform operation on Unstructured data.

Prerequisites:

- Basic understanding of computer science concepts and familiarity with basic programming principles.
- Basic Knowledge of File System & Client server Architecture.

Course Content

Unit No	Description	Hrs
1	**Introduction and Database concepts and Data Model** Purpose of Database Systems, Data abstraction, Data Models, Overall System Design, Entities and Entity sets, Mapping Constraints, E-R Diagram, Reducing ER Diagrams to Tables, Generalization, specialization and Aggregation, Relational Algebra, Tuple Calculus.	06
2	**Structured and Procedural Query Language** Introduction to SQL and PL/SQL, Set operations, Joins, Aggregate operations, Nested queries etc., PL/SQL Cursor, stored procedure and Trigger.	06

3	**Relational Database Design** Domain Constraints, Referential Integrity, Functional Dependencies, Canonical cover, Pitfalls in Relational Database Design, Decomposition and Normalization using Functional Dependencies.	**06**
4	**Transaction Management and Concurrency Control** Basic concepts, States, Concurrent execution, Serializability, Recoverability, isolation; Concurrency control: Timestamps and locking protocols, Validation based protocols, deadlock handling; Recovery: Log-based recovery, Shadow-paging.	**08**
5	**Database Security and Crash Recovery** Introduction to Database Security, Confidentiality, Integrity, Availability Needs of Database Security SQL injection attack, error recovery and logging undo, redo, undo-redo logging, and recovery methods.	**06**
6	**Introduction to NoSQL Database** Fundamentals of NoSQL (NoSQL Features, Data Models, and Distribution Models), Introduction to MongoDB, MongoDB CRUD operations. (Creating, Reading & Updating Data)	**04**

Text Books

- Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database system concepts", Fifth Edition, McGraw Hill International Edition, ISBN 978-0073523323.
- Raghu Ramkrishnan, Johannes Gehrke, "Database Management Systems", Third Edition, McGraw Hill International Editions, ISBN 978-0072465631.

References

- Ramez Elmasri and Shamkant B. Navathe, "Fundamental Database Systems", Third Edition, Pearson Education, ISBN 978-0321204486.
- Kristina Chodorow, "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage".Third Edition

Class:- **T.Y. B. Tech.**	Semester- **V**
Course Code : **EEMD301**	Course Name : **Electrical Machines**

L	T	P	Credits
3	--	--	3

Course Description:
The Electrical Machines minor course is designed to provide students with a fundamental understanding of the principles, operation, and applications of electrical machines in various engineering systems. This course serves as an introduction to the field of electrical machines, covering both theory and practical aspects. Students will gain insights into the performance, and control of electrical machines, which are essential components in modern electrical and electronic systems.

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

1. Describe behavior of dc machine.
2. Explain the working principle of 1-Phase and 3-Phase transformers.
3. Explain working of different induction motors.
4. Select the relevant electrical machines for different applications
5. Interpret the relevant fractional horse power motor for different applications

Prerequisite: Basic Electrical Engineering, Engineering mathematics and Engineering physics

Course Content

Unit No	Description	Hrs
1	**DC Machine** Fleming's right hand rule, Construction of dc machine with their parts information, Principle of operation of dc generator and Motor, Fleming's left hand rule, Voltage equations of dc motor, Torque equation of dc motor, Characteristics of dc motors, Speed control methods of dc motor, Applications of dc machine	06
2	**Transformer** Construction of 1-Phase and 3-Phase transformer, Principle of operation, EMF equation of transformer, transformation ratio, Types of transformers, Ideal transformer on no load, Practical transformer on no load and on load, Phasor diagram of practical transformer for different loads, Losses in transformer, efficiency of transformer, Applications of transformer	06
3	**Induction Motors** **1-Phase Induction motor:**	06

	Resistance start/Split phase induction motor, Capacitor start induction run motor, Capacitor start capacitor run induction motor **3-Phase Induction motor:** Construction and working of 3-Phase Induction motor, Types of 3-Phase Induction motors, Synchronous speed, rotor speed, Slip, Torque equation of 3-Phase Induction motor, Torque-Slip characteristic of 3-Phase Induction motor, Need and types of starters, Speed Control of 3-Phase Induction motors Applications of induction motors	
4	**Synchronous machines** **Alternator:** Construction and working principle, EMF equation, Types of rotors, Terminal voltage, Armature reaction at various p.f., Voltage regulation **Synchronous Motor:** Construction and working principle, Different torques in synchronous motor, Effect of excitation, Applications of synchronous machines.	**06**
5	**Fractional Horse Power Motors** Permanent Magnet DC Motor (PMDC), Brushless DC Motor (BLDC), Steeper Motors, AC and DC Servo Motor, SRM, Universal motor. Applications of various special purpose motors	**06**
6	**Electric Drives** Introduction to controlled rectifiers, Electric Drives, Advantages of Electrical drives, Parts of electrical drives ,Choice of electrical drives, Status of ac and dc drives, fundamental torque equations, Multiquadrant operation, Classification of drives	**06**

References -

Text Books:

- Ashfaq Husain, Electric Machines, Dhanpat Rai & Co
- V K Mehta, Principle of Electric Machine, S Chand Publication
- D.P. Kothari, I Nagrath , Electric Machines, Tata McGraw-Hill Education.

Reference Books:

- P. S. Bimbhra , Electrical Machinery, Khanna Publishers
- B.L.Theraja and A.K.Theraja, Electrical Technology, S Chand Publication
- Charles I. Hubert, Electric Machines: Theory, Operating Applications, and Controls, Pearson publication

Department of Automobile Engineering

Class: - **T. Y. B. Tech.**	Semester-V	L	T	P	Credits
Course Code : **ECMD301**	Course Name: **Advanced Communication Systems**	3	-	-	3

Course Description:
This course covers the basics of antenna and wave propagation, key antenna parameters, and various antenna types. It includes an overview of 5G communication systems, channel modeling, and the challenges of 5G wireless propagation. Additionally, the course introduces modern communication techniques like fiber optics, GSM, CDMA, LTE, Bluetooth, WiFi, ZigBee, LoRA, and RFID.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Explain the principles of antenna and wave propagation.
2. Understand basic antenna parameters and their types.
3. Discuss the evolution, requirements, and challenges of 5G communication systems.
4. Understand and compare various communication techniques.
5. Communicate effectively on complex engineering topics related to modern communication techniques.

Prerequisite:
Knowledge of basic analog and digital communication.

Course Content

Unit No	Description	Hrs
1.	**Basics of Antenna and Wave Propagation** Introduction to Antenna and wave propagation, Types of wave propagation, Wave Polarization, Types of Wave polarization.	06
2.	**Antenna Parameters** Basic Antenna parameters: Antenna pattern, Half power beam width, Beam area, Radiation intensity, Beam efficiency, Directivity and Gain, Resolution, Front to Back ratio, Effective height, Reflection coefficient, Impedance bandwidth, and pattern bandwidth.	06
3.	**Types of Antennas** Dipole Antenna, Antenna Array, Wire Antenna, Microstrip Antenna, Aperture antenna, Dish Antenna, Yagi Uda Antenna.	06
4.	**Overview of 5G Communication**	06

	Evaluation of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G.	
5.	**The 5G wireless Propagation Channels** Channel modeling requirements, propagation scenarios, and challenges in the 5G modeling, Channel Models for mm-Wave MIMO Systems.	**06**
6.	**Communication Techniques** Fundamentals of Fiber Optics Communication, GSM, CDMA, LTE, Blue Tooth, WiFi, ZigBee, LoRA, RFID.	**06**

References -

Text Books:

1. Constantine A. Balanis "Antenna Theory: Analysis and Design" Wiley Publication.
2. John D. Kraus and Ronald J. Marhefka "Antennas and Wave Propagation" McGraw-Hill Publication.
3. Theodore S. Rappaport "Wireless Communications: Principles and Practice" Pearson Publication.
4. Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.

Reference Books:

1. John D Kraus, Antenna for all Application, TMH publication
2. Louis Frenzel, "Communication Electronics Principles and Applications" TMH Publication.
3. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons

Class:- **T.Y.B. Tech.**	Semester- **V**
Course Code: **CIMD301**	Course Name : **Introduction to DBMS**

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: Data Structures

Course Content

Unit No	Descriptio n	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**	06

	Structure of Relational Databases, the Relational Algebra, the Tuple Relational Calculus, Structured Query Language (SQL), Joins	
3.	**Integrity Constraints and Database Design** Domain Constraints, Referential Integrity, Complex datatypes, Functional Dependencies, Pitfalls in Relational Database Design, Decomposition, Normalization	**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.	**Query Processing and Basic of Transactions** Overview, Query Interpretation, Concepts of transaction processing, ACID properties, Transaction states, Serializability, Testing for serializability.	**06**
6.	**Concurrency Control and Recovery System** Lock-based protocols, Timestamp - based Protocols, Multiple Granularities, Deadlock handling, Crash Recovery: Failure Classification, Log-Based Recovery, Checkpoints, Shadow Paging	**06**

References

Text Books :

- Abraham Silberschatz , Hank Korth and S. Sudarshan , "Database System Concepts",McGraw Hill Education.
- Ram Krishnan, Johanses Gehrke, "Database Management Systems", McGrawHill Education.

Reference Books -:

- J.D. Ullman, "Principles of Database Systems ", Galgotia Publications.
- Jio Wiederhold, "Database Design", McGraw Hill International.
- Kristina Chodorow, "MongoDB: The Definitive Guide: Powerful and Scalable DataStorage".

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Common to All Departments

Class:- **T.Y. B. Tech.**	Semester-V
Course Code: **MEMD301**	Course Name: **Manufacturing and Assembly Process**

L	T	P	Credits
3	--	-	3

Course Description
Manufacturing is value adding 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.
This course intends to build the competency in the students to identify & select a proper manufacturing process for manufacturing different components used in engineering industry. Course also focused on selection of plastic & ceramic processes, various assembly lines process, non-traditional machining processes.

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

1. Select appropriate manufacturing process suitable for the component design and production volume
2. Select appropriate joining process for given application.
3. Select appropriate machine tools for machining operations.
4. Select appropriate finishing process for given product.
5. Explain concept of automation in manufacturing.
6. Explain and select appropriate Non Traditional machining process and machine with constructional details for engineering component.

Course Content

Unit No	Description	Hrs
1.	**Casting Process** Importance of casting as manufacturing Process, advantages and disadvantages of casting processes. General introduction to patterns, core boxes and gating systems. Introduction to permanent mould casting. Process-Gravity and pressure die-casting, Centrifugal casting, Continuous casting. shell Molding, CO2 Molding, Investment casting, Defects in casting	7
2.	**Forming Process** Introduction, types and importance of Rolling, Forging, Extrusion, Wire, rod and pipe drawing, Sheet Metal Working.	5
3.	**Joining Processes** Welding processes: Arc, TIG, MIG, submerged arc welding and Resistance welding, Laser cutting and welding, Plasma arc, Brazing and Soldering, Riveting, Adhesive joining, Fasteners.	6

4.	**a) Plastics**- Introduction to plastics, blow molding, injection molding, extrusion, calendaring and Thermo forming. b) Finishing and surface treatment processes. c) Powder metallurgy, Additive manufacturing	**6**
5.	**Machine Tools for Metal Cutting:** Introduction of Lathe, Capstan, turret lathe, Boring Machines, Drilling, shaping machine, planning machine, milling machine, grinding machines. SPM, Transfer lines, Machine Tool Selection, Introduction to FMS, CIM. Industry 4.0	**6**
6.	**Precision machine.** a) Machine Center and Turning Centre-Types, axis system, Characteristic, Capabilities, Construction- LM guide ways, ball screw, Automatic tool changer. b) Non Traditional Machining processes- Introduction, classification, significance of-NTM/NCM- Electric Discharge Machining(EDM), Electrochemical Machining(ECM), Ultrasonic machining(USM), AWJM, EBH, EBM, IBM, USM, CHM, PCM etc. Introduction. working and application.	**6**

References -

Text Books:

- Serope Kalpakjian, Manufacturing Engineering and Technology,Pearson
- 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, Company. New Delhi.
- ASTM Volumes on Welding, casting, forming and material selection.
- ASM Handbook, Casting.
- W.A. J. Chapman, "Workshop Technology", CBS Publishing and Distributors, New Delhi Vol. I [ISBN-13:9788123904016]2001, Vol. II [9788123904115] 2007 and Vol.III [9788123904122] 1995.

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Common to All Departments

Class: - **T.Y. B. Tech.**	Semester-V
Course Code: **MCMD301**	Course Name: **Sensor and Instrumentation**

L	T	P	Credits
3	-	--	3

Course Description:
This course provides an in-depth understanding of sensors and instrumentation used in mechatronics systems. Students will learn the principles of various sensors and their applications in measuring physical quantities. The course will cover topics such as sensor types, signal conditioning, data acquisition, and integration of sensors into mechatronics systems with real life applications.

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

1. Understand the fundamental principles of various sensors and transducers.
2. Analyze the characteristics, advantages, and limitations of different sensor types.
3. Apply appropriate signal conditioning techniques to improve sensor output accuracy and integrate sensors into mechatronic systems for real-time data acquisition and control.
4. Select appropriate sensors for specific mechatronic systems used in real life applications.

Prerequisite:

1. Basic knowledge of mechatronics systems.
2. Familiarity with electronics and electrical circuits.

Course Content

Unit No	Description	Hrs
1	**Introduction to Mechatronics and Sensors:** Definition and scope of mechatronics, Role of sensors in mechatronic systems, Classification of sensors based on transduction principles, Sensor Characteristics and Performance Parameters such as sensitivity, accuracy, precision, resolution, hysteresis, etc., Calibration and compensation techniques.	06
2	**Temperature Sensors:** Thermocouples, Resistance Temperature Detectors (RTDs), Thermistors, Infrared (IR) temperature sensors. **Position and Displacement Sensors:** Potentiometers, LVDT (Linear Variable Differential Transformer), Optical encoders, Inductive sensors.	06
3	**Force and Pressure Sensors:** Strain gauges, Load cells, Pressure transducers, Piezoelectric, Piezoresistive, and Capacitive Pressure Sensors, Ultrasonic Sensors	06

	Motion and Velocity Sensors: Accelerometers, Gyroscopes, Proximity sensors, Hall Effect Sensors.	
4	**Light and Imaging Sensors:** Photodiodes, Phototransistors, Image sensors (CMOS, CCD) **Wireless and IoT Sensors:** Bluetooth, Wi-Fi, Zigbee, and other wireless protocols, Integration of sensors into IoT platforms.	**06**
5	**Sensor Interfacing and Signal Conditioning:** Amplification and filtering, Analog-to-Digital Conversion (ADC), Sensor interfaces, Noise reduction and error compensation **Data Acquisition and Processing:** Sampling theorem and Nyquist frequency, Data acquisition systems (DAQ) Analog and digital signal processing, Sensor fusion techniques	**06**
6	**Case Studies and Real-World Applications:** Robotics and automation systems, Autonomous vehicles, Biomedical applications, Health care, defense applications, agricultural applications, automobile sector, communication devices, home security.	**06**

References -

Text Books:

1. Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill.
2. Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi,
3. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney,
4. Dhanpat Rai & Co,
5. Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt. Ltd,.

Reference Books:

1. Measurement Systems by E.O. Doebelin, McGraw Hill,
2. Process Measurement & Analysis by B.G. Liptak, CRC press,
3. Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani,
4. Tata McGraw-Hill Publishing Company Ltd., New Delhi,
5. Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers,

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Common to All Departments

Class:- **T. Y. B. Tech.**	Semester- V
Course Code: **AIMD301**	Course Name: **Machine Learning**

L	T	P	Credits
3	-	-	3

Course Description:
The students will understand the basics of Machine Learning. They will learn to apply different machine-learning algorithms to various datasets.

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

1. Utilize machine learning techniques and understand the basic theory underlying machinelearning.
2. Articulate supervised, unsupervised and reinforcement learning
3. Identify the basic concepts of learning and decision trees.
4. Utilize Bayesian techniques for problems appear in machine learning
5. Perform statistical analysis of machine learning techniques.

Prerequisites:

- Basic knowledge of Probability theory and python programming

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction:** Learning in the context of ML, three phases of performing ML, Algorithms and Models in ML, Logical, Geometric and Probabilistic models, Underfitting, Overfitting and Right models, Practical ML examples, Types of ML problems, Classification of ML algorithms.	**06**
2	**Decision Trees** Purpose and uses, Constructing a decision tree, Gini Index, Gain ratio, ID3, C4.5, CART, Benefits of decision tree, Random Forest.	
3	**Regression-Based Learning:** Regression Analysis, Covariance, Correlation Coefficient, Regression Methods, Simple liner regression, Regression Model, Multiple Regression, Polynomial regression, Generalized linear models, Logistic regression	**08**
4	**Instance Based Learning and kernel-methods based learning:** KNN algorithm, Determining K, distance measures in KNN, Case based Reasoning, Support vector Machines (SVM).	**06**

5	**Clustering Based Learning:** Types of clustering, K-means clustering algorithm, Advantages and dis-advantages of K-means clustering, Distance measures.	**06**
6	**Bayesian learning:** Classical, Empirical, Subjective methods, Types of events, Types of probabilities, Normal Distribution, Bayes' Theorem, Naïve Bayes' classifier.	**06**

References -

Text Books:

- Sunila Gollapudi "Practical Machine Learning" PACKT Publishing
- Mitchell, Tom. M., "Machine Learning", McGraw-Hill Education.
- John Paul Mueller and Luca Mueller, "Machine Learning for Dummies"

Reference Books:

- Stephen Marsland, "Machine Learning An Algorithmic Perspective", CRC Tylor andFrancis Publication

Class: **T.Y. B. Tech.**	Semester: V
Course Code: **SH3034**	Course: Scholastic Aptitude - I

L	T	P	Audit
1	-	2	

Course Description

Quantitative and Reasoning tests form a major part of most of the competitive exams and recruitment processes. They evaluate numerical ability and problem solving skills of candidates. Along with the arithmetic abilities, candidate's patience while reading through the question is also tested. Decision making is also a crucial part of the process with a question having multiple solutions and the candidate has to choose the most efficient one.

Fast calculations have become an integral part of a candidate's career. Calculating the remuneration and efficiency, estimating profits and interests on the principal, using a logical approach towards solving a problem is now a routine affair for a professional.

Course Learning Outcomes:

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

Develop a thorough conceptual understanding and develop a logical approach towards solving Aptitude and Reasoning problems.

Understand usage of basic aptitude terms of percentages, averages, ratios and applications of business aptitude terms of profits and interests

Develop a bridge in analogies, series and visualizing directions.

Apply various short cuts & techniques to manage speed and accuracy to get equipped for various competitive and campus recruitment exams

Prerequisite:

Fundamentals of various Mathematical and Arithmetic operations, Calculations.

Course Content		
Unit No	**Description**	**Hrs.**
1.	**Number System, HCF, LCM** Basics, Base System, Exponents, LCM and HCF, Factors, Cyclicity, Different Methods to find LCM-HCF, HCF-LCM relation, Applications of HCF –LCM	**03**
2.	**Percentage** Understand Conversion, Single change, Successive change, Product Stability, Applications of percentage.	**02**
3.	**Average, Allegations** Weighted average, Concept of average speed & allegation, Applications of Average & mixture allegation.	**02**
4.	**Ratio & Proportion** Comparison of Ratio & fraction, Properties of Ratio & Proportion, Mean Proportion. Joint ratio	**02**
5.	**Profit & Loss** Same selling price different Cost Price, Same cost price different selling price Concept of false scale.	**02**
6.	**Simple interest -Compound interest** Basics, Difference between SI CI, Conversion Periods, Depreciation.	**02**
7.	**TRW, Pipes & Cisterns** Time, Rate and Work-Unitary Method, LCM Method, Calculation of remuneration. Pipes & Cisterns -Concept of negative work, LCM Method.	**02**
8.	**Blood Relations** Blood Relations -Symbols, generation of tree diagram, types of questions-pointing towards person, tree based, coded blood relation	**02**
9.	**Numerical Analogy** Basics, Relation between two numbers, numerical	**02**
10.	**Pattern, Step Completion** Image completion, Mirror images, Water images, input-Output	**02**

11.	**Series Completion** Types of series, Number series pattern, Letter series, Alphanumeric series,	02
12.	**Direction Sense** Basics, shadow based concept, Concept of local time zone (IST,GMT, Longitude, Latitude), Problems on local time difference, Coded direction sense	02
13.	**Coding Decoding** Letter-Letter, Letter- Number, Number-Number, Letter-Symbol, Mixed Coding,	03
14.	**Syllogism** Basics , Types of Statements, Different diagram for different statements, Types of Questions-Based on Conclusion, Based on Statements	02
	Total Hrs.	30

Reference Books:

1. R. S. Aggarwal, "Quantitative Aptitude", S Chand Publishing, New Delhi.
2. R. S. Aggarwal, "Logical Reasoning", S Chand Publishing, New Delhi.
3. Arun Sharma, "Quantitative Aptitude", McGraw Hill Publishing, New Delhi 7th Edition.
4. Arun Sharma, "Logical Reasoning", McGraw Hill Publishing, New Delhi 3rd Edition.

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Common to All Departments

Class: **T. Y. B. Tech.**	Semester: V
Course Code: **MAMD303**	Course: **Automobile Engineering Lab.**

L	T	P	Credit
-	-	4	2

Course Description:

Students will get orientations towards various automotive systems by demonstrating the construction and working of individual systems. Students will determine performance characteristics of different types of I. C. engines. Student will get proficiency in construction and working of vehicle systems like engine, clutch, gearbox, differential, braking system, steering, chassis, electrical, body, wheels & tyres etc.

Course Outcomes:

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

1. Differentiate between S.I. and C.I. engines.
2. Test engines and plot performance characteristics curves.
3. Describe the working of various automotive systems.

Prerequisite: : Internal Combustion Engines, Automotive Systems

Course Content:

Expt. No.	Description	Hrs.
1	Demonstration of construction arrangement of SI and CI engine.	02
2	Demonstration of Auxiliary engine systems: fuel supply lubrication, cooling, intake, and exhaust system.	02
3	Conduct the test and draw performance characteristics curves on multi-cylinder petrol/diesel engines	02
4	Conduct the test and prepare heat balance sheet.	02
5	Demonstration of working of transmission systems (manual gear boxes) and draw neat sketches.	04
6	Demonstration of working of automotive clutches and draw neat sketches.	04
7	Draw and compare various types of vehicle layouts	04
8	Demonstration of propeller shaft and final drive and draw neat sketches.	02
9	Demonstration of working of differential and draw neat sketches.	02
10	Demonstration of various steering systems and draw neat sketches.	02
11	Demonstration of various suspension systems and draw neat sketches.	02
12	Demonstration of hydraulic brakes and draw neat sketches.	02
13	Demonstration of pneumatic brakes and draw neat sketches.	02
14	Demonstration of wheel and tyre construction and draw neat sketches.	02
15	Demonstration of working of automotive electrical systems and draw neat sketches.	02
16	Demonstration of various vehicle body styles and draw neat sketches.	04

References –
Text Books:
1. V.A.W. Hilliers, Fundamentals of Automotive Electronics, Hatchin, London.
2. Eric Chowanietz, Automobile Electronics, SAE.
3. Tom Denton, Automobile Electrical & Electronic Systems, Allied Publishers Pvt. Ltd.
4. Tomwather J. R., Cland Hunter, Automotive Computer & Control System, Prentice Inc. NJ.

Reference Books:
1. Robert N. Brandy, Automotive Computers & Digital Instrumentation, Prentice Hall.
2. Bechfold, Understanding Automotive Electronics, SAE 1998.

Class: **T. Y. B. Tech.**	Semester: V
Course Code: **CEMD303**	Course Name: **Smart Cities & Sustainable Development**

L	T	P	Credits
2	-	-	2

Course Description:

This course will introduce students to the concepts of smart cities and different ideologies of smart cities and sustainable development. Different approaches of different countries all over the world toward smart cities and sustainable development will be studied and evaluated. The current smart city mission in India its plans and provisions and different aspects will also be studied and critically evaluated. Measurement of sustainability and its assessing framework will also be studied under this course. Present condition of sustainability in India its needs, issues and challenges will also be studied

Course Learning Outcomes:

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

1. Develop a critical understanding of the different concept and ideologies of smart cities.
2. Analyse the different approaches toward planning and development of smart cities on global level.
3. Assess the existing state and approach of Smart city Mission in India.
4. Comprehend the concept of resilience and sustainable development and its measurement.
5. Evaluate the present status of sustainability and rating systems initiatives within the Indian context.

Prerequisite: Basics of civil engineering

Course Content

Unit No.	Description	Hrs.
01	**Introduction:** Smart cities concept, origin, ideology. Typologies and different meanings, Wired city, Virtual city, Intelligent city, Information city, Digital city. Characteristics of smart cities: smart economy, smart people, smart governance, smart mobility, smart environment, smart living Strategies and policies.	04
02	**Critical analysis of Smart City Concept:** Approaches towards smart cities in various countries. Smart city planning in advanced economies, economic, financial viability, social implications. Financial and economic viability of smart city. Critical analysis of smart city development projects in India	04
03	**Smart City Mission in India:**	04

	Smart city mission: Objectives, features, coverage and duration. Preconditions and criteria for the selection of smart city, actions and tools for smart cities Strategies, redevelopment, Greenfield, Brownfield, pan-city, Governance and management special purpose vehicles.	
04	**Resilience and Sustainable Development:** Sustainable Development Introduction, Origin, Definition, three pillars of Sustainable Development, Critiques on Sustainable Development. The concept of resilience: need and significance in the contemporary time, city preparedness, adaptations, risk reduction and mitigation. Climate change and resilience.	**04**
05	**Measurement of Resilience and Sustainability:** The Theory and Measurement of Sustainability: Ideologies and Ethos of Sustainability, Indicators, Indicator Framework for Assessing Sustainability, Measurement Systems for Sustainable Urban Development: Concept Level (Broad) Measurement Systems.	**04**
06	**Sustainability in India:** Sustainability in India: Need, Issues and Challenges, Urbanization in India, Sustainable Development in India, Sustainability Measurement and Rating Systems and Initiatives in India.	**04**

References:

Text Books:

- Sharma P. and Rajput S., "Sustainable Smart Cities in India", Springer International Publishing.
- Srinivasan R., Sookoor T., Jeschke S., "Smart Cities: Foundations, Principles, and Applications", John Wiley Publishing.

Reference Books:

- Mora L., Deakin M., "Untangling Smart Cities", Elsevier Science.
- Dag R. Bennett, Diana Pérez-Bustamante Yábar, "Sustainable Smart Cities", Springer International Publishing.
- Ministry of Environment and Forests, "Sustainable Development in India: Stocktaking in the run up to Rio+20", Government of India.

Class:- **T.Y. B. Tech.**	Semester-V	L	T	P	Credits
Course Code: **CSMD303**	Course Name: **Object-oriented Programming in Python**	**1**	**--**	**2**	**2**

Course Description:
This course is designed to introduce students to the Python programming language, providing a solid foundation in its syntax, principles, and applications. Through hands-on coding exercises and projects, students will gain practical experience, enabling them to apply Python to various programming tasks and problem-solving scenarios. The course emphasizes good coding practices, algorithmic thinking, and an understanding of key programming concepts.

Course Learning Outcomes:
At the end of the course the student should be able to:

1. Demonstrate a comprehensive understanding of Python syntax, data types, and basic operations.
2. Make use of common Python libraries for data manipulation.
3. Implement lists, tuples, sets, and dictionaries for effective data handling.
4. Apply principles of OOP, including classes, objects, inheritance, and polymorphism.

Prerequisites : Basic understanding of programming concepts.

Course Content

Unit No	Description	Hrs
1	**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, Loops and Conditional Statement If-else, while, for, lambda, arrays, Python Iterators, Python scope	02
2	**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.	02
3	**Classes and Objects:** Classes, objects, parameterized and non-parameterized init constructor, object methods, self-parameter, association, Access modifiers: Private, public, protected	02
4	**OOP Concepts:** Inheritance, Encapsulation, Polymorphism: overloading and overriding, abstraction: interface and abstract class	02

5	**File handling and Exception:** File handling syntax, read files, write/create files, delete files, handing runtime exception and custom exception.	02
6	**Modules and Libraries** Introduction, modules, using dir() function, Numpy, Pandas, Matplotlib, Seaborn, markers, line, labels, grid, subplots, scatter, bars, histograms, pie-charts	02

References -

Text Books:

- "Python Programming: A Modular approach" by Sheetal Taneja, Naveen Kumar
- "Python Programming: Using Problem Solving Approach" by Reema Thareja

Reference Books:

- "Learning Python: by Mark Lutz
- "The Complete Reference: Python" by Martin C. Brown

Class:- **T.Y. B. Tech.**	Semester-V
Course Code : **EEMD303**	Course Name : **Electrical Technology Lab.**

L	T	P	Credits
1	-	2	2

Course Description:
This laboratory course emphasis on imparting the practical knowledge and understanding of basic principles, characteristic, performance and testing of electrical systems. In this lab course, students will be familiar with the use of different electrical equipment and safety precautions on work place.

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

1. Demonstrate speed control methods of electrical machines.
2. Analyze performance of DC motor and induction motor for speed control applications.
3. Implement power electronic circuits for given application.
4. Measure electrical quantities using electrical and electronic instruments.

Prerequisite: Basic Electrical Engineering, Basic Electronics Engineering

Course Content		
Unit No	**Description**	**Hrs**
1	**Power Electronic Devices:** Power diode, BJT, Thyristor, MOSFET, IGBT: Structure, Symbol, Working Principle, Comparison.	02
2	**Power Electronic Circuits:** Rectifier: single phase full wave diode rectifier, Chopper: basic step-down and step-up Chopper, Inverter: single phase full bridge inverter.	02
3	**Electrical and Electronic Measurements:** Electrical instruments, characteristics of measuring instruments, standards of measurement, voltmeter, ammeter and wattmeter, digital multi-meter, power analyzer. Comparison of analog and digital meters.	02
4	**Transducers:** Introduction, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Measurement of weight, speed, temperature, pressure and flow.	02
5	**Solar and Wind Energy Systems:** Solar cell fundamentals, V-I characteristics of a PV panel, principles of wind energy conversion, components of wind energy conversion system, classification of wind	02

	turbines- horizontal axis and vertical axis. Wind power integration into grid-power system , grid connected PV systems	
6	**Electric Vehicle:** What Is an Electric Vehicle? Engineering philosophy of EV development, Pure Electric Vehicle, Hybrid Electric Vehicle, Gridable Hybrid Electric Vehicle, Fuel-Cell Electric Vehicle, Overview of EV Technologies.	**02**

Expt. No.	Description	Hrs
1	Study of different starters of DC Motors.	2
2	Perform speed control of DC Shunt Motor by Armature Voltage and Field Current Control Method.	2
3	Perform polarity test on single-phase Transformer.	2
4	Perform speed control of an Induction Motor.	2
5	Measurement of active & reactive power for three phase supply.	2
6	Measurement of Electrical parameters by Power Analyzer.	2
7	Study of Single-Phase Full Wave Rectifier	2
8	Study the effect of wind speed on wind power generation.	2
9	Plot I-V and P-V characteristics of PV modules.	2
10	Study of Electric Vehicle and Battery Management System.	2

Class: T. Y. B. Tech.	Semester- V
Course Code : ECMD303	Course Name : Industrial Electronics

L	T	P	Credits
3	-	-	3

Course Description:
This course provides basics of power electronic devices with switching on/off techniques. It also deals with power converters such as AC to DC, DC to DC and DC to AC with their analysis and performance parameters. This course also gives introduction to PLC.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Identify basics Power Electronics devices and components.
2. Illustrate use of Power Electronics.
3. Develop PLC logic using ladder programming.
4. Analyze industrial electronics applications.

Prerequisite:
Knowledge of basic electronics and programming.

Course Content

Unit No	Description	Hrs
1.	**Power Electronic Components** Applications of power electronics, Power Electronic System, Power semiconductor devices: power diode, power BJT, Power MOSFET, IGBT, SCR, Diac, TRIAC, Ratings, control characteristics of power devices, Characteristics and specifications of switches, Types of power electronic circuits.	06
2.	**Power Converters** AC-DC Converters (Rectifiers), DC-DC converters (choppers), DC-AC converter (Inverters), AC-AC Converters (1-phase, 3-phase) Cycloconverters	06
3.	**DC and AC Drives** Basic characteristics of DC motor, operating modes, DC motor control using choppers and rectifiers, Torque-speed characteristics of induction motor, speed control techniques of AC motor: stator-voltage, rotor resistance, and v/f control, basic equations, characteristics.	06
4.	**Introduction to PLC** Introduction about industrial automation, History of industrial automation Need of automations in industries, Automation control circuit and power circuit, Control system in Industry, Types of PLCs	06
5.	**PLC Programming**	06

	Types of Programming Languages, Introduction about PLC Programming software, Ladder logic diagram, Structure of program, Procedure for creating ladder diagram, Logical function done by ladder program in software.	
6.	**Applications** Industrial conveyor systems, Automatic Bottle Filling System, Traffic Light Control system, UPS, Battery charging circuits and management Systems, Induction heating and dielectric heating.	**06**

References -

Text Books:

1. M. H. Rashid, Power Electronics Circuits Devices And Applications, PHI
2. C. D. Johnson, Introduction to process technologies, PHI

Reference Books:

1. M. D. Singh and K. B. Khanchandani, Power Electronics, TMH
2. P. C. Sen, Power Electronics, S. Chand publication

Class:- **T.Y. B. Tech.**	Semester-V
Course Code : **CIMD303**	Course Name: **OOP using Java**

L	T	P	Credits
1	--	2	2

Course Description:
Object Oriented Programming is pillar of software development. The strong knowledge of object-oriented programming helps to create the better software. The main aim of this course is to cover the object-oriented concepts with java programming language. This course lets students to write computer programs using Java Development Kit and using the principles of Object-Oriented paradigm. The course covers Object-Oriented concepts, Java classes, array, exception handling, string API in Java. Students will develop desktop applications by using object-oriented concepts with use of Java Standard Edition. This course is also useful for learning the advanced java courses such as JSP, Servlet, Struts, and spring frameworks.

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

1. Explain the concepts and terminologies in object-oriented concepts and java programming language.
2. Apply object-oriented programming features and concepts for solving given problem.
3. Develop the java application using the collection framework to solve real word problem.
4. Apply the concepts exception handling to develop error free codes.
5. Utilize the concepts of package to develop efficient codes.

Prerequisite: Basic knowledge of C Programming

Course Content

Unit No	Description	Hrs
1.	**Introduction to Java Programming** Java buzzwords, Features of Java, JDK, JRE and JVM, Variables and data types, I/O statements in Java, Conditional and looping statements, Arrays.	02
2.	**Introduction to Object-Oriented Programming** Features of object-oriented programming, Class and objects, Constructors, Method and constructor overloading, Nested classes.	02
3.	**Features of Object-Oriented Programming** Polymorphism: Method overloading (Compile time Polymorphism), Method overriding (Run time Polymorphism), Inheritance, super, this, static and final keywords, Abstraction, Interface, Garbage collection.	02

4.	**Collection and String** Collection, Collection Framework, List: ArrayList, LinkedList, Vector and Stack, Queue: Deque and Priority Queue, Set: TreeSet and HashSet, Map: Hash Table and Hash Map, Java String.	**02**
5.	**Exception Handling** Exceptions & Errors, Types of Exception, Control Flow in Exceptions, JVM reaction to Exceptions, Exception keyword. In-built and User Defined Exceptions, Checked and Un-Checked Exceptions.	**02**
6.	**Packages** Organizing Classes and Interfaces in Packages, Package as Access Protection Defining Package, CLASSPATH Setting for Packages, Naming Convention for Packages.	**02**

Course Content

Experiment No.	Description	Hrs.
1	Introduction to Java Programming	02
2	Classes, Object, and Method	04
3	Constructor	02
4	Inheritance	02
5	Method overloading and method overriding	02
6	Interface	02
7	Nested classes and abstract classes	02
8	Collection frameworks	04
9	Exception handling	02
10	Packages	02

References -
Text Books:

- M.T. Somashekara, D.S. Guru, K.S. Manjunatha, "Object Oriented Programming with Java", Kindle Edition, PHI Publication.
- Rajkumar Dr. Buyya, "Object Oriented Programming with Java: Essentials and Applications".
- Dr. Ms. Manisha Bharambe, Ms. Manisha Gadekar, "OBJECT ORIENTED PROGRAMMING USING JAVA 1", Kindle Edition, Nirali Publication.

Reference Books:

- Deitel and Deitel, "Java How to Program", Prentice Hall, Seventh Edition.
- Niemeyer & Leuck, "Learning Java", O'REILLY (SPD), Fourth Edition.

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Syllabus (Theory & Laboratory Course)

To be implemented from **2025-26**

Common to All Departments

Class:- **T.Y. B. Tech.**	Semester-V
Course Code: **MEMD303**	Course Name: **Refrigeration and Air Conditioning**

L	T	P	Credits
2	-	--	2

Course Description:

This course is designed to give basic information of Refrigeration and Air Conditioning (RAC) systems, properties of refrigerants, etc. The fundamentals required for learning this course such as Basic of Thermodynamics, Heat Transfer also included in this course. In addition to this, course deals with various types of refrigeration systems, psychrometry, applications of RAC systems.

Course Learning Outcomes:

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

1. Explain the basic laws of thermodynamics, working of various RAC systems, psychrometric process of air, applications of RAC systems.
2. Summarise the properties of refrigerants.
3. Calculate performance of refrigeration and air conditioning system.

Course Content

Unit No.	Description	Hrs
1	**Basic of Thermodynamics:** First Law of thermodynamics, Second law of Thermodynamics, Zeroth Law, Properties of pure substance, Ideal gas equation; **Heat Transfer:** Conduction: Fourier law of heat transfer, thermal conductivity, extended surfaces; Convection; Radiation; heat exchangers	04
2	**Refrigeration Cycles:** Introduction of refrigeration methods, Refrigeration cycles: Reversed Carnot cycle, Simple Vapour Compression Cycle (VCC), COP of VCC. (simple numerical)	04
3	**Refrigerants:** Classification, Desirable Properties of refrigerants, Designation, Comparison among commonly used refrigerants, Ozone depletion Potential (ODP), Global warming potential (GWP) and Total Equivalent Warming Impact (TEWI), Montreal & Kyoto protocol, Secondary Refrigerants, Alternative Refrigerants.	04
4	**Refrigeration Systems:** Split AC, Window AC, Cassette AC, Chillers, freezers, air craft air conditioning system, vehicle AC	04
5	**Psychrometry:** Definition and necessity of air conditioning, Dalton's law of partial pressure, Properties of moist air, Psychrometer, Psychrometric charts, Psychrometric processes. Bypass factor, Mixing of Air streams. Thermodynamic WBT	04
6	**Applications of Refrigeration and Air Conditioning Systems:**	04

	Preservation of different products - Ice factory - Dairy plant refrigeration systems - Air conditioning of hotels and restaurants - Air conditioning of theatres and auditorium - Air conditioning of hospitals	

References –

Text Books: -

- R. S. Khurmi, J. K. Gupta, S Refrigeration and Air Conditioning. Chand Publications,
- Domkundwar, Arora, Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai
- Manohar Prasad, Refrigeration and Air Conditioning, New Age international Publications

Reference Books: -

1. R.K.Rajput, Thermal Engineering, Laxmi Publications, Delhi.
2. Mahesh M. Rathore, Thermal Engineering, McGraw Hill,

Class: - T.Y. B. Tech.	Semester-V	L	T	P	Credits
Course Code: MCMD303	Course Name: Industrial Automation	2	-	--	2

Course Description:
To provide a clear view on Programmable Logic Controllers (PLC) & to learn the various methods involved in automatic control and monitoring & to familiarize with the communication protocol this course has been inducted.

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

4. Explore the architecture of PLC and its functions.
5. Execute the various instructions and logic in PLC.
6. Develop the PLC program for various applications.
7. Design and develop the SCADA, DCS system for various applications.

Prerequisite:
Knowledge of fundamentals of Mechatronics

Course Content

Unit No	Description	Hrs
1.	**PROGRAMMABLE LOGIC CONTROLLERS** Introduction - Parts of PLC - Principles of operation - PLC sizes - PLC hardware components - I/O section - Analog I/O modules - digital I/O modules CPU processor memory module - PLC programming Simple instructions - Output control devices - Latching relays PLC ladder diagram,	04
2.	**INSTRUCTIONS** Timer instructions ON Delay, OFF Delay and Retentive Timers-UP Counter, DOWN Counter and UP down Counters.	04
3.	**APPLICATION OF PLC** Traffic light control, 24-hour clock design, Automatic stacking process, temperature control, Automatic control of warehouse door,	04
4.	**NETWORKING OF PLC AND SCADA** Networking of PLCs-Data Communication-Fieldbus, PROFI bus, and Mod bus-OSI. Supervisory Control and Data Acquisition-Architecture.	04
5.	**DISTRIBUTED CONTROL SYSTEM** Architectures - Comparison - Local control unit, Operator interfaces - Low level and high-level operator interfaces - - Low level and high-level engineering interface	04

6.	**APPLICATIONS OF DCS** Pulp and paper environment -Power plant - Petroleum - Refining environment, Wireless control system in challenging environments like welding shops, Introduction to Soft PLC.	**04**

References -

- Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Lucas, M.P., Distributed Control System, Van Nonstrandreinhold Co. NY.
- Webb, John W. Programmable Logic Controllers: Principles and Application, Fifth edition, Prentice Hall of India, New Delhi.
- Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, ISA Publication. Bolton , "Programmable Logic Controllers" Newnes.

Class:- T. Y. B. Tech.	Semester- V
Course Code: AIMD303	Course Name: Business Intelligence

L	T	P	Credits
2	-	-	2

Course Description:
This course is very useful as it aims in applying statistical techniques for analyzing data to help managerial people make informed decisions. It covers data preprocessing, modeling and visualization tasks thoroughly to give insight into the life cycle of a BI task. It makes students explore various analysis techniques which are also studied in various advanced data management related courses.

Course Learning Outcomes:
1. Articulate data pre-processing techniques
2. Analyze the data modeling required for business intelligence related tasks
3. Determine the role of statistical techniques in data analysis tasks
4. Identify big data analysis techniques
5. Utilize different reporting/visualization tool

Prerequisites:
- Database Management Systems
- Basic Probability and Statistics

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction** What is business intelligence (BI)? Need for BI. Drawing insights from data: DIKW pyramid, levels of decision making (strategic, tactical and operational BI).Examples of business analyses–funnel analysis, distribution channel analysis and performance analysis.	**05**
2	**Data Preprocessing** Notion of data quality. Typical preprocessing operations: combining values into one, handling incomplete/ incorrect / missing values, recoding values, sub setting,sorting, transforming scale, determining percentiles, removing noise, removing in consistency es, transformations, standardizing, normalizing - min-max normalization, score standardization.	**04**
3	**Inferential Statistics** Role of probability in analytics, probability distributions and their characteristics. Need for sampling, generating samples, sampling and non-sampling error. Sampling Distribution of Mean, Central Limit Theorem, Standard Error. Estimation: Point and Interval Estimates, Confidence Intervals, level of confidence, sample size.	**04**

4	**Data Warchousing** What is a data warehouse, need for a data warehouse, architecture, data marts, OLTP vs OLAP, Multidimensional Modeling: Star and snow flake schema, Datacubes, OLAP operations, Data Cube Computation and Data Generalization, Data Lake	04
5	**Enterprise Reporting** Metrics, Measurement, Measures, KPIs, Dashboards, Reports, Scorecards	03
6	**Hypothesis Testing** Basic concepts, Errors in hypothesis testing, Power of test, Level of significance,p-value, general procedure for hypothesis testing. Parametric and non-parametric tests – z test, t test, chi-square test. Two tailed and one-tailed tests. Chi-square test for independence and goodness of fit. ANOVA	04

References -

Text Books:

- Business Analytics by James R Evans, Pearson
- Data Mining: Concepts and Techniques", Jiawei Hanand Micheline Kamber, Morgan Kaufman, ISBN 978- 81-312-0535-8, 2nd Edition for overview of data mining, OLAP andcube technology, data preprocessing
- Fundamentals of Business Analytics", by R. N. Prasad, Seema Acharya, ISBN: 978-81- 256-3203-2, Wiley-India – Types of Digital Data, OLTP-OLAP, Introduction to BI
- Business Analytics for managers, Wolfgang Jank–exploring and discovering Data ModelinG

Reference Books:

- Business Intelligence for Dummies
- Applied Business Statistics: Making Better Business Decisions(English) 7 th Edition byKen Black, Wiley India
- Forecasting: Principles and Practices, Rob JHyndman, George Athanasopoulos, Otext

Class: **T.Y. B. Tech.**	Semester: V
Course Code: **MA3431**	Course: **Heat Transfer Lab.**

L	T	P	Credits
-	-	2	1

Course Description:
This laboratory course is designed to prepare the student to understand and apply the skills and knowledge of Heat transfer and applied thermodynamics, to resolve the issues arises due to heat losses and thermal imbalance while designing as well as operating thermal systems. The practical's includes hands on to determine conduction, convection and radiation parameters, evaluation of performance of heat exchangers etc.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Apply laws of heat transfer in conduction, convection and radiation domain.
2. Compute effectiveness of heat exchangers.
3. Determine effectiveness of pin fin.
4. To find out Critical flux on metal wire.

Prerequisite: Applied Thermodynamics, Heat Transfer

Course Content

Expt. No.	Description	Hrs
1.	To determine thermal conductivity of metal rod.	02
2.	To determine thermal conductivity of insulating powder.	02
3.	To find efficiency of insulated tip fin and short fin.	02
4.	To find thermal resistance of composite wall.	02
5.	To measure emissivity of Opaque surface by using emissivity measuring apparatus.	02
6.	To find Steafan Boltzmann constant by Steafan Boltzmann apparatus.	02
7.	To find heat transfer coefficient under forced convection.	02
8.	To find heat transfer coefficient under natural condition.	02
9.	To compare effectiveness of parallel; flow and counter flow heat exchanger.	02
10.	To conduct trial on Heat Pipe.	02
11.	To find critical flux on wire by critical flux apparatus./	02

Note: Any 10 experiments from the list

References -

Text Books:

1. M. M. Rathore, Thermal Engineering, Mc Graw Hill.
2. J.P. Holman, Heat Transfer, John Wiley & Sons, New York.

Reference Books:

1. P.K. Nag, Engineering Thermodynamics, Tata Mc Graw Hill, New Delhi
2. Ballaney P.L., Thermal Engineering, Khanna Publishers, New Delhi.
3. Cengel, Thermodynamics: An Engineering Approach, 3/e, Tata McGraw-Hill,
4. Arpasi, V.S., Conduction Heat Transfer, Addison – Wesley.
5. W.M. Keys & A.L. Landon, Compact Heat Exchangers, Mc. Graw Hill.
6. Siegel, R. and J.R. Howell, Thermal Radiation Heat Transfer, Mc. Graw Hill.

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Syllabus (Theory & Laboratory Course)

To be implemented from **2025-26**

Common to All Departments

Class: **T. Y. B. Tech.**	Semester: V
Course Code: **MA345**	Course: **Solid Modelling Lab.**

L	T	P	Credits
--	--	2	1

Course Description:

Modelling software is essential for any industry in design as well as production phase. This course aims to create awareness in the students and give the desired practice of CAD modelling software like CATIA, Solid Edge, Unigraphics. More emphasis is given on part modelling, assembly modelling, and drafting.

Course Outcomes:

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

1. Develop base features for modeling of parts.
2. Develop 3D model of automotive components.
3. Assemble components using functional constraints.
4. Prepare production drawings in drafting workbench.

Prerequisite: Engineering Graphics, Workshop Practice I.

List of experiments (Any 10)

Course Content

Expt. No.	Description	Hrs.
1.	Introduction to CAD	02
2.	To create 2D closed profiles of different shapes using sketching tools.	02
3.	To create solid models using modelling features – I	02
4.	To create solid models using modelling features – II	02
5.	To create solid models using modelling features – III	02
6.	To create solid models using modelling features – IV	02
7.	To create solid models using modelling features – V	02
8.	To Create assembly using different components – I	02
9.	To Create assembly using different components – II	02
10.	To create 2D drafting using drafting tools	02
11.	CAD modeling for 3D printing	02

Note: Any 10 experiments from the list

References Books:

1. Prof. Sham Tickoo, Creo Direct 2.0 and Beyond for Designers, CADCIM Technologies.
2. Tutorials: www.solidworks.com
3. R. S. Ratan, Theory of Machines, Tata Mcgraw Hill.

Class: **T. Y. B. Tech.**	Semester: **V**
Course Code: **MA347**	Course: **Automotive Systems Lab.**

L	T	P	Credits
--	--	2	1

Course Description:
This laboratory complements the classroom learning of Automotive Systems course through demonstrations and testing of various automotive transmission and chassis systems. The students get an opportunity to understand the constructional details and operation of various automotive systems like transmission, suspension, braking and others in the laboratory set up. They use various real-life systems, models, cut-section, to realize the overall operation and functioning. Considering the need for advanced courses like vehicle dynamics, automotive design and electric vehicles, the laboratory course remains relevant and important.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Identify various elements of automotive transmission and chassis systems.
2. Present the systems in the form of labelled diagrams/sketches/schematics.
3. Describe the operation of these systems along with roles of sub-system/s and elements.

Prerequisite: A course on Theory of machines is complementary for effective laboratory experience

Course Content

Expt. No.	Description	Hrs.
1	Demonstration of automotive powertrain	02
2	Demonstration of automotive clutches	02
3	Demonstration of manual gearbox	02
4	Demonstration of automatic/semi-automatic transmission (AT/CVT)	02
5	Demonstration of Propeller shaft assembly	02
6	Demonstration of final drive and differential unit	02
7	Demonstration of axles	02
8	Demonstration of steering system	02
9	Demonstration of suspension system	02
10	Demonstration of hydraulic braking system	02
11	Demonstration of pneumatic braking system	02
12	Demonstration of Ackermann steering geometry	02

Any TEN from above list to be conducted.

References -

Text Books:

1. Newton, Steed & Garret, Motor Vehicles, Butterworth Heinemann
2. Henz Heisler, Advanced Vehicle Technology, SAE International

Reference Books:

1. Henz Heisler, Vehicle and Engine Technology, SAE International
2. J. Reimpell, H. Stoll, J. W. Betzler, The Automotive Chassis, Butterworth Heinemann
3. Giles J. G., Steering, Suspension & Tyres, Illiffe Book Ltd. London
4. William Crouse, Donald Anglin, Automotive Mechanics, McGraw-Hill
5. N. K. Giri, Automotive Mechanics, Khanna Publishers

Class: T.Y. B.Tech.	Semester - V	L	T	P	Credits
Course Code: MA3511	Course Name: Massive Open Online Courses (MOOC)	-	-	-	1

Course Description:
Online courses offered through platforms like NPTEL, SWAYAM, and NASSCOM provide opportunities to deepen students' understanding of advanced robotics and automation concepts and emerging technologies in Robotics and Automation. These courses focus on critical domains such as robot programming, robotic process automation, artificial intelligence and machine learning etc. They blend theoretical foundations with practical applications, enabling students to strengthen problem-solving skills, engage with modern tools, and prepare for industry-oriented challenges, enabling life-long learning. The objective of this course is to emphasize the development of skills and attitudes that enable continuous learning & adaption 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 robotics and automation
2. Analyze the problems in the domain of robotics and automation using mathematical and engineering fundamentals.
3. Design solutions for robotics and automation systems using modern engineering tools and platforms.
4. Write a robot program to design an automation system for industrial and real life applications.
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,
   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.

References-

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

Class: **T. Y. B. Tech.**	Semester: V
Course Code: **MA349**	Course: **Summer Internship**

L	T	P	Credits
-	-	-	2

Course Description:
This course gives opportunity to work in garages and get acquainted with simple diagnosis techniques. Apart from technical knowledge, he/she can explore interpersonal skills as well as ability to learn independently and handle tools & equipments. This course brings awareness about systematic and logical report writing and presentation of the technical efforts.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Acquaint with garage environment and processes to be carried out.
2. Handle various tools and equipments used in garages.
3. Diagnose minor faults of vehicle.
4. Summarize the uses of advanced tools and equipments.
5. Communicate and present his ideas/work in front of peers and superiors.

Course Content:
1. Every student has to undergo four weeks training in garages (internship) after the end of third semester.
2. A mentor from the faculties will be allotted to every student. Mentor will visit to the garage for progress tracking during the training.
3. Students must fill Daily Work Report every day & needs to submit all the reports to respective faculty allotted.
4. Students have to prepare a report on Garage Training using given format.
5. After submission of certificate student has to give presentation in front of students and faculty.
6. Assessment will be made on learning outcomes, presentation, knowledge addition, and confidence.
7. Faculty will conduct students' presentations in tutorial hours.
8. Every student has to submit the certificate of completion in the first week of starting of fourth semester; after that, no submission will be done and it will be assumed that the student has not undergone garage training and no credit will be awarded.
9. Students must follow rules & regulations of their respective workshop & maintain utmost discipline during the training
10. Students should wear apron & safety shoes during the training period.
11. Students are expected to extend their learnings by referring to online resources, books, magazines, etc.

Guidelines for selecting the garage/workshop: Students can do internship in any of the following garages/workshops:
1. Authorised service centers of two-wheelers / three-wheelers / four-wheelers / Any other types of vehicles
2. Private garages/service centers in which a minimum of 10 employees are working
3. Multi-brand service centers, Government vehicle workshops like MSRTC workshops.

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Syllabus (Theory & Laboratory Course)
To be implemented from 2025-26

Common to All Departments

Class: **T.Y. B. Tech.**	Semester – VI
Course Code: **MA3281**	Course Name: **Automotive Power Plant**

L	T	P	Credits
3	-	--	3

Course Description: This course provides understanding of fundamental requirements of power plants for propulsion of automotive. The course will make automotive engineers to select appropriate and optimum power plants for their vehicles. This course describes the construction and operation of power plants with variety of fuels. The thermodynamic behavior and its analysis and performance testing methodologies of the power plants are taught during the course.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Know the fundamentals of automotive power plants for selection for appropriate application.
2. Perform a primary thermodynamic analysis of automobile power plant.
3. Choose appropriate systems for automobile power plant.
4. Conduct performance testing of the automotive power plant to portray operating characteristics.
5. Identify abnormal behavior of power plant and remedy over it.
6. Select appropriate lubricant and lubrication system for engine.

Prerequisite: Engineering Mechanics, Thermodynamics, Theory of Machines, Heat Transfer

Course Content

Unit No	Description	Hrs
7.	**Power Plants for Automotive Propulsion** Power plants for Conventional, Flexi fuel, Hydrogen, Electric, Hybrid, and Fuel Cell Vehicles, Operation and Selection of these power plants, Comparison, Power plant nomenclature & terminology, SI and CI engines, two-stroke and four-stroke engines, Valve and Port timing diagram, Engine Cycles, fuel-air cycle, Actual cycle	06
8.	**Power Plant Performance** Performance parameters like torque, power, speed, BSFC, all efficiencies, and Heat balance and its measurement, IS codes of power plant testing, Heat rejection and cooling, air and liquid cooling, Numerical on Performance.	06
9.	**Fuel Supply System for Power Plants** Fuel systems for fuel cell, Bio fuel engines, Multi / flexi fuel engines, Hydrogen fuel supply, Carburetion, Injection, Electronic control of fuel	06

	systems, ECU-Operation and programming, Numerical on carburetor and gasoline injection system.	
10	**Fuel supply system for C I Engine** Requirements & types of Fuel injection pumps, injectors, Governor, Common rail and Electronic-injection system, Engine ECU- Operation and programming, Numerical on Fuel injection pumps, injectors, and CRDI. CNG fuel systems.	**06**
11	**Thermal Behavior and Management** Combustion of gaseous and liquid fuels, SI & CI Combustion stages, Abnormal combustion in SI and CI engines, Control of abnormal combustion, Combustion chambers for SI & CI engines.	**06**
12	**Induction and Exhaust System** Air intake system, filters & manifolds, Mufflers and resonators, Supercharging, Turbo-charging, Scavenging of two-stroke and four-stroke engines, Engine Friction and Lubrication, Lubricating systems, Pumping and blow-by losses.	**06**

References -

Text Books:

- John B Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Publishing Company
- V. Ganeshan, Internal Combustion Engine Fundamentals, McGraw Hill Publishing Company

Reference Books:

1. Heinz Heisler, Advanced Engine Technology and Advanced Vehicle Technology
2. Mehrdad Ehsani, Yimin Gao, E. Gay, Ali Emadi, Modern Electric, Hybrid electric and Fuel Cell Vehicle, CRC Press.
3. Automotive Handbook, Published by SAE
4. E. F. Obert, I.C. Engine & Air Pollution, Harper & Row Publishers, New York

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Syllabus (Theory & Laboratory Course)

To be implemented from **2025-26**

Common to All Departments

Class: **T. Y. B. Tech.**	Semester: **VI**
Course Code: **MA332**	Course: **Research Methodology**

L	T	P	Credits
2	-	-	2

Course Description:

Research Methodology is important for any student who wishes to make meaningful contribution through engineering research. The objective of this course is to provide an opportunity for the students to learn systematic research process and its components. The course also exposes the students to presenting skills which are essential for professional life.

Course Outcomes:

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

1. Formulate a research problem.
2. Analyze research related information
3. Prepare and present research proposal/paper by following research ethics
4. Make effective use of computers and computing tools to search, analyze information and prepare report.

Prerequisite: Engineering Mechanics, Engineering Materials, and Mechanics of Materials.

Course Content

Unit No.	Description	Hrs.
1	**Meaning of Research Problem:** Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.	04
2	**Effective Literature Studies Approaches:** Plagiarism, Research ethics, Approaches of investigation of solutions for research problem, data collection, Data analysis with software, interpretation, Necessary instrumentations.	04
3	**Research Design:** Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.	04
3	**Effective Technical Writing:** How to write technical report and paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	04
4	**Measurement:** Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.	04
5	**Data Analysis:**	04

	Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.	
6	**Interpretation of Data and Paper Writing:** Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.	**04**

References -

Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science-engineering students", Juta & Co Ltd.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", Juta Academic.
3. Ranjit Kumar, , "Research Methodology: A Step by Step Guide for beginners", 2 nd Edition SAGE Publication

Class:- **T. Y. B. Tech.**	Semester: **VI**	**L**	**T**	**P**	**Credits**
Course Code:**MA334**	Course: **Mechanics of Composite Materials**	**3**	**--**	**--**	**3**

Course Description:
Due to wide existing and potential applications, composite technology has been developed very intensively over recent decades. Composite materials whose mechanical properties are controlled by high-strength and high-stiffness continuous fibers embedded in polymeric, metal, or ceramic matrix. Composite materials are ideal for structural applications where high strength to weight and stiffness to weight ratio are required. This course covers study of manufacturing processes, anisotropic elasticity and micro and macro analysis of composite materials.

Course Outcomes:
After completion of this course student will be able to
1. Identify the properties of fiber and matrix materials used in composites.
2. Select an appropriate manufacturing process for composite parts.
3. Analyse fiber composites based on the constituent properties.
4. Design engineering structures with fiber reinforced -composites.
5. Analyse the failure of composite laminate.

Prerequisite: Material Science and Metallurgy, Mechanics of Materials.

Content

Unit No	Description	Hrs
1.	**Introduction to Composites:** Classification composite materials, general characteristics of composite materials, laminae and laminate, applications of composites, material selection process.	06
2.	**Constituents of Composite Materials:** Reinforcement and fillers: glass fibers, carbon fibers, organic fibers, boron fibers, natural fibers, ceramic fibers Matrix: thermoset matrix and thermoplastic matrix, metal matrix materials, ceramic matrix materials.	06
3.	**Manufacturing of Composites:** Bag-molding, compression molding, filament winding, liquid composite molding, metal matrix composite manufacturing, ceramic matrix composite manufacturing, selection of manufacturing method.	06
4.	**Elastic Behavior of Unidirectional Lamina:** **Stress** strain relationship, Anisotropic and Orthotropic materials, Fiber matrix interaction, Failure theories for composite materials. Mechanics of material approach, Elasticity approach. Static mechanical properties, comparison of approaches.	06

5.	**Elastic Behavior of Laminate:** Classical laminate theory, single layered, configuration, symmetric and antisymmetric laminates, strength of laminates, strength of cross ply and angle ply laminates. Bending of laminated plates. Vibrations of laminated plates.	06
6.	**Failure Analysis of Laminates:** Types of failures, Stress analysis and safety factors for first ply failure of symmetric laminates, Micromechanics of progressive failure; Progressive and ultimate laminate failure, Design methodology for structural composite materials.	06

References –

1. K. K. Chawla, Composite Materials: Science and Engineering, Springer, Third Edition.
2. Robert M. Jones, Mechanics of composite materials, Taylor and Francis, second edition 1999.
3. Bryan Harris, Engineering Composite Materials, the Institute of Materials, Landon.
4. Hussain, Farzana, et al., Review article: polymer-matrix nanocomposites, processing, manufacturing, and application: an overview. Journal of composite materials 40.17, 2006:1511-1575.
5. M. Ashby, Material Selection in Mechanical Design, Elsevier, Fourth Edition, 2010.
6. P.K. Mallick, Fiber-Reinforced Composites: Materials, Manufacturing, and Design, CRC Press, Third Edition, 2007.

Class:- **T. Y. B. Tech.**	Semester: VI
Course Code:**MA336**	Course: **Sensors and Actuators**

L	T	P	Credits
3	--	--	3

Course Description:
The course introduces the sensors and actuators used in the automotive applications. The course contents cover various sensors along with their applications and selection criteria. The different actuators used in automotive applications are also covered in the syllabus to help the students to discuss the construction and working of the actuators and enable them to select the actuators for the automotive applications.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Illustrate the construction and working of various automotive sensors and actuators.
2. Select suitable sensor for automotive applications.
3. Select suitable actuator for automotive applications.
4. Describe the diagnostics tools and equipments used for testing of electronic components, sensors and actuators.

Prerequisite: Electrical Drives and Controls

Course Content

Unit No	Description	Hrs
1.	**Introduction** Introduction to automotive sensors and instrumentation, market perspective for sensors and instrumentation techniques, sensor electronics and techniques, overview of sensor measurements, sensor linearization and characterization, sensor classification, signals and systems, sensor product selection guide	06
2.	**Sensors for engines** Sensors and interfacing – pressure, position, flow, temperature, humidity, speed, acceleration, oxygen, torque, light, distance and level.	06
3.	**Sensors for chassis** Sensors and interfacing techniques for engine control, adaptive cruise control, braking control, traction control, steering and stability	06
4.	**Intelligent sensors** Sensors for intelligent transport system, lighting, wipers, climate control and electronic displays, sensors for occupant safety, The digital vehicle, intelligent vehicle systems	06

5.	**Actuators and Controllers** Principles of actuation and control, DC motors, stepper motors, relays and solenoids, hydraulic and pneumatic, components for electronic engine management system, open and closed loop control strategies, PID control, look-up tables, introduction to modern control strategies like fuzzy logic and adaptive control, parameters to be controlled in SI and CI engines.	06
6.	**Testing of electronic components, sensors and actuators** Testing sensors, Testing actuators, Basic equipment, Basic hand tools, Accuracy of test equipment, Multimeters, Logic probe, Oscilloscopes, Waveforms, Scanners/Fault code readers and analysers, On-board diagnostics introduction, Serial port communications, OBD2 signal protocols, AutoTap OBD scanner, Bosch KTS diagnostic equipment, Engine analyzers, Automotive pressure oscilloscope transducer, Breakout boxes, Diagnostic procedures, The 'theory' of diagnostics	06

References -

Text Books:

1. Tom Denton, Automobile Electrical & Electronic Systems, SAE International.
2. P. L. Kohli, Automotive Electrical Equipments, Tata McGraw Hill Pub. Co. Ltd.
3. Wiliam B. Ribbens, Understanding Automotive Electronics, SAE International
4. Heinz Heisler, Advanced Engine Technology, SAE International

Reference Books:

1. E. Q. Doebelin, Measurement Systems, Application and Design, 4th Edition, McGraw-Hill, 2002
2. Wiliam B. Ribbens, Understanding Automotive Electronics, 5th Edition, SAE International Newnes, 2006.
3. Ronald K. Jurgen, Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, 2007
4. Tomwather J. R., Cland Hunter, Automotive Computer & Control System, Prentice Inc. NJ
5. Robert N. Brandy, Automotive Computers & Digital Instrumentation, Prentice Hall Eaglewood, Cliffs, NJ

Class:- T. Y. B. Tech.	Semester: VI
Course Code:MA3381	Course: Vehicle Body Repair

L	T	P	Credits
3	--	--	3

Course Description:
The Vehicle Body Repair course is designed to provide students with comprehensive knowledge in the repair and restoration of automotive body components. The course covers a range of topics, from understanding the construction of vehicles to various repair techniques and emerging technologies in the automotive industry.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Explain the fundamentals of vehicle body repair
2. Examine the anatomy of vehicles and different types of construction.
3. Analyze different types of vehicle damage.
4. Suggest repair techniques.

Prerequisite: Vehicle Body Structure

Course Content

Unit No	Description	Hrs
1.	**Introduction to Vehicle Body Repair** Car body construction details, overview of vehicle body repair, importance of vehicle body repair in automotive industry, safety precautions and regulation's introduction to tools and equipment used in body repair	06
2.	**Vehicle Construction and Materials** Vehicle anatomy: body and frame, types of vehicle construction (unibody, body-on-frame), different materials used in vehicle construction (steel, aluminium, composite materials), impact of materials on repair techniques.	06
3.	**Damage Assessment and Analysis** Types of vehicle damage (collision, rust, corrosion), assessment techniques and diagnostic tools, structural and non-structural damage identification, estimating repair costs and time	06
4.	**Repair Techniques and Processes** Metal straightening and repair, plastic and composite repairs, welding and joining techniques, paint preparation and application, dent removal methods.	06
5.	**Painting and Refinishing** Surface preparation (sanding, cleaning), paint mixing and matching, application of primers, basecoats, and clearcoats, colour sanding and buffing, environmental considerations in painting.	06

6.	**Advanced Repair Technologies** Introduction to advanced repair technologies (ADAS, composite materials) use of computer-aided design (CAD) in repair, emerging trends in vehicle body repair, case studies and real-world applications	06

References -

Text Books:

1. John Haynes, Automotive Body Repair and Painting Manual, Haynes Manuals N. America, Inc.
2. James E. Duffy, Auto Body Repair Technology, Delmar Cengage Learning

Reference Books:

1. Michael Crandell, Automotive Body Repair and Refinishing, Delmar Cengage Learning
2. John Pfanstiehl, Automotive Paint Handbook: Paint Technology for Auto Enthusiasts and Body Shop Professionals, HP Books

Class: **T. Y. B. Tech.**	Semester: **VI**
Course Code: **MA340**	Course: **Automotive Dealership Management**

L	T	P	Credits
3	-	-	3

Course Description:
Automotive Dealership Management should have an overall view of the detail aspects of various systems of automobile and their maintenance. This course provides a broad knowledge about the management after sales and service. Interested students may avail an opportunity to make career in the field of vehicle maintenance management.

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

1. Prepare automotive dealership & showroom layout and its requirements.
2. Know the Scope, functions and objectives of Logistics to solve Managerial issues
3. Design maintenance documents and maintain automotive maintenance records.
4. Apply the concept of management in servicing and parts ordering.
5. Identify and understand various strategies and innovations in selling skills.

Prerequisite: Nil

Course Content

Unit No	Description	Hrs
1.	**Showroom Management** Understanding Dealership Infrastructure requirements, contemporary showroom management. Institutionalizing, structuring and monitoring the sales process, managing the showroom floor and the sales team	06
2.	**Logistic Management** Definition and Scope of Logistics – Functions & Objectives – Customer Value Chain – Service Phases and attributes – Value added logistics services – Integrating logistics into supply chain - Role of logistics in Competitive strategy – Customer Service, E- Logistics	06
3.	**Maintenance Management** Preventive (scheduled) and breakdown (Unscheduled) maintenance, requirements of maintenance, preparation of check Lists, Inspection schedule, maintenance of records, log sheets	06
4.	**Service Management** Service management, process and fundamentals, repair order analysis, productivity and efficiency, scheduling, loading, warranties and service retention	06

5.	**Spare Part Management** Spare parts and inventory management processes and principles – EOQ, PR models, Basic spare part and inventory analysis – ABC, VED, FSN, SDE, HML, RRS	06
6.	**Customer Care & Digital Marketing Management** Customer relationship, customer delight strategies Customer Satisfaction tracking tools & various techniques. Strategies in Digital Marketing - Aligning Internet with Business Objectives	06

References:

Text Books:

1. Sivakumar, Retail Management, Excel Books, New Delhi.
2. Kapil Sharma, Marketing Management, Global India Publication Pvt. Ltd., New Delhi.
3. KVS Madaan, Fundamentals of Retailing, Tata McGraw Hill, New Delhi Other

Reference Books:

1. Gibson G. Vedamani, Retail Management, Jaico Publishing House, New Delhi
2. Bowersox Donald J, Logistics Management – The Integrated Supply Chain Process, Tata McGraw Hill.
3. Dave Chaffey, Fiona Ellis-Chadwick, Digital marketing.

Class: **T.Y. B.Tech.**	Semester-VI
Course Code: **OE3024**	Course Name: **Reliability Engineering**

L	T	P	Credits
3	-	-	3

Course Description:
The concepts of Reliability Engineering are applicable to almost every engineering system to ensure that reliable products are designed and manufactured. Therefore, this course is introduced as an Open Elective for Third Year students. This course aims at making the students capable of analyzing the reliability of engineering systems and ensure that they study the techniques to determine and improve the reliability of different engineering systems. The course introduces fundamental concepts of reliability engineering, techniques to calculate the reliability of different types of systems, methods to improve the reliability, system reliability modelling, reliability analysis methods, reliability testing and software reliability.

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

1. Explain the fundamental concepts and applications of Reliability Engineering.
2. Determine the reliability of simple and complex systems
3. Apply different reliability allocation techniques for reliability analysis
4. Apply the principles and techniques for reliability design and improvement
5. Apply different techniques for reliability analysis of engineering systems
6. Explain the methods of testing for hardware and software reliability

Prerequisite: Engineering Mathematics

Course Content

Unit No.	Description	Hrs
1	**Introduction to Reliability Engineering** Reliability Engineering and Applications, failures and failure modes, reliability function, MTTF, MTBF, MTTR, repairable and non-repairable items, reliability economics, safety and reliability, quality and reliability, cost and system effectiveness, life characteristic phases, IoT in reliability analysis	6
2	**System Reliability Modeling** Discrete probability distribution, Continuous Probability Distributions, Reliability Block Diagram, Hazard rate and failure density, constant hazard rate model, increasing hazard rate models, decreasing hazard rate model, Series system, Parallel system, Series-Parallel system, Complex system, k-out-of-m systems	6
3	**Reliability Allocation** Definition, reliability allocation techniques, equal apportionment, AGREE method, ARINC method, feasibility of objectives apportionment technique, minimum effort method	6

4	**Design for Reliability** Reliability design process, reliability considerations in design, stress-strength interaction, factor of safety, margin of safety, loading roughness, redundancy, reliability improvement techniques, types of redundancy, Markov models, single unit, two unit and three-unit Markov models	6
5	**Techniques for Reliability Analysis** Failure modes, effects and criticality analysis (FMECA), fault tree analysis, minimal cut set method, minimal tie set method, Ishikawa diagram, case study,	5
6	**Reliability Testing** Introduction to reliability testing, Accelerated Life Testing and Highly Accelerated Life Testing (HALT), Highly Accelerated stress Screening (HASS), software reliability: fundamental concepts, comparison and prevention, software testing	6

References –

Text Books:

- L. S. Srinath, Reliability Engineering, East-West Press, 4th Edition.
- Elsayed A. Elsayed, Reliability Engineering, Addison Wesley, 1996.
- Kailash C. Kapur, Reliability Engineering, 2012

Reference Books:

- Ebeling C.E., Introduction to Reliability and Maintainability Engineering", Overseas Press. Pvt Ltd.
- B.S.Dhillon, Maintainability, Maintenance and Reliability for Engineers, CRC Press.
- L.S.Srinath, Reliability Engineering, EWP, 3rd Edition 1998
- Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Springer, 2007
- Roger D Leitch, Reliability Analysis for Engineers: An Introduction, Oxford University Press, 1995
- S S. Rao, Reliability Based Design, Mc Graw Hill Inc. 1992
- E.E.Lewis, Introduction to Reliability Engineering, John Wiley and Sons.
- Basu S.K, Bhaduri, Terotechnology and Reliability Engineering, Asian Books Publication.
- Dr. A. K. Gupta, Reliability, Maintenance and Safety Engineering.
- John D. Musa, Software Reliability Engineering, Tata McGraw Hill.

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Syllabus (Theory & Laboratory Course)

To be implemented from **2025-26**

Common to All Departments

Class:-**T. Y. B. Tech.**	Semester-VI
Course Code : **OE3084**	Course Name: **Materials Management**

L	T	P	Credits
3	-	-	3

Course Description:

Any engineering project can be completed by consuming resources. Project materials constitute major portion of project cost averagely to the tune of 65% over and above this at the rate of 10-15 % goes in management of these materials. Engineering refers to providing optimized solutions. Research shows that, 1% saved through materials management is equal to 6-10 % increase in sells volume. This course floated as open elective at VI semester of B. Tech would be applicable to all branches, as materials and their management is required by all disciplines. This course will help to find, procure, store, manage and utilize materials in an optimized manner. Students will also be familiar with international purchase, negation and decision making related to materials.

Course Learning Outcomes:

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

1. Apply management principles to material management,
2. Develop and apply codification and standardization process,
3. Derive material procurement plan and evaluate vendors,
4. Develop stores layout for optimum stores management,
5. Apply inventory control techniques for material management.
6. Apply M.R.P. logic and systems to material management

Prerequisite: Basic knowledge of the materials as a resource, basic mathematical operators

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to Material Management** Importance of materials management, Materials function, Need of Integrated Concept, Scope of material management, Organizations for materials management, span of Control.	06
2	**Codification and Standardization** Standardization and simplification, Aim, Pro's and Con's and scope of Standardization, Classification and levels of standards. Codification, Nature, process, methods and advantages of codification.	06
3	**Purchasing and vendor development** Functions, steps, purchasing cycle. Types of buying, Details of International buying, Procedure, Relevance of Good Supplier Need for Vendor Evaluation-Goals of Vendor Rating-Advantages of Vendor Rating, Negotiation.	06

4	**Warehousing and stores management** Layout of stores and warehouse, material handling in stores, physical control of stocks: obsolete, surplus and scrap management, accounting and record keeping of stores	**06**
5	**Inventory Management and Control** ABC analysis- advantages, mechanism, purpose, objectives Importance & Scope of Inventory Control, Types of Inventory, Costs Associated with Inventory, Inventory Control, Selective Inventory Control, Economic Order Quantity, Safety Stocks	**06**
6	**Materials Requirement Planning (MRP)** Introduction, objectives, Terminology, Functions served by MRP, MRP Logic, systems and output, Management information form, Lot size consideration, Introduction to Manufacturing resource planning (MRP II)	**06**

References -

Text Books:

- Gopalkrishna & Sudarsan, 1. Materials Management, An Integrated approach, 3, PHI,
- Waters, Inventory Control and Management , Wiley

Reference Books:

- C. M. Sadiwala, Ritesh C. Sadiwala, 1. Materials and Financial Management, 2, New Age International Publishers
- J. R. Tony Arnold, Stephen N. Chapman and Lloyd M. Clive, Introduction to Materials Management, 6, Pearson Publication
- Materials Management-Procedures, Texts & Cases, A.K. Dutta, Pearson
- Bailey/Farmer/Crocker/Jessop– Pearson, Procurement Principles & Mgt.
- Inventory Management – Principles and Practices –Narayan/Subramanian– Excel
- Martand Telsang, Industrial engineering and production management- -S. Chand publication

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Syllabus (Theory & Laboratory Course)

To be implemented from **2025-26**

Common to All Departments

Class: - **T.Y. B. Tech.**	Semester- **VI**
Course Code: **OE3182**	Course Name: **Industrial Drives**

L	T	P	Credits
3	–	–	3

Course Description:

This course deals with the basics of electrical machines and power electronic drives. This course provides the knowledge about AC Drives, DC Drives and special purpose drives used in various industries. The operating principles as well as control of each drive systems is also covered in the syllabus.

Course Learning Outcomes:

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

1. Analyze stability, moment of inertia, speed and torque in industrial drive system
2. Elaborate energy conservation in industrial drive system
3. Identify various sensors required for industrial drives
4. Compare various control strategies for AC and DC drives
5. Select special motors for industrial applications

Prerequisite: Basic Electrical Engineering.

Course Content

Unit No	Description	Hrs
1	**Introduction to industrial drives:** Basic electric drives and its components, Types of loads, coupling systems, factors for choice of drives, Fundamental torque equation, speed torque conventions, equivalent values of drive parameters, thermal modelling of motor, classes of motor duty.	06
2	**Energy conservation in industrial drives:** Concept of energy conservation, losses in drive system, Measures for Energy Conservation in industrial drives, use of efficient converters, use of efficient motors, improvement of quality of supply, improvement of p.f. maintenance of drive system, safety and maintenance aspects in industrial drives	06
3	**Sensors for Industrial drives:** Introduction to sensors, Force measuring sensor, Load cells, Torque measurement, speed measurement, tachometers and angular speed detectors, piezoelectric transducer, hall Effect transducers, case study of sensors.	06

4	**Control of AC and DC Drives:** Introduction to converters for electrical drives, Modes of operation, closed loop torque and speed control, closed loop control of multi-motor, converter & chopper fed DC motor drives, rotor resistance & V/f control of AC drives, Types of braking	06
5	**Stepper-Motor and Switched-Reluctance Drives:** Introduction to stepper motors, construction and working principle, control of stepper motor, Introduction to switched reluctance motor drives, torque characteristics, Voltage impulse control, Current control, Torque control converter topologies, SRM drive design factors, Industrial applications.	06
6	**BLDC and Servo Motor Drives:** Principle of operation of BLDC Machine, Sensing and logic switching scheme, Speed control of BLDC drive, Low Cost Brushless DC Motor Drives, Introduction to servo mechanism, types of servo motors, servo motor drive, Brushless DC Motor Drive for Servo Applications, Industrial applications.	06

References -

Text Books:

- Gopal K Dubey, Fundamentals of Electrical Drives, Narosa publication.
- Vedam Subrahnyam, Electrical Drives Concepts and applications, Tata McGraw Hill publication.

Reference Books:

- Sawhney. A.K, —A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai & Company Private Limited.
- B.K. Bose, Modem power Electronics and A.C. Drives, Pearson Education.

Class: -T.Y. B. Tech	Semester-VI
Course Code: **OE3284**	Course Name: Supply Chain Management

L	T	P	Credits
3	--	--	3

Course Description:
In a typical supply chain, raw materials are procured and items are produced at one or more factories, shipped to warehouses for intermediate storage, and then shipped to retailers or customers. Consequently, to reduce cost and improve service levels, effective supply chain strategies must take into account the interactions at the various levels in the supply chain. In this course, students will be able to present and explain concepts, insights, practical tools, and decision support systems important for the effective management of the supply chain. This course will help the students to develop an understanding of the following key areas and their interrelationships:

- The strategic role of a supply chain
- The key strategic drivers of supply chain performance
- Supply chain network design and analytical methodologies for supply chain analysis

This course will help the students to learn the strategic importance of good supply chain design, planning, and operation for every firm. The students will be able to understand how good supply chain management can be a competitive advantage, whereas weaknesses in the supply chain can hurt the performance of a firm.

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

1. Identify the role and key issues in supply chain management.
2. Select appropriate SC strategies under given situations.
3. Design the inventory system and level at various locations in supply chain.
4. Specify the distribution and transportation requirements.
5. Develop appropriate strategic alliances for enhancing the performance of SC
6. Describe different strategies used to mitigate risk in global supply chain.

Prerequisite: Nil.

Course Content		
Unit No	**Description**	**Hrs**
1	**Understanding of Supply Chain:** Objectives of a supply chains, decision phases, stages of supply chain, supply chain process view, cycle view of supply chain process, push/pull view of supply chain processes, key issues in SCM	06
2	**Supply chain drivers and obstacles:** Four drivers of supply chain- inventory, transportation, facilities and information; A framework for structuring drivers in supply chain, supply chain strategies, strategic fit, Obstacles to achieve strategic fit, value of information, Bullwhip effect and reduction	06

3	**Role of Inventory Management in supply chain:** Role of forecasting, characteristics of forecast, Components of forecast, Basic approach to demand forecasting, Role of cycle inventory, Economics of scale to exploit fixed costs and discounts, cycle time related costs, Safety inventory, single stage inventory model, risk pooling, centralized and decentralized systems of planning inventory in supply chain	06
4	**Network Planning and supply chain Integration:** Network design, warehouse location, service level requirements, integrating inventory positioning and network design, supply chain integration. Push-pull and pull-push type systems, demand driven strategies, Impact of internet on supply chain strategies, Transportation in a supply chain, facilities affecting transportation decision, modes of transportation and their performance characteristics.	06
5	**Distribution strategies and strategic alliances:** Introduction, Centralized vs. decentralized control, direct shipment, cross docking, push based vs. pull based supply chain, third party logistics (3PL), Retailer-Supplier relationship issues, requirements, success and failures, distributor integration types and issues, role of pricing and revenue management in supply chain. Role of sourcing in supply chain, supplier scoring and assessment.	06
6	**Global logistics and Risk management:** Agile supply chains, Introduction to global SCM, risk management, issues in international SCM, regional differences in logistics, design for logistics, supplier integration in to new product development, pricing issues and smart pricing. IT and Business processes in supply chain.	06

References -

Text Books:

- Supply Chain Management: Strategy, Planning, and Operation, Sunil Chopra and Peter Meindel, Prentice Hall.

Reference Books:

- Logistics and Supply Chain Management,Christopher Martin, Pearson Education Asia.
- Marketing logistics: A supply chain Approach, Kapoor KK; KansalPurva, Pearson Education Asia.
- Designing And Managing Supply Chain Concepts, Strategies And Case Studies, David Simchi-Levi, Ravi Shankar; McGraw Hill Publication.

Class:-**T.Y. B. Tech.**	Semester-**VI**
Course Code : **OE3324**	Course Name: **Entrepreneurship Development**

L	T	P	Credits
3	--	--	3

Course Description:
Nowadays all engineers run behind campus interviews and secure job. Very few of them think seriously about their career as entrepreneurs. Instead of becoming job seekers, they should become job creators. Nation also expects same thing from young technocrats. Therefore, startup India & Make in India mission are in progress. Technopreneurers should take advantage of these missions to start their career as entrepreneurs. Up till now belief was Entrepreneurs are born and cannot be created. But research by David Mc Leland& Entrepreneurship Development Institute of India, Ahmedabad, has proved that with proper guidance & training successful entrepreneurs can be created. With reference to guide lines provided by EDI Ahmedabad, NIESBUD, NIMSME, syllabus for course is designed

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Identify, analyze & select business opportunity to suit his personality based on SWOT analysis
2. Make market research & survey for selected business
3. Prepare and apprise detailed Project Report
4. Formulate plan for financial management of project.
5. Apply managerial inputs for starting & establishing his own business

Prerequisite: Students from any branch of engineering with strong passion for Entrepreneurship.

Course Content

Unit No	Description	Hrs
1	**Entrepreneurial motivation:** Entrepreneur-Definition, Concept, importance, nature, types, entrepreneurial culture, growth, entrepreneurial traits & motivations. **Entrepreneurship:** Aspects, Barrier to entrepreneurship, Entrepreneur competencies, Industrial Economics,	06
2	**Project identification:** Concept of Project & classification, searching for business idea, opportunity finding, Scanning Business Idea & development. Selection of Product/ Service, core competence, product life cycle, new product development process, creativity and innovation in product modification/development.	06

	Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection. Factors affecting selection of location for an industry. Importance of material handling and its relevance with facility location. Calculate capacity of plant and its relation with economies of scale. Including flexibility	
3	**Design Thinking:** Steps in design thinking, application, case study **Business Canvas:** Importance, construction and application with case study **Marketing:** Market survey, 4 P of marketing, USP, Branding. **JBTD**: Jobs to be done	**08**
4	**Setting Up of Enterprise:** Steps for starting small scale industry, whom to approach for what, incentives and subsidies, Role of state development, finance corporations, nodal agencies, Role of consultancy Organization, Lead Bank, various clearances & certificate required for a particular industry, Start Up India & Make in India program. Factory design and Layout	**04**
5	**Costing and Accounting:** Financial appraisal, Direct and Indirect costs, Financial projections, Balance Sheet, Profit and loss account, Income tax, GST, Excise Tax, Long term loan, short term loan, over drafts, letter of credit, working capital management.	**04**
6	**Project Report:** Project Report preparation, Preliminary Project Report, feasibility report, marketing research, Project appraisal, statement of cash flow, accounting ratios, Break-even analysis	**08**

References -

Text Books:

- Dynamics of Entrepreneurial Development and Management -By Vasant Desai, Himalaya Publishing House.
- Management of small scale Industries, -By Vasant Desai; Himalaya Publishing House, Delhi.
- Small Scale Industries and Entrepreneurship, -By Vasant Desai, Himalaya Publishing House, Delhi.

Reference Books:

- Entrepreneurship Development and Management -By Neeta Bopodikar, Himalaya Publishing House, Delhi.
- Project Profiles for S.S.I. Mechanical Products.
- E.D.P. Study Material by by Dr. Dinesh Awasthi, Mr. Raman Jossi V Padmananal E.D.I Ahamadabad.
- E.D.P. Study Material by MITCON Pune.& E.A.P. Study Material by Mr. Raman Gujaral E.D.I. Ahmadnagar.

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Syllabus (Theory & Laboratory Course)
To be implemented from **2025-26**
Common to All Departments

Class:- **T.Y. B. Tech.**	Semester-**VI**
Course Code : **OE3401**	Course Name : **Cyber Security**

L	T	P	Credits
3	--	--	3

Course Description:
Cybersecurity is the practice of protecting systems from cyber-attacks. It is important because effective cybersecurity reduces the risks of cyber-attacks. Cybersecurity is a high-demand but changing field. Since hackers are trying to find new ways to access, change, or delete sensitive information and extort money, users must be aware of cyber threats and comply with basic cybersecurity principles. This course will help in understanding cybercrimes, their laws & and various techniques for investigating different cybercrimes. This course also focuses on advanced issues in e-banking and financial crimes.

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

1. Describe fundamental terms in cybercrime legislation.
2. Compare various cyber-attacks & offences.
3. Analyze the Indian IT Act 2000 & amendments in the IT Act.
4. Asses social networks and security issues related to social media platforms.
5. Apply a strategy for creating awareness about cyber security for e-banking and legal issues among the social community.
6. Devise the best practices and policies in various layers of cyberspace.

Prerequisite: Basic Computer Technology

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to Cybersecurity** Defining Cyberspace and Overview of Computer and Technology, Architecture of cyberspace, Communication and web technology, Internet, World Wide Web, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.	**06**
2	**Cyber Crime and Cyber Law** Classification of cybercrimes, Common cybercrimes - cybercrime targeting computers and mobiles, cybercrime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, viruses and worms, Cybercriminal's modus-operandi, Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime.	**07**
3	**The Indian IT Act**	**05**

	Cybercrime and Legal landscape around the world, cyber laws, challenges faced in designing cyber laws, IT Act: Cyber Crime (Section 65-74), Amendments to the Indian IT Act 2000.	
4	**Social Media Overview and Security** Introduction to Social Networks. Types of social media, social media platforms, social media monitoring, Hashtag, Viral content, social media marketing, social media privacy, Challenges, opportunities and pitfalls in online social networks, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, best practices for the use of social media, Case studies.	**06**
5	**E-Commerce and Digital Payments** Definition of E-Commerce, Main components of E-Commerce, Elements of E-Commerce Security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stakeholders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act,2007.	**06**
6	**Digital Devices Security, Tools and Technologies for Cyber Security** End Point device and mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third-party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.	**06**

References -

Text Books:

- Sumit Belapure and Nina Godbole, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt. Ltd.
- Henry A. Oliver, "Security in the Digital Age: Social Media Security Threats and Vulnerabilities ", Create Space Independent Publishing Platform. (Pearson, 13th November, 2001)

Reference Books:

- James Graham, Ryan Olson, "Cyber Security Essentials", Rick Howard CRC Press, Taylor & Francis Group.
- Cyber Crime Impact in the New Millennium, by R. C Mishra, Auther Press.
- Kumar K, "Cyber Laws: Intellectual Property & E-Commerce Security" Dominant Publishers.

Class:- **T.Y. B. Tech.**	Semester-**VI**
Course Code: **OE342**	Course Name: **Data Mining**

L	T	P	Credits
3	-	-	3

Course Description:
The course helps to learn concepts, techniques and tools they need to deal with various facets of data mining process, including data collection and its preprocessing. The orientation of course is to understand the data mining concepts. The course helps to learn Data mining techniques and algorithms. It assists in comprehending the data mining environments inline to supervised and unsupervised learning patterns. The organization of web data inline to structured/unstructured will be examined. Moreover, a holistic view data mining application will be surveyed.

Course Learning Outcomes:
1. After successful completion of the course, students will be able to,
2. Compare various conceptions of data mining as evidenced in both research and application
3. Apply Classification and Clustering techniques for real time problems
4. Characterize the various kinds of patterns that can be discovered by association rule mining
5. Analyze web mining techniques for structured/un-structured data patterns
6. Evaluate mathematical methods underlying the effective application of data mining

Prerequisite: Basic Mathematics, Descriptive statistical techniques.

Course Content

Unit No	Description	Hrs
1	**Introduction:** Data Mining Tasks, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining, Data Pre-processing: Why Preprocessing, Cleaning, Integration, Transformation, Reduction, Discretization	06
2	**Classification:** Decision Trees, Bayesian Classification, Rule-Based Classification, Neural Network-Based Algorithms, Support Vector Machines, Classification by Association Rule Analysis, Nearest Neighbor Classifier	06
3	**Clustering:** Classification of clustering algorithms, Hierarchical Algorithms, Agglomerative Algorithms, Divisive Clustering, K-Means Clustering, Clustering Large Databases	06
4	**Association Rules:** What is an Association Rule?, Methods to Discover Association Rules, A Priori Algorithm, Partition Algorithm, FP-Tree Growth Algorithm, Generalized Association Rule	06
5	**Web Mining:** Web Mining, Web Content Mining, Web Structure Mining, Web Usage Mining, Text Mining, Unstructured Text, Text Clustering	06

6	**Applications:** Applications and Trends in Data Mining, Data Mining Applications, Social Impacts of Data Mining, Trends in Data Mining	06

References -

Text Books:

- Margaret H. Dunham," Data Mining Introductory and Advanced Topics", Prentice Hall
- Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, The Morgan Kaufmann Series in Data Management Systems

Reference Books:

- Arun K Pujari, Data Mining Techniques, University Press
- P. Tan, M. Steinbach and V. Kumar, "Introduction to Data Mining", Addison Wesley

Class: - **T. Y. B. Tech.**	Semester-VI
Course Code: **OE344**	Course Name: **Supply Chain Analytics**

L	T	P	Credits
3	-	-	3

Course Description:
In a typical supply chain, raw materials are procured, and items are produced at one or more factories, shipped to warehouses for intermediate storage, and then shipped to retailers or customers. Consequently, to reduce cost and improve service levels, effective supply chain strategies must consider the interactions at the various levels in the supply chain. In this course, students will be able to present and explain concepts, insights, practical tools, and decision support systems important for the effective management of the supply chain. This course will help the students to develop an understanding of the following key areas and their interrelationships:

- The strategic role of a supply chain
- The key strategic drivers of supply chain performance
- Supply chain network design and analytical methodologies for supply chain analysis

This course will help the students to learn the strategic importance of good supply chain design, planning, and operation for every firm. The students will be able to understand how good supply chain management a competitive advantage can be, whereas weaknesses in the supply chain can hurt the performance of a firm.

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

1. Identify the role and key issues in the supply chain management.
2. Explain the important supply chain drivers and their significance in strategic planning.
3. Estimate the demand using suitable demand forecasting method.
4. Design the inventory system and level at various locations in supply chain.
5. Design the supply chain network using appropriate network design methodology for the given problem.
6. Describe the importance of handling uncertainty in supply chain using decision tree.

Prerequisite: Write prerequisite required to study this course.

Course Content		
Unit No.	**Description**	**Hrs**
1	**Understanding of Supply Chain:** Introduction to Supply Chain Management, Evolution of Supply Chain Management, Analytics in Supply Chain Management, Supply Chain Planning, Different views of Supply Chain	**06**
2	**Supply chain drivers and obstacles:** Four drivers of supply chain- inventory, transportation, facilities and information; A framework for structuring drivers in supply chain, supply chain strategies, strategic fit, Obstacles to achieve strategic fit, value of information,	**06**

3	**Demand forecasting in Supply chain:** Bullwhip Effect and Time Series Analysis, Exponential Smoothing Method of Forecasting, Measures of Forecasting Errors, Tracking Signal and Seasonality Models, Forecasting using multiple characteristics in Demand Data and Inventory Management in Supply Chain	**06**
4	**Inventory Management in supply chain:** Inventory Management in Supply Chain, Role of cycle inventory, Economics of scale to exploit fixed costs and discounts, cycle time related costs, levels of safety, single stage inventory model, risk pooling, centralized and decentralized systems of planning inventory in supply chain, Multi echelon Inventory Management.	**06**
5	**Network Design and analytics in supply chain:** Network design, warehouse location, service level requirements, integrating inventory positioning and network design, supply chain integration, Optimal Level of Product Availability in Supply chain. Time Value of money in Supply Chain, Different types of Analytics in Supply Chain	**06**
6	**Handling uncertainty and future trends of Supply chain** Using Decision Tree for handling Uncertainty, Example of using Decision Tree incorporating Uncertainty in Single Factor, Example of using Decision Tree incorporating Uncertainty in two Key Factors, Modelling Flexibility in Supply Chain, Trends, Challenges and Future of Supply Chain	**06**

References:

Text books:

- Supply Chain Management: Strategy, Planning, and Operation, Sunil Chopra and Peter Meindel, Prentice Hall.

Reference Books:

- logistics and supply chain management, Christopher martin, Pearson Education Asia.
- Marketing logistics: A supply chain Approach, Kapoor KK; Kansal Purva, Pearson Education Asia.
- Designing and managing supply chain concepts, strategies and case studies, David Simchi-Levi, Ravi Shankar; McGraw Hill Publication.

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Class: - **T.Y. B. Tech.**	Semester-VI
Course Code: **OE346**	Course Name: **Mobile Robotics**

L	T	P	Credits
3	-	-	3

Course Description:
Mobile robotics refers to the field of robotics that focuses on the design, construction, operation, and use of robots that are capable of autonomous movement. Unlike stationary robots, mobile robots have the ability to navigate and operate in various environments, both indoor and outdoor, without being confined to a fixed location.
Key components and aspects of mobile robotics include1. Sensors 2. Actuators 3. Control Systems 4. Power Systems 5. Communication 6. Autonomy.
One of the defining features of mobile robots is their ability to operate autonomously, meaning they can make decisions and navigate without direct human intervention. This autonomy can range from simple behaviors, like obstacle avoidance, to complex tasks such as mapping an unknown environment. Applications of mobile robotics are diverse and include Autonomous Vehicles: Self-driving cars, drones, and other autonomous vehicles are examples of mobile robots used for transportation and surveillance.
Warehouse Automation: Mobile robots are employed in warehouses for tasks such as inventory management, order picking, and transportation of goods.
Search and Rescue: Mobile robots equipped with sensors and cameras can be deployed in disaster-stricken areas to search for survivors or assess the situation.
Agriculture: Agricultural robots can be used for tasks like planting, harvesting, and monitoring crops.
Healthcare: Mobile robots can assist in hospitals for tasks like delivery of supplies, patient assistance, or disinfection.Mobile robotics is an interdisciplinary field that combines elements of computer science, mechanical engineering, electrical engineering, and other related disciplines to create intelligent and adaptable robotic systems capable of navigating and performing tasks in dynamic environments. Advances in mobile robotics continue to drive innovation in various industries, making these systems increasingly capable and versatile.

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

1. Identify and explain the main components of a robot, including sensors, actuators, and control systems.
2. Solve forward and inverse kinematics problems for mobile robots.
3. Apply basic motion planning algorithms such as A* and Dijkstra's algorithm.
4. Apply Simultaneous Localization and Mapping.
5. Implement inter-robot communication and human-robot interaction.

Prerequisite: Basics of algebra, kinematics.

Course Content		
Unit No	**Description**	**Hrs**
1	Robot locomotion: Types of locomotion, hopping robots, legged robots, wheleled robots, stability, manoeuvrability, controllability.	06
2	Robot components and applications, sensors and actuators in mobile robots, robot control architecture, introduction to microcontroller science embedded systems.	06
3	Kinematics and Dynamics-robot kinematics -forward and inverse kinematics, Robot dynamics-Newton-Euler equations, Lagrange's equations. holonomic and nonholonomic constraints, kinematic models of simple car and legged robots, dynamics simulation of mobile robots.	06
4	Motion Planning and Path following-basics of motion planning, path planning algorithms based on A-star, Dijkstra, Voronoi diagrams, probabilistic roadmaps (PRM), rapidly exploring random trees (RRT), Markov Decision Processes (MDP), stochastic dynamic programming (SDP), trajectory generation and control for robots. Localization and Mapping-sensor based localization simultaneous localization and mapping (SLAM), types of maps in mobile robots	06
5	Perception for Mobile Robots-computer vision for mobile robots, sensor fusion, object detection and recognition. Control system for mobile robots-PID control, model predictive control (MPC), reactive and deliberative control strategies.	06
6	Mobile Robot Communication-wireless communication for mobile robots, inter robot communication, human robot interaction.	06

References -

Textbooks:

- R. Siegwart, I. R. Nourbakhsh, "Introduction to Autonomous Mobile Robots", The MIT Press, 2011.
- "Robotics: Modelling, Planning and Control" by Bruno Siciliano and Lorenzo Sciavicco.
- "Probabilistic Robotics" by Sebastian Thrun, Wolfram Burgard, and Dieter Fox.

Reference Books:

- Peter Corke, Robotics, Vision, and Control: Fundamental Algorithms in MATLAB, Springer Tracts in Advanced Robotics, 2011.

Class: -T.Y. B. Tech.	Semester-VI
Course Code: OE348	Course Name: Information Technology Foundation Program

L	T	P	Credits
3	-	-	3

Course Description:
This Course represent basic Knowledge of Information Technology subject to entry level Engineers from different background and discipline to deliver world class projects to global customer.The purpose of this course is to trained to entry level engineer to help them make industry ready.

Course Learning Outcomes:
After successful completion of the course, students will be able to:
1. Solve the real-world problem using Programming Concept
2. Apply Data structure Algorithm to solve Computational Problem
3. Make use of an ER model for a given problem domain.
4. Relate the relationship between project integration, scope, cost and time Management System to improve quality of projects.

Prerequisite: Basic Knowledge of Computer System and Programming language

Course Content		
Unit No	**Description**	**Hrs**
1	**Problem Solving Techniques** Introduction to Logic, Problem Solving, Algorithms, and Flowcharts	06
2	**Fundamentals of C and Data Structures** Introduction to C, Basic Programming, Selection Control Structure, Iteration Control Structure, Demonstration of 1D and 2D arrays, Function, Strings. Introduction to basic data structures, Searching and Sorting Algorithms.	06
3	**Programming Paradigm** Introduction of Programming Paradigm, Coding Standards, Best Practices, , Introduction to code optimization, Modular approaches through Functions, Testing and Debugging	06
4	**Object Oriented Concepts** Introduction to Object Oriented Programming, C versus C++, Features of OOP, Constructor, Destructor, Inheritance, Polymorphism.	06
5	**Relation Database Management** Introduction, ER modelling, SQL Queries	06
6	**Project Management** Project Management Concepts, Project Management Activities, Project Estimation, Project Planning and Scheduling, Project Risk Management, Project	06

	Execution and Monitoring, Project Communication Management, Project Management Tools, Project Monitoring and Tools	

References -

Text Books:

- Aho-Ullman, Addison wesely. "Data Structure and algorithm'. Perrson Publication
- E Balagurusamy, Object-Oriented Programming with C++ ,McGraw,Publication
- Henorykorth, Database system concepts',MGM International.
- Information Technology Project Management, Kathy Schwalbe, Thomson Course Technology, Fourth Edition.

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To be implemented from **2025-26**

Common to All Departments

Class: -T. Y. B. Tech.	Semester-VI
Course Code: **OE350**	Course Name: **Operations Research**

L	T	P	Credits
3	-	-	3

Course Description:

This course is intended to provide students with a knowledge that can make them appreciate the use of various research operations tools in decision making in organizations. Operations Research is the study of scientific approaches to decision-making. Through mathematical modelling, it seeks to design, improve and operate complex systems in the best possible way. The mathematical tools used for the solution of models are either deterministic or stochastic, depending on the nature of the system modelled. In this class, we focus on basic deterministic models and methods in Optimization Techniques.

Course Learning Outcomes:

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

1. Identify the necessity and scope of operation research in decision making.
2. Formulate and solve linear programming problems using mathematical models and various optimization techniques.
3. Apply quantitative analysis methods to real-world decision-making scenarios in various industries.
4. Evaluate and improve decision-making processes under uncertainty

Prerequisite: Possess basic knowledge of mathematics

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction:** Introduction: Importance of optimization techniques, Applications of Optimization techniques in construction industry, Operations Research models, Phases of OR, Limitations of OR Linear programming	06
2	**Linear Programming Problem:** Formulation of LPP, Solution by Graphical Method, Simplex Method, Sensitivity analysis	06
3	**Transportation Problem:** Transportation Problem and its variants- Unbalanced, Maximization, Restrictions on route.	06
4	**Assignment Problem:** Assignment problem and its variants- Non Square, Maximization, Prohibited assignments, Alternate possible solutions.	06

5	**Decision Strategies:** Decision strategies – decision making under certainty – decision making under risk – decision making under uncertainty–formulation – decision criterion	06
6	**Game Theory:** Game Theory, Characteristics of game, Game model, Rules for game theory, Mixed Strategies (2×2 games), (2×n).	06

References -
Reference Books:

- Er. Prem Kumar Gupta, Dr. D. S. Hira, "Operations Research" S. Chand publications.
- Taha, H.A., "Operations Research - An Introduction", Prentice Hall.
- J. K. Sharma, "Quantitative Techniques-for managerial decisions", Macmillan Business books.
- Singiresu S. Rao, "Engineering Optimization", New Age International Publishers.

Common to All Departments

Class: - **T. Y. B. Tech**	Semester-VI
Course Code: **OE352**	Course Name: **Image Processing**

L	T	P	Credits
3	-	-	3

Course Description:
Image Processing has fundamental importance to fields where images are enhanced, manipulated, and analyzed. They play a key role in remote sensing, medical imaging, inspection, surveillance, autonomous vehicle guidance, and more. Students will benefit from the direct visual realization of image processing concepts, and learn how to implement efficient algorithms to perform or design applications for various tasks.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Explain different concepts and processes in digital image processing.
2. Apply different image processing operations on an image.
3. Analyze various operations on image using different tools.
4. Compare various filtering, enhancement, segmentation and classification techniques used in image processing.
5. Design various applications in Image Processing.

Prerequisite: Basic knowledge of Linear Algebra and programming language

Course Content		
Unit No	**Description**	**Hrs**
1	**Digital Image Fundamentals** Components of image processing system, human and computer vision, hierarchy of image processing system, applications, image formation and digitization, binary, gray scale and color images.	06
2	**Image Enhancement & Image Filtering** Gray level transformation function: Image Negatives, Log Transformations, Power Law Transformation, Piecewise Linear Transformation Functions, Histogram equalization, Basics of spatial filtering, smoothening and sharpening spatial filter.	06
3	**Morphological Image Processing** Dilation and erosion, opening and closing operation, Hit or miss transformation, Edge Detection, Applications of Morphological Image Processing.	06
4	**Image Segmentation** Thresholding, Role of illumination, global and adaptive thresholding, pixel-based segmentation, region-based segmentation and edge-based segmentation.	06
5	**Image Shape and Classification** Shape representation, Feature space, Clusters and classification techniques, Supervised and Unsupervised classification, Basic algorithms: Boundary extraction, region filling, thinning and thickening, skeletons.	06

6	**Real Life Applications and Case Studies** Face recognition, Object detection, Object Classification, various case studies and applications of Digital Image Processing.	**06**

References –

Text Books:

- R.C. Gonzalez & R.E. Woods, Digital Image Processing, Pearson.
- Pratt W.K, Digital Image Processing, John Wiley & Sons.

Reference Books:

- R.C. Gonzalez & R.E. Woods, Digital Image Processing using MATLAB, Pearson.
- Georgy Gimel' farb, Patrice Delmas, Image Processing and Analysis: A Primer, World Scientific.

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To be implemented from **2025-26**

Common to All Departments

Class: -**T.Y. B. Tech**	Semester-VI
Course Code: **OE354**	Course Name: **Fuzzy Logic and Neural Network**

L	T	P	Credits
3	--	--	3

Course Description:

This comprehensive course delves into the core principles of Soft Computing, covering topics such as fuzzy sets and operations, relations and composition, and fuzzification and defuzzification. Students will gain a solid understanding of soft computing methodologies, including the distinctions between soft and hard computing, and the role of biological neural networks in computational models. The course further explores neural network fundamentals, including various learning mechanisms and architectures, paving the way for advanced topics such as recurrent neural networks and their applications.

Course Learning Outcomes:

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

1. Develop a comprehensive understanding of fuzzy sets, operations, and their applications in problem-solving scenarios.
2. Solve problems related to relations and composition.
3. Design, implement various neural network architectures.
4. Analyze various neural network architectures for real-world applications.

Prerequisite: Basic knowledge of probability and control system

Course Content

Unit No	Description	Hrs
1	**Foundations of Fuzzy Sets** Fuzzy sets and membership, Universe of discourse, Classical sets operations and properties, Fuzzy sets operations and properties, Mapping of Classical Sets to Functions, Problems based on Fuzzy sets operations and properties.	06
2	**Fuzzy Relations and Operations** Cartesian product, Cardinality of Crisp Relation, crisp relations, fuzzy relations, Operations on Fuzzy Relations Properties of Fuzzy Relations, membership functions, Composition, Fuzzy Cartesian Product and Composition, Value Assignments, Problems based on relation and composition.	06
3	**Membership Functions, Fuzzification and Defuzzification** Features of the Membership Function, Fuzzification, Defuzzification to Crisp Sets, Λ-Cuts for Fuzzy Relations, Defuzzification to Scalars, Problems based on Λ -Cuts and Fuzzy Relations, Fuzzy Control system.	06
4	**Introduction to Soft Computing and Neural Networks**	06

	What is soft computing? Differences between soft computing and hard computing, Biological Neural Networks, The Journey of Neural Networks, Activation Function, Soft Computing constituents.	
5	**Neural Networks and Learning Mechanisms** Learning, Supervised Learning, Unsupervised Learning, Supervised mechanism, Unsupervised Mechanism, Reinforcement Learning, Learning Rules, The Perceptron learning, Architecture of Neural Networks, Feedforward Networks, Multilayer feedforward network.	**06**
6	**Advanced Neural Networks and Applications** Recurrent Neural Network or Feedback Network, Backpropagation Networks, Radial Basis Function Network, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing.	**06**

References -

Text Books:

- Kuntal Barua and Prasun Chakrabarti, Fundamentals of Soft computing, BPB Publications.
- S.N. Shivanandam, Principle of soft computing, Wiley.
- Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India.
- James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson publication.

Reference Books:

- Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall.
- David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley.

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To be implemented from **2025-26**

Common to All Departments

Class: -**T.Y. B. Tech**	Semester-VI
Course Code: **OE356**	Course Name: **Project Management**

L	T	P	Credits
3	--	–	3

Course Description:

To improve and update knowledge of new entrepreneurs in the areas of project preparation & appraisal techniques; decision-making process in the sector of industrial, infrastructure & sustainable opportunities that would lead to improved viability, returns and effective investment decisions. Writing a business plan which can gain interest of the fund providers like venture capitalists and other sources of funding.

Course Learning Outcomes:

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

1. Explain concept of project Management.
2. Prepare project analysis.
3. Prepare technical appraisal of selected project.
4. Prepare financial appraisal of selected project.
5. Apply different techniques for project management.

Prerequisite: General knowledge of economics, Project & clear concept about business model.

Course Content

Unit No	Description	Hrs
1	**Overview of Project appraisal:** Project Development Cycle, identifying data requirements and analyzing their suitability for preparation of feasibility studies, project formulation, screening for pre-feasibility studies, stages of feasibility report preparation, Project Analysis including Market Analysis, Technical Analysis & Financial Analysis, applying various techniques and integrating the data gathered into a full-fledged business plan.	07
2	**Project Analysis:** Environmental Analysis, Risk Analysis, Infrastructure Development & Financing, Risk Management, Risk identification, Qualitative risk analysis, Quantitative risk analysis, Risk planning, Risk control, Evaluating the rewards & risks for sustainable opportunities. National Cost-Benefit Analysis, Financing Sustainable Opportunities.	06
3	**Project Planning:** Planning fundamentals, project master plan, work breakdown structure & other tools of project planning, work packages project organization structures & responsibilities, responsibility matrix ,Time and cost estimates with AON and AOA conventions, Budget estimates, Network analysis, Float analysis, crashing concepts	06

4	**Project appraisal:** **Technical Appraisal:** Operation and Production Plan: Types of production systems, Product design and analysis, New product development, location and layout decisions, project layout, plant and technology choices, product specification and customer needs, production planning and control, Commercializing Technologies	**06**
5	**Commercial Appraisal:** Economic feasibility and commercial viability, market analysis, Market Research, Industry Analysis, Competitor analysis, defining the target market, market segmentation, market positioning, building a marketing plan, market strategy. **Financial Appraisal:** Pro-forma income statements, financial projections, working capital requirement, funds flow and Cash flow statements; Ratio Analysis.	**06**
6	PERT, CPM, Resource allocation: Tools & techniques for scheduling development, crashing of networks, time-cost relationship, and resource levelling multiple project scheduling. Computer applications and Software forProject Management	**05**

References -

Text Books:

- Dwivedi, A.K.: Industrial Project and Entrepreneurship Development, Vikas Publishing House.
- Prasanna Chandra: Project Planning estimation and assessment.
- Gray and Larson: Project Management the Managerial Process, Third edition, Tata McGraw-Hill.

Reference Books:

- Bangs Jr., D.H., The Business Planning Guide, Dearborn Publishing Co.
- Katz, J.A. and Green, R.P., Entrepreneurial Small Business, McGraw Hill.
- Mullins, J. and Komisar R., Getting to Plan B, Harvard Business Press.
- O'Donnell, M., The Business Plan: Step by Step, UND Center for Innovation.
- Scarborough, N.M. and Zimmerer, T.W., Effective Small Business Management,Pearson.
- Pickle, H.B. and Abrahamson, R.L., Small Business Management, Wiley.
- Desai, V., Dynamics of Entrepreneurial Development & Management, Himalaya, Publishing.
- Kao, J., Creativity & Entrepreneurship, Prentice Hall .
- Singh, Narendra, Project Management & Control, Himalaya Publications.

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To be implemented from **2025-26**

Common to All Departments

Class:-**T. Y. B. Tech.**	Semester-**VI**
Course Code : **OE358**	Course Name: **Plumbing (Water and Sanitation)**

L	T	P	Credits
3	-	-	3

Course Description:

This subject deals with the Plumbing system and its codes for civil engineering practices. This course is designed to fulfill the requirements of plumbing systems for residential, and industrial building construction. This course will help to select appropriate fixtures, fittings, and treatments based on the user's requirements. A major emphasis in the course is on water plumbing and sanitary fittings.

Course Learning Outcomes:

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

1. Explain the scope and purpose of building industry codes and standards
2. Explain different plumbing fixtures and its working.
3. Prepare layout of sanitary drain and storm drain.
4. Calculate water requirement and suggest layout for water supply.
5. Discuss functions of WTP and STP in plumbing system.

Prerequisite: Possess basic knowledge of construction activities, Environmental engineering, Building planning and design.

Course Content

Unit No	Description	Hrs
1	**Importance of Codes, Architectural and Structural Coordination** Codes and Standards: Scope, purpose; codes and standards in the building industry, UIPC-I, NBC and other codes, Local Municipal Laws, approvals, general regulations, standards. **Architectural and Structural Coordination:** Provisions for plumbing systems, coordination during the planning stage, various agencies involved and their roles, space planning for plumbing systems, plumbing shafts, basements and terraces planning, sunken toilets, location of columns and beams, slabs position, the importance of ledge walls, protection of pipes and structures, waterproofing.	06
2	**Plumbing Terminology** **Plumbing Fixtures**: readily accessible, aerated fittings, flood level rim, floor sink, flushometer valve, flush tanks, lavatories, macerating toilet, plumbing appliances: Traps, Drainage, Valves and Water supply meter.	06
3	**Plumbing Fixtures and Fittings** Introduction to Drainage Fixture Units (DFU): pipes, water closets, bidets, urinals, flushing devices, washbasins, bath/shower, toilets for differently abled, kitchen sinks, water coolers, drinking fountain, clothes washer, dishwasher, mop sink,	06

	overflows, strainers, prohibited fixtures, floor drains, floor slopes, hot water temperature controls, installation standard dimensions in plan and elevation, introduction to vent size and vent requirement, the purpose of venting, vent connections, vent stacks, cleanouts, venting of interceptors,	
4	**Sanitary Drainage and Storm Drain** One pipe and Two pipe systems, different pipe materials and jointing methods, special joints, hangers and supports, protection of pipes and structures, alternative materials, workmanship, prohibited fittings and practices, T and Y fittings, cleanouts, pipe grading, fixtures below invert level, sizing case study as per NBC, safety,	**05**
5	**Water Supply, Grey and Reclaimed Water** Sources of water, potable and non-potable water, reclaimed water, calculating daily water requirement and storage, hot and cold water distribution system, backflow prevention, air gap, cross connection control, controls and thermal expansion fixtures its installation and testing, protection of underground pipes, introduction to Water Supply Fixture Units (WSFU) and sizing.	**05**
6	**Introduction to WTP and STP** Need to reduce and reuse, 24x7 water supply, metering and sub-metering, typical daily water and wastewater calculations for a project. Sources, utility and treatment of water, parameters of water quality, parts of water treatment plant (WTP), disinfection methods, storage conditions, RO water systems, rainwater harvesting treatment, desalination. Grey water and black water, characteristics of domestic sewage, sewage treatment methods, aerobic and anaerobic treatment, level of treatment, reclaimed water.	**08**

References -

Codes of Practice:

- Bureau of Indian Standards IS 17650 Part 1 and Part 2 for Water Efficient Plumbing Products, BIS, New Delhi
- National Building Code (NBC) of India
- Uniform Illustrated Plumbing Code-India (UIPC-I) An IPA and IAPMO (India) Publication
- Water Efficient Products-India (WEP-I), An IPA and IAPMO (India) Publication
- Water Efficiency and Sanitation Standard (WE. Stand) An IPA and IAPMO (India) Publication

Reference Books:

- Berry, "Water Pollution", CBS Publishers.
- An IPA and IAPMO (India), "A Guide to Good Plumbing Practices", An IPA and IAPMO (India) Publication.
- O.P. Gupta, "Elements of Water Pollution Control Engineering", Khanna Book Publishing, New Delhi.

Class: T.Y. B.Tech.	Semester-VI
Course Code: OE362	Course Name: Flexible Manufacturing System

L	T	P	Credits
3	-	-	3

Course Description:
A flexible manufacturing system (FMS) gives manufacturing firms an advantage to quickly change a manufacturing environment to improve process efficiency and thus lower production cost. However, upfront costs may be greater for installing specialized equipment that allows for flexibility and customization. This course imparts knowledge of FMS evolution, objectives, applications and focuses on FMS layout, processing stations material handling systems etc.

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

1. Apply the concepts to the development of FMS.
2. Discuss the control structure used in manufacturing systems.
3. Discuss the Scheduling & Loading of FMS.
4. Identify hardware and software components of FMS.
5. Summarize the concepts of Cellular Manufacturing.
6. Summarize the concepts of Additive Manufacturing.

Prerequisite: Nil

Course Content

Unit No.	Description	Hrs
1	**Introduction** Flexible and rigid manufacturing, F.M. Cell and F.M. System concept, Types and components of FMS, Tests of flexibility, Group Technology and FMS, unmanned factories, Economic and Social aspects of FMS. Advantages and disadvantages of FMS Group technology	06
2	**Control structure of FMS** Architecture of typical FMS, Automated work piece flow, Control system architecture – Factory level, Cell level; hierarchical control system for FMS, LANs - characteristics, transmission medium, signalling, network topology and access control methods.	06
3	**Scheduling & Loading Of FMS** Introduction, Scheduling of operations on a single machine, 2 machine flow shop scheduling, 2 machine job shop scheduling, scheduling 'n' operations on 'n' machines, Scheduling rules, loading problems , Tool management of FMS, material Handling system schedule. Problems.	06

4	**FMS hardware and software** FMS computer hardware and software, general structure and requirements, PLCs, FMS installation and implementation, acceptance testing Characteristics of JIT pull method, small lot sizes, work station loads, flexible work force, line flow strategy. supply chain management	**06**
5	**Cellular Manufacturing** Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing. Various case studies of implementation of FMS at industries.	**06**
6	**Additive Manufacturing** Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Classification of AM processes-Benefits- Applications.	**06**

References –

Text Books:

- Shivanand H.K., Benal MM, Koti V, "Flexible Manufacturing System", New age international (P) Limited, New Delhi, 2006
- Mikell P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", PHI, 2008

Reference Books:

- Kalpakjin, "Manufacturing Engineering and Technology ", AddisonWesley Publishing Co., 1995.
- Viswanadhan, N. & Narahari, Y. (1998), "Performance Modelling of Automated Manufacturing Systems", PHI
- Pinedo, Michael & Chao, Xiuly (1999), "Operations Scheduling with Applications in Manufacturing & Services", McGraw Hill International Editions (with 2 Floppy Disks of LEKIN Scheduling Software)
- Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006

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Syllabus (Theory & Laboratory Course)

To be implemented from **2025-26**

Common to All Departments

Class:- **T.Y. B. Tech.**	Semester- **VI**
Course Code: **OE364**	Course Name: **AI for Manufacturing**

L	T	P	Credits
3	--	--	3

Course Description:

This course introduces the applications of Artificial Intelligence in the manufacturing sector. It explores AI Industry use cases and techniques like quality monitoring, predictive maintenance, and demand forecasting. The course also discusses AI's ethical concerns, AI project cycle and its usability in manufacturing applications.

Course Learning Outcomes:

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

1. Describe Artificial Intelligence and its potential impact in manufacturing.
2. Apply AI techniques to solve problems in the manufacturing sector.
3. Demonstrate the use of AI techniques for robotic perception, environment understanding, and intelligent decision-making.
4. Illustrate key AI techniques used for fault detection and prediction in mechanical and industrial systems.
5. Explain the principles and techniques of demand forecasting in the context of manufacturing operations.
6. Examine ethical concerns of AI to create Responsible AI.

Prerequisite: Basics of Manufacturing, Python Programming.

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to AI for Manufacturing** Domains of AI, How can AI contribute to Manufacturing, Different AI opportunities in the manufacturing sector, popular use cases in the manufacturing, AI project life cycle and its use in manufacturing sector.	06
2	**AI Modeling and Evaluation** Data acquisition, Data analysis and Preprocessing, Model Training, Evaluation, and deployment, Platforms for AI project deployment.	05
3	**Computer Vision and Robotics Process Automation** Basic of computer vision, Use of computer vision in manufacturing process, AI for robot perception and decision-making, AI-driven robots and cobots, Path planning and motion control using ML, Human-robot collaboration, Real-world applications: welding, assembly, pick-and-place.	07
4	**Predictive Maintenance** Predictive maintenance in manufacturing, AI techniques for fault prediction in mechanical systems, Use cases of AI in equipment maintenance, Vibration analysis and failure prediction.	06

5	**Inferencing on Edge and Demand Forecasting** Edge inferencing, edge inferencing in manufacturing, demand forecasting, solving problem in manufacturing using demand forecasting.	06
6	**AI Ethics and Responsible AI** AI Ethics, Importance of AI Ethics in manufacturing, Responsible AI, frameworks for developing responsible AI.	06

References -

Text Books:

- Masoud Soroush, Richard D Braatz, "Artificial Intelligence in Manufacturing: Concepts and Methods", Academic Press, Paperback ISBN: 9780323991346
- Andrew Ng, "Machine Learning Yearning", https://info.deeplearning.ai/machine-learning-yearning-book
- Xiaofei Wang, Yiwen Han, Victor C. M. Leung, Dusit Niyato, Xueqiang Yan, Xu Chen, "Edge AI: Convergence of Edge Computing and Artificial Intelligence", Springer Singapore.
- Vincent C. Muller, "Ethics of Artificial Intelligence and Robotics", Metaphysics Research Lab, Stanford University.

Reference Books:

- George Chryssolouris, Kosmas Alexopoulos, Zoi Arkouli, "A Perspective on Artificial Intelligence in Manufacturing", Springer, Kindle Edition.
- Kim Phuc Tran, "Artificial Intelligence for Smart Manufacturing: Methods, Applications, and Challenges", Springer International Publishing AG.

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Syllabus (Theory & Laboratory Course)
To be implemented from **2025-26**

Common to All Departments

Class:- **T.Y. B. Tech.**	Semester- **VI**
Course Code : **OE366**	Course Name: **AI for Cybersecurity**

L	T	P	Credits
3	-	-	3

Course Description:
This course explores the integration of AI and cybersecurity, covering key concepts, frameworks, and machine learning techniques for threat detection, malware analysis, and network security. Students will gain hands-on experience with AI tools for penetration testing, log analysis, and security automation, while also learning about responsible AI use and future trends in cybersecurity.

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

1. Describe fundamental concepts of cybersecurity, AI, and key frameworks.
2. Use Python and machine learning tools for basic malware and anomaly detection tasks.
3. Examine and differentiate AI techniques for threat detection, intrusion detection, and network security operations.
4. Design and evaluate AI-driven solutions for vulnerability management, log analysis, and security dashboard development.

Prerequisite: Basic knowledge of networks, Machine learning concepts and cybersecurity concepts

Course Content

Unit No	Description	Hrs
1	**Foundations of AI-Driven Cybersecurity** Overview of Cybersecurity and AI concepts, Intersection of Cyber Security and Artificial Intelligence (AI), Applications of AI for solving real-world challenges,CIA Triad Modelling-Addressing trade-offs and conflicting priorities, Cybersecurity Framework Prevention, detection, and response, NIST AI Risk Management Framework, Traditional cyber threats, Introduction to OWASP Frameworks and risks documentation	06
2	**Machine Learning and Generative Models for Cybersecurity** AI applications in cybersecurity, AI project cycle, future trends in AI-cybersecurity integration,Python Libraries Scikit-learn, TensorFlow and scripting for cybersecurity tasks. Supervised Learning: Basics, malware detection, anomaly detection for critical infrastructure, threat detection models.Unsupervised Learning: Anomaly detection (hands-on), clustering for threat analysis. Generative Adversarial Networks (GANs), threat detection/prevention using generative AI. Hands-On: Implementing generative AI tools	06
3	**AI-Powered Threat Detection and Malware Analysis** Security Innovation for Threat Detection, Behavioral Analytics with AI,AI for Intrusion Detection systems (IDS), Threat Hunting and Detection Intelligence,	06

	Adversarial Attack Detection and Mitigation, Basics of malware analysis techniques, Automated malware detection and classification, Introduction to tools using AI for malware analysis, Dynamic and Static Analysis, AI-Powered Sandboxing	
4	**AI in Network Security** AI-driven network traffic analysis, Identifying network intrusions and attacks, AI-enhanced Network Access Control (NAC),AI-based firewalls and network segmentation, Secure Software-Defined Networking (SDN),Introduction to AI-based SOAR (Security Orchestration, Automation, and Response),Introduction to SIEM (Security Information and Event Management) systems, Investigation, containment, remediation, recovery, and reporting with AI, Hands-on: Data dashboarding for security operation reports, Hands-on: AI-powered spam detection, Automated security management techniques	**06**
5	**AI in Vulnerability Management** Key requirements to Penetration Testing with AI, Automated OSINT and Social Engineering with AI, Vulnerability scanning and prioritization, Dashboard development for vulnerability intelligence, Introduction to Open-source bug hunting barriers, Applications of AI Fuzzing in bug bounty, AI-Assisted Exploitation and Attack Simulations, AI applications in CAPTCHA development and decoding.	**06**
6	**Future Trends in Log Management and AI Security** Log Analysis in Cybersecurity, Log Management using extended detection and response (XDR), Augmenting log analysis with AI tools, Hands-on: Use ELK Stack (Elasticsearch, Logstash, Kibana) for log analysis, Governance through responsible AI frameworks in cybersecurity, The future of AI security challenges and mitigations, Role of advanced threat detection systems in data protection,Apply cybersecurity and AI concepts in practical, dashboarding project	**06**

References -

Text Books:

- Alessandro Parisi, Hands-On Artificial Intelligence for Cybersecurity, Packt Publishing.
- Mark Stamp, Introduction to Machine Learning for Security Professionals, Wile

Reference Books:

Ishaani Priyadarshini, Rohit Sharma , Artificial Intelligence and Cybersecurity: Advances and Innovations, Routledge.

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Syllabus (Theory & Laboratory Course)

To be implemented from **2025-26**

Common to All Departments

Class: - **T. Y. B. Tech**	Semester-VI
Course Code: **OE368**	Course Name: **AI for Agriculture**

L	T	P	Credits
3	--	--	3

Course Description:

Course introduces students to the intersection of Artificial Intelligence (AI) and agriculture. It focuses on applying AI techniques such as data analysis, computer vision, NLP, and generative AI to solve real-world agricultural problems. Students will explore ethical concerns, sustainable development goals (SDGs), and AI project development. The course includes case studies and practical use cases to enhance experiential learning.

Course Learning Outcomes:

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

1. Specify AI fundamentals, domains, and ethical aspects in agriculture.
2. Identify agricultural problems and apply data acquisition techniques.
3. Develop and evaluate AI models for agricultural applications.
4. Use statistical and generative AI methods for agri-analysis.
5. Analyze AI policies, ethical issues, and future agri-trends.

Prerequisite: Basic Statistics and Probability, Fundamentals of Artificial Intelligence and Python Programming.

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to AI in Agriculture** Role of AI in agriculture, types and domains of AI, relevance to SDGs, overview of AI Project Cycle, introduction to AI Ethics.	**06**
2	**Problem Scoping and Data Acquisition** Problem scoping in agriculture, challenges in Agri-domain, data types, sources, data acquisition, data handling and visualization, AIoT.	**06**
3	**AI Modeling and Deployment** Introduction to modeling, training and testing datasets, model evaluation metrics, deployment, practical examples of AI models in Agri-apps.	**06**
4	**Statistical AI Techniques in Agriculture** Statistical data analysis, regression and classification techniques, crop yield and damage prediction, introduction to generative AI for data.	**06**
5	**AI Applications: CV and NLP in Agriculture** CV techniques and use cases (e.g., crop/rice/livestock), NLP applications (chatbots, market intelligence), ethical implications, generative AI in CV/NLP.	**06**

6	**Policy, Ethics, and Future Trends in AI for Agriculture** Ethical considerations in deploying AI solutions in agriculture, privacy and data protection issues, AI policy frameworks, government initiatives, global and national regulations, future trends and opportunities in AI-driven agriculture.	06

References

Text Books:

- Abhishek Ghosh & Manju Khari, "Artificial Intelligence for Agriculture", CRC Press.
- Melanie Mitchell, "Artificial Intelligence: A Guide for Thinking Humans", Penguin.
- J. Zhou, J. Guo, "Artificial Intelligence in Precision Agriculture", Springer.

Reference Books:

- Rohit Sharma, "AI and IoT for Sustainable Development in Agriculture", Springer.
- Niall Adams, "Data Science for Agriculture and Environmental Research", CRC Press.
- Rajalingappaa Shanmugamani, "Deep Learning for Computer Vision", Packt Publishing.

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Syllabus (Theory & Laboratory Course)

To be implemented from **2025-26**

Common to All Departments

Class:- **T. Y. B. Tech.**	Semester-**VI**
Course Code : **OE370**	Course Name: **AI for Sustainability**

L	T	P	Credits
3	-	-	3

Course Description:

This course introduces the fundamental concepts of artificial intelligence (AI) and sustainability and applications for sustainable development. The course aims to enable learners to understand the potential of AI for addressing environmental, social and economic sustainability challenges through case studies and real-life solutions. Students will explore environmental, social and economic dimensions of sustainability and identify AI appropriateness in each context. They will also evaluate the impact of AI projects in different dimensions and discuss crucial critical consideration.
The course will be Open Elective choice for all students

Course Learning Outcomes:

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

1. Explain fundamentals of Artificial Intelligence and Sustainability
2. Analyze the potential and impacts of AI to address environmental, social and economic challenges
3. Develop critical thinking skills for evaluating and comparing AI solutions in sustainable context
4. Apply AI, IOT and other technologies to prototype sustainable solutions for real-world challenges

Prerequisite: Basic knowledge of Environmental and Sustainability knowledge, Basics of Mathematics and Programming skills

Course Content

Unit No	Description	Hrs
1	**Introduction to AI and Sustainability** Introduction to Sustainability, Approaches to Sustainability, Dimensions of Sustainability, Introduction to AI and Domains of AI, AI Ethics, AI Contributing to Green Skills, AI's role in achieving sustainability goals	06
2	**AI Foundations** Supervised, unsupervised, reinforcement learning, Introduction to Neural networks and deep learning, Tools and frameworks for AI: Python, TensorFlow, Scikit-learn	06
3	**Environmental Sustainability** Introduction to Environmental Sustainability, Business Approach for Environmental Sustainability, AI for Environmental Sustainability, Environmental Challenges for AI, AI in Clean water and sanitation, AI in Climate Action, AI in Affordable and Clean Energy	06
4	**Social Sustainability**	06

	Introduction to Social Sustainability, Business Approach for Social Sustainability, AI for Social Sustainability, Social challenges for AI, AI in Zero Hunger, Good Health and Well-being, AI in Accident Detection	
5	**Economic Sustainability** Introduction to Economical Sustainability, Business Approach for Economical Sustainability, AI for Economical Sustainability, Economical Challenges for AI, AI in Decent Work and economic growth, AI in Industry Innovation and Infrastructure, AI in Intelligent Recycling	**06**
6	**Case Studies and AI Projects** Steps in AI Project Development, AI in Quality Education, Transportation, healthcare chatbot, Fraud Detection Predictive Maintenance, Sentiment Analysis for social media	**06**

References -

Text Books:

- Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson.
- Margaret Robertson, "Sustainability Principles and Practice", Routledge.
- S. Suresh, "Artificial Intelligence for Sustainable Development", Wiley.

Reference Books:

- Francisco J. Martin and Uwe Meinberg, "Artificial Intelligence for a Better Future: An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies", Springer
- Klaus Schwab "The Fourth Industrial Revolution", Crown Publishing Group
- Peter Dauvergne "AI in the Wild: Sustainability in the Age of Artificial Intelligence", MIT Press
- Srikanta Patnaik, Siddhartha Bhattacharyya, Nilanjan Dey (Eds.), "Smart Intelligent
- Computing and Applications", Springer

Class:- **T. Y. B. Tech.**	Semester-VI
Course Code : **OE3242**	Course Name: **Marketing for Engineers**

L	T	P	Credits
3	-	-	3

Course Description:

Marketing is the core of operating any business. Marketing defines & guides companies for interfacing with customers, competitors, collaborators, and the environment. Marketing helps you plan and execute the creating a value proposition by determining pricing, promotion, and distribution of ideas, goods, and services. It begins with needs and wants determination, assessing the five forces existing in the competitive environment. Selecting the most appropriate customer targets and developing marketing strategy and implementation program for an offering that satisfies consumers' needs better than the competition. Marketing is the art and science of creating customer value in exchange it benefits the organization and its stakeholders.

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

1. Assess market opportunities by analyzing customers, competitors, collaborators, and the strengths and weaknesses of a company.
2. Develop effective marketing strategies to achieve organizational objectives.
3. Design a strategy implementation program to maximize its chance of success.
4. Examine how marketing strategies impact the profitability of an organization
5. Communicate and defend your recommendations to your classmates both quantitatively and qualitatively.

Prerequisite: No prerequisites are needed for enrolling into this Open Elective course.

Course Content

Unit No	Description	Hrs.
1	**Introduction to Marketing:** Core concept of marketing, Marketing Process, Function of Marketing Environment, Analyzing needs & trends in micro, macro business environment.	06
2	**Market Segmentation, Targeting & Positioning:** Basis for market Segmentation, Targeting, Positioning. Marketing Mix, Significance of competitive environment.	06
3	**New Product Development:** Product and product line decisions. Product life cycle (PLC), Managing PLC, Test marketing and the new product, Branding and Packaging decisions.	06

4	**Pricing & Distribution:** Price determinants, policies, Methods. Channel Management, Channel conflict and resolutions.	**06**
5	**Promotion:** Promotion mix, Advertising, Media decisions, Sales Promotion, Personal selling, Managing sales force. Global Marketing.	**06**
6	**Strategy:** An Introduction, Dealing with competition, Porter's five force model, Strategy, Strategy execution.	**06**

References -

Text Books:

- Philip Kotler, Kevin Lane Keller – "Marketing Management" Pearson Publications – 15th Edition – 2019.
- Rajan Saxena – "Marketing Management", The McGraw-Hill Companies Publication – 3rd Edition - 2017

Reference Books:

- Vijay Prakash Anand, "Marketing Management – An Indian Perspective" Wiley India Pvt. Ltd. 2019.
- Joel R. Evans, Berry Berman - "Marketing Management" 1st Edition 2018.
- James C. Anderson James A. Narus Das Narayandas, Business Market Management: Understanding, Creating, and Delivering Value, Prentice Hall; 3rd Edition, 2018.
- Stephen Wunker, Capturing New Markets: How Smart Companies Create Opportunities Others Don't, McGraw-Hill Education; 1st Edition, 2017.

Class: T.Y. B. Tech.	Semester: VI
Course Code: MAMD202	Course: I.C. Engines

L	T	P	Credits
3	-	-	3

Course Description:

This course describes the fundamentals of internal combustion engines used in automotive and allied applications. 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 engine performance such as power and efficiency. Students examine the design features and operating characteristics of different types of internal combustion engines like spark-ignition and compression ignition engines.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Perform a primary thermodynamic analysis of Otto and diesel cycle engines.
2. Select appropriate engine for specific application.
3. Select proper fuel system for IC engine.
4. Conduct performance test of IC engine and portray operating characteristics of engine.
5. Identify abnormal combustion in engine and remedy over it.
6. Select proper lubrication, intake, exhaust, cooling system for engine

Prerequisite: Applied Thermodynamics, Fluid Mechanics and Machinery, Theory of Machines, Heat Transfer.

Course Content:

Unit No.	Description	Hrs.
1.	**I. C. Engine types and applications** Engine nomenclature and classification, Valve and Port timing diagram, Engine selection, Engine Cycles, fuel-air cycle, Actual cycle.	06
2.	**Engine Performance** Performance parameters and its measurement, Heat balance, IS codes of engine testing, Heat rejection and cooling, Air cooling, liquid cooling, Numerical on Performance.	06
3.	**Fuel Supply System S.I. Engine** Carburetion, Gasoline injection, Electronic fuel injection system, Engine ECU -	06

	Operation and programming, Numerical on simple carburetor and gasoline injection system.	
4.	**Fuel Supply System for C.I. Engine** Requirements & types of Fuel injection pumps, injectors, Governor, Common rail and Electronic injection system, Engine ECU - Operation and programming, Numerical on Fuel injection pumps, injectors and CRDI.	**06**
5.	**Combustion** Combustion in S. I. Engine, Stages, Abnormal combustion, Control of abnormal combustion, Combustion chambers, Stages of combustion in CI engine, Abnormal combustion, Control over abnormal combustion, Combustion chambers for CI engines	**06**
6.	**Induction and Exhaust System** Air intake system, filters & manifolds, Mufflers and resonators, Supercharging, Turbocharging, Scavenging of two stroke and four stroke engines, Engine Friction and Lubrication, Pumping and blow by losses, Lubricating systems	**06**

References-

Text Books:

1. John b Heywood, Internal Combustion Engine, Tata McGraw Hill Publication.
2. V. Ganeshan, I C Engine, Tata McGraw Hill Publication.

Reference Books:

1. E. F. Obert, I.C. Engine & Air Pollution, Harper & Row Publishers.
2. SAE, Automotive Handbook, Bosch.

Class: **T.Y. B. Tech.**	Semester: **VI**
Course Code: **CEMD202**	Course Name: **Building Estimation and Valuation**

L	T	P	Credits
3	--	--	3

Course Description:
Building Estimation and Valuation course intends to develop the proficiency and confidence of the students so that they can prepare estimate of different civil engineering structures. The students will be able to analyze the rate of different building items. Thus, by studying this course, students will be more comfortable to prepare different bills on construction site.

Course Outcomes:
After successful completion of the course, student will be able to,
1. Explain the types and basic requirements of the estimate.
2. Explain measurement sheet, abstract sheet, and detailed specifications of different construction items.
3. Prepare detailed estimate of load bearing structure and framed structure.
4. Prepare rate analysis and bar bending schedule of different construction items.
5. Explain the tenders and contracts.
6. Describe basic terms of valuation.

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

Course Content

Unit No.	Description	Hrs.
1.	**Introduction SSR:** 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 S.S.R., General notes and guide lines.	06

2.	**Specifications:** Specification- purpose and types, General specifications for different class of buildings, Detailed specifications of building items like PCC, RCC, brick and stone masonry, plastering, flooring. Measurement sheet, Abstract sheet, long wall-short wall and center line method for finding quantities and problems.	06
3.	**Detailed estimate of building, road and culvert:** Detailed estimate of load bearing structures and RCC structures.	06
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. Preparation of bar bending schedule for isolated footings, pile footings, beams, columns, slabs, staircase, lintel, chajja.	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 liquidated damage, Arbitration, Escalation of cost, Daily reports maintained on site.	06
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, Methods of valuation, Freehold and leasehold property, types of lease, Mortgage, Mortgage deed and Precautions, Problems based on valuation.	06

References –

References Books: -

- B. N. Dutta, "Estimating and Costing in Civil Engineering", USB Publishers, Distributors Pvt. Ltd. Delhi-110 002.
- M. Chakroborty, "Estimating, Costing, Specification and Valuation in Civil Engineering", USB Publishers, Bhabananda Road, Kolkata-700026.
- B. S. Patil, "Civil Engineering Contracts and Estimates", Universities Press Private Ltd. Hyderguda, Hyderabad. 500029, (A.P), India.
- S. C. Rangwala, "Elements of Estimating and Costing", Charotar Publishing House - opposite Amul dairy, court Road Anand. 388001.India

I. S. Code:-

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

Class: T.Y. B. Tech.	Semester: VI
Course Code : CSMD202	Course Name : Problem Solving using JAVA

L	T	P	Credits
2	-	2	3

Course Description:

This lab course provides practical exposure to the fundamentals of Java programming and object-oriented principles such as classes, objects, inheritance, and polymorphism. Students will gain hands-on experience in implementing concepts such as abstraction, interfaces, packages, exception handling, and file operations. By practicing structured problem-solving using Java, students will be able to write modular, reusable, and robust code. The course promotes skill development through real-world coding exercises and mini-projects.

Course Learning Outcomes:

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

1. Describe the fundamental concepts of Java programming including variables, data types, control structures, arrays, and memory management.
2. Apply object-oriented principles such as classes, objects, constructors, access modifiers, and static members to develop Java programs.
3. Implement Inheritance, Polymorphism, Interfaces, Abstraction, and Nested Classes to build modular Java applications.
4. Manage packages and handle runtime errors using exception handling mechanisms.
5. Design and develop file-based Java applications using file handling classes and methods to perform basic CRUD operations.

Prerequisite: Basics of C programming, Fundamentals of Data Structures

Course Content

Unit No	Description	Hrs
1	**Fundamentals of Java:** Java: Overview, Features, JVM, JDK, JRE, Environmental Setup, Hello World Program, User Input, Comments, Variables, Data Types, Type Casting, Operator, Expression, Control loops and Statements, Arrays, Garbage Collection	04

2	**Introduction to Object Oriented Programming:** Introduction to OOP, Class & Object, Methods and Variables, Constructor, this keyword, Access Modifiers, static keyword	04
3	**Inheritance & Polymorphism:** Inheritance, super keyword, Polymorphism: Method Overloading and Overriding	04
4	**Interfaces & Abstraction:** Abstraction, Encapsulation, Interface, Final keyword, Nested Classes	04
5	**Package and Exception Handling:** **Package**: Organizing Classes and Interfaces in Packages, CLASSPATH setting for Packages, Naming Convention for Packages, **Exception Handling**: Exception and Errors, Types of Exception, Try-Catch Block, finally, throw and throws keyword, Java Built Exception and Custom Exception	04
6	**File Handling:** **File Handling**: CRUD Operations on File, File Methods	04

It should consist of 10 to 12 experiments based on the syllabus and experiment list mentioned below.

Experiment List		
Experiment No	**Description**	**Hrs**
1.	Write a program using input, data types, type casting, loops, and arrays.	02
2.	Implement a class with methods, constructor.	02
3.	Demonstrate the use of access modifiers, static and this keyword in a program.	02
4.	Write a program for inheritance and its types.	02
5.	Demonstrate method overloading and overriding in Java.	02
6.	Create a program using abstract classes and encapsulated attributes.	02
7.	Implement interface and final keyword in a real-time use case.	02
8.	Create user-defined packages and access them with correct class path settings.	02
9.	Handle built-in and custom exceptions using try-catch-finally.	02

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10.	Perform file creation, read, write, and delete operations using File class.	**02**

References -

Text Books:

- Balagurusamy, Programming with Java, , McGraw Hill
- Herbert Schildt, Java: The Complete Reference, , McGraw Hill

Reference Books:

- Kathy Sierra and Bert Bates, Head First Java, O'Reilly
- Joshua Bloch, Effective Java, Addison-Wesley
- Official Oracle Java Documentation – https://docs.oracle.com

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Common to All Departments

Class: **T.Y. B. Tech.**	Semester: **VI**
Course Code : **EEMD202**	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 equipments as per requirement.

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:** Classification of substations, outdoor and indoor substations. Symbols for equipment in substations and their functions	06

References -

Text Books:

- V.K Mehta, Principles of Power Systems, S. Chand
- Ashfak Husain, Electrical Power System, CBS Publication

Reference Books:

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

Class:- T.Y. B. Tech.	Semester- VI
Course Code : ECMD202	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**	**06**

	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	
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 & Analog Communication Systems, Wiley India
- RP Singh, S D Sapre, Communication System-Analog & Digital, Tata Mc-Graw Hill
- Kennedy, Davis, Electronics Communication Systems, Tata McGraw Hill

Reference Books:

- Bernard Sklar, Digital Communication-Fundamentals and Applications, Pearson Education
- Tomasi, Electronic Communication Systems Pearson Education.
- Taub, Schilling, Principles of communication systems, Tata McGraw Hill.
- Louis E Frenzel, Communication Electronics Principles & Applications, Tata McGraw Hill

K.E. Society's

Rajarambapu Institute of Technology, Sakharale

(An Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Syllabus (Theory & Laboratory Course)

To be implemented from **2025-26**

Common to All Departments

Class: **T.Y. B. Tech.**	Semester: **VI**
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**	**07**

	General method, Multistage graphs, all pair shortest paths, 0/1 Knapsack problem, Reliability design, Traveling sales person problem.	
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" The MIT Press.

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.

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Syllabus (Theory & Laboratory Course)
To be implemented from 2025-26
Common to All Departments

Class: T.Y. B. Tech.	Semester: VI	L	T	P	Credits
Course Code: MEMD202	Course Name: Design and Drawing of Machine Components	3	-	--	3

Course Description:
Design and Drawing of Machine Component is offered as the multidisciplinary minor course at the fourth semester of Engineering undergraduate program and consists of six chapters. The first chapter focuses on Free hand sketches and representation of assembly drawing, the second chapter deals with limits, fits, tolerances and production drawing. The third chapter deals with Basic design procedure, requirement of machine element and material selection. Design of machine elements against static loading like knuckle joint, Design of shaft, keys is dealt with in the fourth chapter. The next chapters' deal with Design of Spur Gear and Selection of bearing. Last chapter emphasizes on design of component subjected to fluctuating load.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Produce the production drawing of simple mechanical assemblies.
2. Design the machine components subjected to static loading.
3. Design of spur gear and selection of roller bearing.
4. Design a components against fluctuating load.

Prerequisite:
The students should have knowledge of basic principles of science. They should have knowledge of fundamentals of Engineering Graphics..

Course Content		
Unit No.	**Description**	**Hrs.**
1.	**Assemblies of basic mechanical components:** Importance of sketching, Introduction to basic mechanical components Nuts, bolts, couplings, pulleys, belt, shaft, gear, spring etc. Free hand sketches of types of nuts, bolts, couplings and pulleys. Details and assembly drawing of Screw jack, Tools post of center lathe.	**06**
2.	**Production drawing:** Limits, Fits and Tolerances ISO system of tolerance, Tolerance charts, Hole -base and shaft -base system of tolerance, Types of fits, symbols and applications. Geometric Tolerances: Introduction, Nomenclature, Rules,	**06**

	Symbols. Surface Roughness & Production Drawing.	
3.	**Design procedure of machine components:** Introduction: Engineering Design and classification, Basic design procedure, requirement of machine element, standards and codes, State of stresses, Theories of elastic failure, Classification of engineering materials, selection of materials.	06
4.	**Design against static loading:** Design of knuckle joint, Design of solid & hollow shafts, transmission shafts, Design of keys.	06
5.	**Gear and bearing:** Types of gears, Terminology of gear, force analysis, Spur gear design based on beam strength and wear strength criteria. Types of bearings, Terminology of bearing, Selection of roller bearing from manufacturer's catalogue.	06
6.	**Design for Fluctuating Load:** Stress concentration - causes & remedies, fluctuating stresses, fatigue failure, S-N curve, Endurance limit, Notch sensitivity, Endurance strength, modifying factors, reversed stresses. Design for finite & infinite life, Soderberg & Goodman diagram, Modified Goodman diagram, Fatigue design of components under combined stresses such as shaft.	06

References -

Textbooks:

1. P. S. Gill, *Machine Drawing*, S. K. Kataria & Sons.
2. V. B. Bhandari, *Design of Machine Elements*, New Edition, Tata McGraw Hill.

Reference Books:

1. Machine Design Integrated Approach by Robert L. Norton.
2. PSG Design Data Book
3. Machine Design by Pandya Shah.
4. Design of Machine Element by M. F. Spotts.
5. Mechanical Analysis & Design by H. Burr & Cheata.

Class: T.Y. B. Tech.	Semester: VI
Course Code: MCMD202	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.**
7.	**Fluid Power Systems and Fundamentals** 1. Introduction to fluid power, Advantages of fluid power. 2. Application of fluid power system. 3. Types of fluid power systems, Properties of hydraulic fluids, General types of fluids. 4. Fluid power symbols. (ISO/JIC) 5. Use of Automation studio to draw circuits.	06
8.	**Hydraulic System and Components (Pumps And Actuators)** 1. Pumping theory, Pump classification. 2. Gear pump, Vane Pump, construction and working of pumps, pump performance, piston pump 3. Variable displacement pumps. 4. Linear hydraulic actuators, Types of	06

	hydraulic cylinders, Single acting, Double acting cylinders. 5. Special cylinders like tandem, Rod less, Telescopic - Construction and application. 6.Cushioning mechanism, Mounting of actuators 7. Rotary actuators - Gear, Vane and Piston motors.	
9.	**Hydraulic Valves, Accumulators and Circuits** 1. Directional control valve .4/2, 4/3, 5/3-way valves. 2. Shuttle valve check valve 3. Pressure control valve,4. Flow control valve (Fixed and adjustable) 5. Electrical control solenoid valves 6. Types of accumulators, Accumulators circuits 7. Intensifier Circuit and Application, 8. Speed control circuits, synchronizing circuit and industrial application circuits copying circuit and press circuit, regenerative circuit.	**06**
10.	**Pneumatic Systems, Components and Circuits** 1.Properties of air Compressors. 2.Filter, Regulator, and Lubricator Unit 3. Air control valves, Quick exhaust valves and pneumatic actuators 4. Pneumo-hydraulic circuit 5. Time delay circuits 6. Sequential circuit design for simple applications using cascade method.	**06**
11.	**Fluid Logic Control System** 1. Hydro Mechanical servo systems. 2 Electro-hydraulic and Electro-pneumatic systems and proportional valves 3. Electro-hydraulic and Electro-pneumatic systems and proportional valves 4. Introduction to fluidic devices, simple circuits 5. PLC applications in fluid power control 6. Failure and troubleshooting in fluid power systems 8. Pneumatic positioning and servo systems, air hydro boosters.	**06**
12.	**Hydraulic/Pneumatic Circuit Design** 1. Steps in hydraulic circuit design, and simulation using Automation Studio. 2. Steps in pneumatic circuit design, and simulation using Automation Studio.	**06**

References -

Textbooks:

- Fluid Power, Anthony Esposito, Prentice Hall Publications.
- Industrial Hydraulics and Pneumatics, Stewart
- Industrial Hydraulics and Pneumatics, H.P. Garg.
- Oil Hydraulic Systems: Principles and Maintenance by S. R. Mujumdar.

Reference Books:

- Industrial Hydraulics, Vickers Handbook.
- Hydraulics-Basic level TP501 handbook by FESTO.

Class: T.Y. B. Tech.	Semester: VI
Course Code : AIMD202	Course Name : Data Structures & 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:
The course should enable the students 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. Analyze 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, Knowledge of 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 :** 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.	**07**
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:

- Data structures -- Seymour Lipschutz (MGH) Schaum's Outlines.

Reference Books:

- Data structures and Algorithms -- Alfred V. Aho, John E. Hopcroft, J. D. Ullman (Addision- Wesely Series)
- Introduction to Data Structures in C – Ashok N. Kamthane (Pearson Education).

Class: **T.Y. B. Tech.**	Semester: VI
Course Code: **MAMD302**	Course: **Electric Vehicles**

L	T	P	Credits
3	-	-	3

Course Description:
Electric and hybrid electric vehicles are being seen as substitutes for conventional IC engine powered vehicles. Because of current and future transportation challenges, HEV technology is poised for significant growth. Policy initiatives of Government of India like NEMMP and FAME encourage this technology and help penetrate the market. Research is going on to find solutions to the current limitations of this technology. This course exposes the students to the EV and HEV technology and equips them to avail emerging opportunities in the area of HEV technology in automotive industry.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Articulate the need of EVs and HEVs in today's transportation context.
2. Design an electric vehicle for given requirements.
3. Design a hybrid electric vehicle for given requirements.
4. Elaborate fuel cell technology for vehicular application.

Prerequisite: Automotive Systems, Electric Drives and Controls.

Course Content:

Unit No.	Description	Hrs.
7.	**Introduction and background** Environment impact, market scenario, well-to-wheel analysis, carbon credits conventional drive train, I C engine characteristics, performance curves of typical manual transmission, ideal power curve, GoI policy initiatives	06
8.	**Electric vehicles - technology and design** Configurations of EVs, Electric motor characteristics, design process and issues, modelling and performance estimation, energy consumption, regenerative brakes	06
9.	**Hybrid electric vehicle technology** Concept, modes and operation patterns, architectures of hybrid drive trains, series hybrid drive train, parallel hybrid drive train with torque coupling and speed coupling	06
10.	**Series and Parallel hybrid drive trains** Operation patterns, design objectives, control strategies, sizing of components, parametric design	06
11.	**Energy sources and drives for EVs** Electrochemical batteries, charging of batteries, charging infrastructure, Battery Management System (BMS), super capacitors, ultra-high-speed flywheels, electric motors used for EVs and HEVs like dc motors, induction motors, synchronous motors, SRM etc.	06

12.	**Fuel Cell Electric Vehicle drive train** Fuel cell technology, PEM and direct methanol fuel cell, drive train design for FCVs.	06

References-

Text Books:

1. Ehsani, Gao and Emadi, Modern Electric, Hybrid Electric and Fuel cell vehicles, CRC Press.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley & Sons
2. Iqbal Hussain, Electric & Hybrid Vehicles: Design Fundamentals, CRC Press.
3. Robin Hardy, Iqbal Husain, Electric and Hybrid Vehicles, CRC Press
4. Dr. Mike Westbrook, M H Westbrook, The Electric Car: Development & Future of Battery, Hybrid & Fuel-Cell Cars

Class: **T. Y. B. Tech.**	Semester: **VI**
Course Code : **CEMD302**	Course Name: **Public Health Engineering**

L	T	P	Credits
3	-	-	3

Course Description:

Environmental Engineering course offered as MDM in 6th semester, which focuses on water supply engineering and wastewater treatment, solid waste management and air pollution. The course enables students to work as a consultant or contractor for infrastructure projects related to water supply and waste management projects. This course intends to build the competency in the students to identify water source, to check water quality, to design of water supply scheme and wastewater treatment plant. Also this course enables student to control environmental degradation by using AI tools.

Course Learning Outcomes:

After successfully completing the course, student will able to:

1. Explain importance of water and wastewater analysis for various parameters.
2. Discuss impact of pollution on man, animal and plants.
3. Prepare layout of water and wastewater treatment process.
4. Design Water and Wastewater Treatment Plant.
5. Apply AI tools for impact of humans on environment.

Prerequisite: Basic knowledge of Environmental Science.

Course Content		
Unit No.	**Description**	**Hrs**
01	**Introduction to Public Health Engineering** Introduction to Water Supply Engineering (WSE) Sources of Water and quality issues, water quality requirements for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.	**06**
02	**Water Treatment Process** Layout of Water Treatment Plant, Aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes, design problems on water treatment process, application of SCADA for water treatment plant	**06**
03	**Sewage and Storm Water Collection system**	**06**

	Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification, and design of Storm water; Sewage and Sludge, Pollution due to improper disposal of sewage,	
04	**Wastewater Treatment Process** Layout of Sewage Treatment Plant, wastewater treatment-Physical, chemical and biological treatment,, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes, design problems on components of wastewater treatment, Applications of SCADA for STP operations.	**06**
05	**Solid Waste Management** Solid waste, physical and chemical composition of solid waste, Functional elements of solid waste, Treatment and disposal of solid waste and Integrated solid waste management, application of remote sensing and GIS for SWM	**06**
06	**Air Pollution and Control** Air pollution, effects of air pollution on man material and vegetation, Metrological aspects of air pollution, Control of air pollution, Vehicular pollution, Global issues of environment viz. Global warming, acid rain, ozone layer depletion, Applications of AI tools for control of air pollution	**06**

References:

Text Books:

- Punmia B. C. "Water Supply Engineering" Lakshmi Publications Pvt. Ltd. New Delhi
- Punmia B. C."Wastewater Treatment and Reuse" Lakshmi Publications Pvt. Ltd. New Delhi
- Modi P. N. "Water Supply Engineering" Standard Book House, New Delhi
- Modi P. N. "Wastewater Treatment and Reuse" Standard Book House, New Delhi
- Rao M. N. & Datta A. K. "Wastewater Treatment" Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.

Reference Books:

- Metcalf and Eddy, "Wastewater Engineering: Treatment & Reuse" Tata McGraw Hill Publication.

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Class:- **T.Y. B. Tech.**	Semester-**VI**
Course Code: **CSMD302**	Course Name: **Artificial Intelligence**

L	T	P	Credits
3	–	–	3

Course Description:
In this course students will learn the basic concepts and techniques of Artificial Intelligence. These students will be able to develop AI algorithms for solving practical problems.

Course Learning Outcomes: on completing this course, students will be able to
1. Understand the basic concepts and techniques of Artificial Intelligence.
2. Apply AI algorithms for solving typical practical problems.
3. Describe appropriate knowledge representation schemes in AI.
4. Apply reasoning schemes in AI.
5. Analyze the planning schemes for goal stack.
6. Evaluate performance of solution for constraint satisfaction problem.

Prerequisites:
- Basic knowledge of logical reasoning and Probability theory.

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction** Artificial Intelligence and its applications, Definitions of AI, Intelligent Agents, Concept of rationality, PEAS description of the task, Simple reflex agents, Model based agents, Learning Agents, advantages, Impact and Examples of AI, Application domains of AI.	06
2	**Problem solving techniques** State space search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hill climbing, best first search, A* search, Constraint satisfaction problem, Mean-end analysis, Game playing, Min-Max Search, Alpha-Beta Pruning. Iterative deepening.	06
3	**Logic and Knowledge Representation schemes in AI** Propositional logic, predicate logic, Resolution, Resolution in proportional logic and predicate logic, Clause form, unification algorithm.	06
4	**Reasoning schemes in AI** Introduction to non-monotonic reasoning, default reasoning, statistical reasoning, probability and Bayes' theorem, combining uncertain rules.	06
5	**Planning** The Planning problem, planning with state space search, blocks world approach, Goal stack planning.	06

6	**Understanding** Level of interactions among components, understanding as a constraint satisfaction, Line labeling, The Waltz algorithm.	**06**

References:

Text Books:

- Artificial Intelligence by Rich and Knight, The McGraw Hill publication
- Artificial Intelligence: A modern approach by Stuart Russel, Peter Norvig, Third Edition, Pearson Education, 2010

References:

- https://www.edx.org/course/artificial-intelligence-ai
- https://www.udemy.com/course/artificial-intelligence-az/

Class:- **TY B. Tech.**	Semester- **VI**
Course Code: **EEMD302**	Course Name: **Smart Grid**

L	T	P	Credits
3	--	--	3

Course Description:
This course covers the fundamental aspects of the smart grid, various technologies, communication and applications of renewable sources for developing smart grid. It introduces state of the art smart grid technologies like electric vehicles, microgrids, energy storage, phasor measurement unit and cyber security, etc. In addition, it discusses the architecture of smart gird, various distributed energy sources, smart metering and distribution automation equipment.

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

1. Summarize the concept and future of smart grid
2. Develop smart grid architecture
3. Compile various smart grid technologies
4. Identify communication and information technologies for smart grid
5. Elaborate distributed generation and storage technologies
6. Recommend smart metering and distribution automation

Prerequisite:
Fundamentals of Power system.

Course Content

Unit No	Description	Hrs
1	**Introduction to smart grid:** Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India, comparison between smart grid and micro grid, Grid Codes.	06
2	**Smart grid architecture:** Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, centralized, distributed and hierarchical control strategies, power line communications, supervisory control and data acquisition system.	06
3	**Communication technology in smart grid:** Introduction to communication technology, Home Area Network (HAN), Neighborhood Area Network (NAN) and Wide Area Network (WAN), two-way digital communications paradigm, synchro-phasor measurement units (PMUs) – wide area measurement systems (WAMS), Introduction to Internet of things (IoT)- Applications of IoT in Smart Grid.	06

4	**Information technology in smart grid:** Data communication, dedicated and shared communication channels, switching techniques- circuit switching, message switching, packet switching, virtual packet switching, datagram packet switching, standards for information exchange, information security for the smart grid,	06
5	**Distributed generation and storage:** Introduction to distributed energy sources, solar PV system, wind energy system, microgrids, microgrid architecture, AC micro grid, DC microgrid, storage technologies- battery, super capacitor, compressed air energy storage, pumped hydro energy storage, introduction electric vehicles- vehicle to grid (V2G), grid to vehicle (G2V), vehicle to vehicle (V2V) and vehicle to home (V2H) operation in smart grid.	06
6	**Smart metering & distribution automation:** Evolution of electricity metering, key components of smart metering, overview of the hardware used, communications infrastructure for smart metering and protocols for smart metering, equipment's used in smart grid - current transformers, voltage transformers, intelligent electronic device, bay controller, remote terminal units, components for fault isolation and restoration, fault location.	06

References -
Text Books:

- Janaka Eknayake, "Smart Grid- Technology and applications", Wiley publications.
- A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Application", Springer.

Reference Books:

- S. Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press.
- G. Masters, "Renewable and Efficient Electric Power System", Wiley–IEEE Press.
- T. Ackermann, "Wind Power in Power Systems, Hoboken", N J, USA, John Wiley.

Class: T.Y. B. Tech.	Semester: VI
Course Code : ECMD302	Course Name : Electronic Product Design

L	T	P	Credits
2	-	-	2

Course Description:
This course aims to introduce various methods, processes and protocols in product design. In this course student will develop a strong fundamental base for the design of electronic product.

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

6. Elaborate product design processes.
7. Explain various aspects of PCB design.
8. Differentiate product-testing methods.
9. Create various documents for the product.

Prerequisite:
Knowledge of basics analog and digital electronics and communication.

Course Content

Unit No	Description	Hrs
7.	**Product Design and Development** Introduction, Product Development Basics, Product Development Stages, Identification of the Customer Requirements, Techno-Commercial Feasibility of a Product, Pilot Production Batch , Product Assessment, Availability, Screening Test of Component, Redundancy, Ergonomic and Aesthetic Design Considerations	04
8.	**Noise and Heat Management** Power Supply Protection Devices, Transient Voltage Suppressor, Fuses, Line Filters, Noise Consideration of a Typical System, Noise in Electronic Circuits, Grounding, Shielding, Guarding. Thermal Management.	04
9.	**PCB Design** Introduction to PCBs, Layout, Issues Related to PCB Size, Design Issues Related to Supply and Ground Conductors, Multilayer Boards, Component Assembly Techniques, Comparison of PCBs.	04
10.	**Hardware and software Design and Testing Methods** Introduction, Signal Integrity, Software Design and Testing Methods, Phases of Software Design, Selection of Language for Software Development, Assemblers, Compilers, Simulators, Emulators.	04
11.	**Electronic Product Testing** Introduction, Environmental Testing, Temperature Testing, Thermal Modeling of Components, Humidity Testing, Electrical Overstress Testing,	04

	Altitude Testing, Special Testing, Environmental Test Chambers and Rooms, Various Tests on Enclosures, EMI and EMC Related Testing, Importance of Standards, List of Some Standards.	
12.	**Product Documentation** Introduction, Types of Documentation, How to Prepare an Effective Document, PCB Documentation, Bill of Material: A Documentation of Part List, Manual Types.	**04**

References -

Text Books:

1. R.G.Kaduskar, V.B.Baru, Electronic Product Design, Wiley Publication

Reference Books:

1. Walter C Bosshart, Printed Circuit Board design and technology, Tata McGraw Hill
2. Clyde Coombs ,Handbook of Printed Circuit, MCGraw Hill publication
3. M.G. Loveday, Electronic testing and fault diagnosis, Longman publication

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Class:- **T.Y. B. Tech.**	Semester-VI
Course Code : **CIMD302**	Course Name: **Software Engineering**

L	T	P	Credits
3	--	--	3

Course Description:
This course deals with various concepts of Software Engineering. It includes concepts such as software requirements, software process models, function-oriented and object-oriented design. Software engineering covers the basic concepts such as data analysis, modeling and design required for developing software. It also covers concepts such as Objects, classes, links and associations, generalization and inheritance, aggregation, abstract classes and advanced modeling concepts in UML.

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

1. Describe fundamental concepts in software engineering and project management
2. Practice software process models for the undertaken software problems
3. Design function-oriented and object oriented models using modern tools.
4. Identify classes and build the domain model using advanced concepts in object, dynamic and functional modeling.
5. Analyze existing software systems using function and object-oriented analysis.
6. Design models using UML diagrams for software systems: use case, class, sequence, collaboration, activity, state chart diagrams, component and deployment.

Prerequisite: Fundamentals of Computers

Course Content

Unit No	Description	Hrs
1.	**Software Requirements, Analysis and Specification** Software requirement analysis and specification, problem analysis, Requirement Specification, Validation, effort estimation, risk management, software testing types	06
2.	**Software Process Models** Waterfall model, V model, Prototyping, Spiral model, Agile software development	07
3.	**Function-oriented Design** Design principles, module level concepts, Design notation and specification, structured design methodology, Verification	05

4.	**Structural Modeling using UML** Classes, Relationships, Common mechanisms. Diagrams, Class Diagrams, Interfaces, Types and Roles, Packages, Instances and Object Diagram	**06**
5.	**Behavioral Modeling and Architectural Modeling using UML** Interactions, Use cases, Use case diagram, Activity diagrams, Events and signals, State Machines, Components, Deployment, Collaboration, Patterns and Frame works, Component diagrams and Deployment Diagrams	**06**
6.	**Case studies:** A. Case study on DFD for Hospital Management System, Library Management System, Railway Reservation System and Online Shopping System. B. Case study design using UML on Banking system, College management system, online food ordering system.	**06**

References -

Text Books:

1. Pankaj Jalote, "An Integrated Approach to S/W Engineering.", Narosa Publication House, Eleventh edition, 2011
2. Grady Booch, Jeams Rambaugh, Ivar Jacotson, "The Unified Modeling Language User Guide" (Addison Wesley)

Reference Books:

1. Roger S. Pressman, "Software Engineering – Practitioner's Approach", TATA McGraw-Hill, Seventh Edition, 2014

K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Autonomous Institute, Affiliated to Shivaji University, Kolhapur)
Syllabus (Theory & Laboratory Course)
To be implemented from **2025-26**
Common to All Departments

Class:- **T.Y. B. Tech.**	Semester-VI
Course Code : **MEMD302**	Course Name : **Power Plant Engineering**

L	T	P	Credits
3	-	--	3

Course Description:
The course power plant engineering deals with the study of energy, its sources and utilization of energy for power generation. The power is generated by prime movers (example Hydraulic turbines, steam turbines, diesel engines). Large amount of power is generated using prime movers in a site or layout called power plants, where all the equipment and machineries required for power generation is located.
It is the challenging task to meet increasing demands of power for modern era researchers. For harvesting energy from various resources, power plants are used depending upon type of resource available. Knowledge of various power plants are essential for Mechanical engineering undergraduate.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Explain economics of power generation and energy scenario
2. Explain improvisations in Rankine cycle and its effect on performance
3. Analyze thermodynamics gas power cycles and effect of various parameter on efficiency.
4. Analyze different techniques for improvement of efficiency of gas turbine plant
5. Explain construction and working of nuclear power plants and its subsystems
6. Explain construction and working of different renewable energy power plants

Prerequisite:
For understanding of this course prior knowledge of following courses is essential.
1. Applied thermodynamics
2. Basics of Mechanical Engineering

Course Content

Unit No	Description	Hrs
1.	**Economics of Power Generation:** Load duration curves, location of power plants, Power plant economics (Construction costs, fixed costs and depreciation, fuel cost, present-worth concept, incremental heat rate, economics scheduling principle, effect of load factor on cost), Indian energy scenario (Numerical treatment)	06
2.	**Thermal Power Plants:** General layout of modern thermal power plant, Fuel and ash handling, Draught system, Feed water treatment, Improvisation in Rankine Cycle,	06

	Reheat Rankine cycle, Super critical Rankine cycle, Regenerative Rankine cycle, Mean temperature of heat addition, Cogeneration (Numerical treatment)	
3.	**Analysis of Gas Power Cycles:** Introduction, Carnot cycle, Stirling cycle, Ericsson cycle, Lenoir cycle, Atkinson cycle, Brayton cycle, Effect of pressure ratio on efficiency of Brayton cycle (Numerical treatment)	**06**
4.	**Gas Turbine Power Plants:** Gas turbine: Classification, open and closed cycle, deviation of actual gas turbine cycle from Brayton cycle, methods for improvement of thermal efficiency of gas turbine plant (Regeneration, reheating, intercooling, reheating and regeneration), (Numerical treatment)	**06**
5.	**Nuclear Power Plants:** Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.	**06**
6.	**Renewable Energy Power Plants:** Principle, Construction and working of Hydro-electric, Wind, Tidal, Solar Photo Voltaic (SPV), Geo Thermal, Biogas and Fuel Cell power systems	**06**

References -

Text Books:

- Nag. P.K., "Power Plant Engineering", Tata McGraw Hill Publishing Company Ltd.
- Arora and Domkundwar, "Power Plant Engineering", Dhanpat Rai and Co. Delhi.
- R.K. Rajput, "Power Plant Engineering", Laxmi Publication, Delhi

Reference Books:

- El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd.
- Veatch & Black, "Power Plant Engineering", CBS Publishers & Distributors New Delhi

Class: - **T.Y. B. Tech**	Semester-VI
Course Code: **MCMD302**	Course Name: **Industrial Robotics**

L	T	P	Credits
3	-	-	3

Course Description:
Industrial robots are nearly on the verge of revolutionizing Manufacture as they end up noticeably more intelligent, quicker, and less expensive, they are being called upon to accomplish more. They are going up against more "human" abilities and attributes, for example, detecting, expertise, memory, and trainability. Accordingly, they are going up against more employments for example, picking and packaging, testing, or investigating items, or assembling minute gadgets.

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

1. Explain the basic concepts of Robots.
2. Select an end effector and sensor for application.
3. Explain drives and controls for robotic system.
4. Develop program for robot to perform tasks in industrial applications.

Prerequisite: Sensor and Instrumentation

Course Content

Unit No.	Description	Hrs.
1	**Fundamentals of Robotics:** History of Robotics, Definitions of Industrial Robot, Type and Classification of Robots, Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot.	06
2	**Grippers for Robotics:** Grippers, Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper systems.	06
3	**Sensors for Robotics:** Types of Sensors used in Robotics, Touch Sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure sensors, Application of Sensors, Characteristics of Sensing devices, Selection for Particular application Case study.	06
4	**Drives and Control for Robotics:** Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system, Types of Controllers, Introduction to closed loop control.	06

5	**Programming and Languages for Robotics:** Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, ROS.	**06**
6	**Application of Robotics in Industry:** Application of robot in welding, machine tools, material handling, and assembly operations, parts sorting and parts inspection, AI in robotics, Introduction to Cobots, Future Application and Challenges and Case Studies.	**06**

References -
Text Books:

- Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, Robotic Engineering - An Integrated Approach, Prentice Hall Department of Industrial Design Detail Syllabi 318NIT Rourkela India, New Delhi,
- Mikell P Groover, Industrial Robotics - Technology, Programming and Applications, McGraw Hill,
- Introduction to Robotics- John J. Craig, Addison Wesley Publishing,

Reference Books:

- James A Rehg, Introduction to Robotics in CIM Systems, Prentice Hall of India,
- Deb S R, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi,
- Janaki Raman P A, Robotics and Image Processing, Tata McGraw Hill,
- Robotics for Engineers -YoramKoren, McGraw Hill International,

Class: - T.Y B. Tech.	Semester – VI
Course Code: AIMD302	Course Name: Principles of AI

L	T	P	Credits
3	-	-	3

Course Description:
In this course students will learn the basic concepts and techniques of Artificial Intelligence. These students will be able to develop AI algorithms for solving practical problems.

Prerequisite:
- Basic knowledge of logical reasoning
- Probability theory.

Course Learning Outcomes:
After completing this course, students will be able to
1. Articulate basic concepts and techniques of Artificial Intelligence.
2. Apply AI algorithms for solving typical practical problems.
3. Designate appropriate knowledge representation schemes in AI.
4. Analyze reasoning schemes in AI.

Course Content

Unit No	Description	Hrs
1	**Introduction** The four categories of definitions of AI, Concept of rationality, The AI Problems, Artificial Intelligence Technique, Tic-Tac-Toe game and its data structure, Question-Answering and its one typical data structure, Sample few examples of the state-of-art AI applications.	06
2	**Intelligent Agents** PEAS description of the task, Simple reflex agents, Model based agents, Learning Agents, advantages, Impact and Examples of AI, Application domains of AI.	06
3	**Problem solving techniques** State space search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hillclimbing, best first search, A* search.	06
4	**Constraint satisfaction problem** Mean-end analysis, Game playing, Min-MaxSearch, Alpha-Beta Pruning. Iterative deepening.	06
5	**Logic and Knowledge Representation schemes in AI** Propositional logic, predicate logic, Resolution, Resolution in proportional logic and predicate logic,Clause form, unification algorithm.	06

6	**Reasoning schemes in AI** Introduction to nonmonotonic reasoning, default reasoning, statistical reasoning, probability and Bayes' theorem, combining uncertainrules.	**06**

References -

Text Books:

- Artificial Intelligence by Rich and Knight, The McGraw Hill publication
- Artificial Intelligence: A modern approach by Stuart Russel, Peter Norvig, Pearson Education

Reference:

- Artificial Intelligence | Electrical Engineering and Computer Science | MIT OpenCourseWare

Class: **T. Y. B. Tech.**	Semester: **VI**
Course Code: **SH3064**	Course Name: **Scholastic Aptitude-II**

L	T	P	
1	-	2	**Audit**

Course Description

Quantitative and Reasoning tests form a major part of most of the competitive exams and recruitment processes. They evaluate numerical ability and problem solving skills of candidates. Along with the arithmetic abilities, candidate's patience while reading through the question is also tested. Decision making is also a crucial part of the process with a question having multiple solutions and the candidate has to choose the most efficient one.

Fast calculations have become an integral part of a candidate's career. Calculating the remuneration and efficiency, estimating profits and interests on the principal, using a logical approach towards solving a problem is now a routine affair for a professional.

Course Learning Outcomes:

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

Develop a thorough conceptual understanding and develop a logical approach towards solving Aptitude and Reasoning problems.

Understand usage of basic aptitude terms of percentages, averages, ratios and applications of business aptitude terms of profits and interests

Develop a bridge in analogies, series and visualizing directions.

Apply various short cuts & techniques to manage speed and accuracy to get equipped for various competitive and campus recruitment exams

Prerequisite:

Fundamentals of various Mathematical and Arithmetic operations, Calculations.

Course Content		
Unit No	**Description**	**Hrs.**
1.	**Speed Time Distance** Average Speed, Special Cases of Average Speed, Relative Speed, Cases of relative speed Circular motion, Applications of STD	03
2.	**Trains** Stationary Object with Negligible length, Stationary Object with considerable length, Moving object with negligible length, Moving object with considerable length, Including-Excluding Stoppages.	02
3.	**Boat & Streams** Upstream case, Downstream case , Perpendicular movement	02
4.	**Races** Head Start , Dead heat,defeat,3 man participating in race, ratio related examples,	02
5.	**Permutation & Combination** Difference between P & C, Theorems of Permutation Theorems of Combination, Counting numbers of squares & rectangles, Triangle	02
6.	**Probability** Introduction, Range of Probability, Sum & Product Rule, Coins, Dice, Cards, Bags & Balls	02
7.	**Geometry** Triangles, Quadrilaterals, Circles, Polygons	02
8.	**Mensuration** Cube, Cuboid, Cylinder, Cone Sphere, Prism	02
9.	**Clock** Basic, Time lag constant, Standard time of coincidence, Various concepts of hour and minute hand, Questions on strikes of clock, Find time in the mirror, Questions based on faulty clock, Time gains or loss	02
10.	**Calendar** Leap year, Odd day concept, Month code, century codes, Same Calendar concept, Finding day or date (Box method)	02

11.	**Seating Arrangement** Type of arrangements, Types of information, Data extraction, Linear-Non Linear movement, Advance movement	**02**
12.	**Analytical Reasoning I** Figure Counting,Pattern Completion / Figure Matrix,Embedded Figures / Hidden Figures,	**03**
13.	**Analytical Reasoning II** Water images , Mirror Images , Cubes and Dice , Paper Folding and Cutting	**02**
14.	**Statements & Conclusion** Understanding the Premise, Identifying Logical Deductions, Cause and Effect	**02**
	Total Hours	**30**

Reference Books:

1. R. S. Aggarwal, "Quantitative Aptitude", S Chand Publishing, New Delhi.
2. R. S. Aggarwal, "Logical Reasoning", S Chand Publishing, New Delhi.
3. Arun Sharma, "Quantitative Aptitude", McGraw Hill Publishing, New Delhi 7th Edition.
4. Arun Sharma, "Logical Reasoning", McGraw Hill Publishing, New Delhi 3rd Edition.

Class: **T.Y. B. Tech.**	Semester-VI
Course Code: **MA3411**	Course Name: **Automotive Power Plant & Vehicle Testing Lab.**

L	T	P	Credits
-	-	4	2

Course Description:
This course is including the study and demonstration of I.C. Engine, it is working along with various sub-systems like cooling and lubrication – both for S.I. and C.I. engines, MPFI and CRDI system, cooling & lubrication systems. Also, the testing of I.C. engines to determine the engine performance of the students. This course explains the process of conducting testing of single-cylinder; multi-cylinder petrol; diesel engines (Constant Speed; Variable Speed Tests), heat balance sheet calculations, air/fuel ratio determination, etc.
Vehicle testing is an essential part of research and development to improve the performance of vehicle in order to meet the customers' expectations. The course aims at learning vehicle performance parameters, testing methodologies and instrumentation needed for vehicle testing. The contents of course include testing and analysis of the vehicle to evaluate the vehicle performance by knowing the parameters such as noise, vibration, acceleration, braking, fuel economy and emission parameters.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Demonstrate the fuels supply, lubrication, cooling systems and its components.
2. Describe working of MPFI & CRDi System.
3. Conduct the test on single cylinder and multi-cylinder petrol & diesel engines
4. Plot the engine performance characteristics curves and interpret the curves.
5. Analyze performance of two and four wheelers using on road and laboratory testing methods.
6. Determine noise level in automotive systems using noise measurement systems.
7. Use vibration measurement system to determine vibration characteristics of automotive systems and components.
8. Select appropriate sensor for performance evaluation of vehicle and vehicle components.

Prerequisite: Internal Combustion Engines

Course Content

Experiment No	Description	Hrs
1.	Demonstration of petrol & diesel engine fuel system	02
2.	Demonstration of fuel injection pump, injector and governor	02
3.	Demonstration of MPFI and CRDI System	02
4.	Demonstration of lubrication and cooling system of engine	02
5.	Demonstration of valve timing diagram	02

6.	Introduction to ISI codes for engine testing	**02**
7.	Engine performance curves and its interpretation	**02**
8.	Measurement of air/fuel ratio of diesel engine	**02**
9.	Trial on single cylinder diesel engine –Willan's Line Method	**02**
10.	Morse test on petrol engine.	**02**
11.	Heat balance test on single cylinder diesel engine.	**02**
12.	Trial on multi-cylinder petrol engine – Variable speed test.	**02**
13.	Heat balance test on computerized single/multi cylinder diesel engine.	**02**
14.	Performance testing of a two-wheeler using chassis dynamometer	**02**
15.	On road testing of a four-wheeler for acceleration and braking performance	**02**
16.	Modal Analysis of Automotive components	**02**
17.	Measurement of noise level inside the vehicle	**02**
18.	Measurement of vibrations inside the vehicle	**02**
19.	Measurement of damping of Automotive components	**02**
20.	Industrial Visit	**02**

References -

Text Books:

- Ganesan V., Internal Combustion Engines, Tata McGraw Hill Co.
- Heywood J.B., Internal Combustion Engine Fundamentals, McGraw Hill Book Co., New York.

Reference Books:

- Edward F .Obert, Internal combustion engines and air pollution, Harber and Row Publishers.
- M. Khovakh, Motor Vehicle Engines, Mir Publishers, Mascow.
- W.H.Crouse and A.L.Anglin, Automotive Emission Control, McGraw Hill Book Co.
- G.S.Springer and A.J.Patterson, Engine emissions and pollutant formation, plenum press, Newyork.

Department of Automobile Engineering

Class: **T.Y. B. Tech.**	Semester-VI
Course Code: **MA3431**	Course Name: **Automotive Electrical and Electronics Lab.**

L	T	P	Credits
-	-	4	1

Course Description:
This lab provides hands-on experience of modeling and simulation of electric and hybrid electric vehicles along with testing of various components like battery, electric motor drives, etc. Student has to prepare a detailed report on case study of any electric and hybrid electric vehicle.

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

1. Apply the concept of WTW to the electric powertrain
2. Demonstration of electric powertrain in terms of elements and working
3. Describe series, parallel, series – parallel and complex hybrid electric vehicle topologies.
4. Test the charge status of an automotive battery to decide whether it is adequately charged.
5. Model and simulate two-wheeled, four wheeled, and hybrid electric vehicles

Prerequisite: Basics of Automotive Technology, Basics of Electrical Engineering, MATLAB Simulink

Course Content

Experiment No	Description	Hrs
1.	Well-to-Wheel analysis of conventional and electric powertrain	02
2.	Demonstration of powertrain of a typical electric vehicle	02
3.	HEV topologies and case studies	02
4.	Electric motor performance testing	02
5.	Electric Vehicle battery testing	02
6.	Component sizing for electric vehicles	02
7.	Modelling and Simulation of four-wheeled Electric vehicle application	02
8.	Modelling and Simulation of two-wheeled Electric vehicle application	02
9.	Modelling and Simulation of Series Hybrid Electric vehicle application (eg. bus)	02
10.	Case study on Electric Vehicle.	02

11.	Modelling and Simulation of Series-Parallel Hybrid Electric vehicle application	**02**

References:

Text Books:

1. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. M. (2018). Modern electric, hybrid electric, and fuel cell vehicles. CRC press.
2. Larminie, J., & Lowry, J. (2012). Electric vehicle technology explained. John Wiley & Sons.
3. Husain, I. (2021). Electric and hybrid vehicles: design fundamentals. CRC pres

Reference Books:

- Liu, W. (2017). Hybrid electric vehicle system modeling and control. John Wiley & Sons.
- Hayes, J. G., & Goodarzi, G. A. (2018). Electric powertrain: energy systems, power electronics and drives for hybrid, electric and fuel cell vehicles.

Department of Automobile Engineering

Class: **T. Y. B. Tech.**	Semester: **VI**
Course Code: **MA3262**	Course: **Capstone Project Phase - I**

L	T	P	Credits
-	-	2	1

Course Description:
This course gives opportunity for the students to offer engineering solutions to a relevant problem by working in a group. Apart from technical knowledge, he/she can explore interpersonal skills as well as ability to plan, executive and justify the tasks. This course brings the awareness about systematic and logical report writing and presentation of the technical efforts.

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

1. Carry out literature survey and identify as well as select a problem.
2. Comprehend and analyze an engineering problem and report findings to provide an appropriate solution.
3. Design an experimental setup or develop an analytical model to analyze the system under consideration.
4. Communicate problem, methodology and outcomes systematically and effectively in the form of a technical report.
5. Work as a member and a team leader in engineering teams / multidisciplinary teams.
6. Demonstrate an ability to use different tools and techniques to solve the given problem.
7. Demonstrate ethical behavior while completing the project work within given constraints and while delivering the expected outcomes.

Prerequisite:

Course Content:
Students may undertake their Projects related to -

1. Design, build and test
2. Analytical work
3. Modeling and simulations
4. Industry based projects
5. Laboratory experimentation
6. Application/Implementation of management philosophy

The department always encourages projects which are related to industrial problems or of interdisciplinary nature to provide opportunity for the students to work on real life problems.

Guidelines:

1. The Project group in (T. Y. Second Term) sixth semester will continue the project work in (B. Tech. First Term) seventh semester and complete project in all respect (assembly, testing, fabrication, tabulation, test result etc.).
2. The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by guide.

3. The guides should regularly monitor the progress of the project work.
4. Assessment of the project for award of ISE marks shall be done by the guide and a departmental committee (consisting of minimum two faculty members) as per the guidelines given by department.
5. The candidate shall submit the synopsis of the project work to the evaluation committee at the starting of sixth semester.
6. It shall include the problem definition, literature survey, approaches for handling the problem, finalizing the methodology and estimation of time and cost for the project work and design calculations / experimental design etc.
7. The candidate shall prepare a formal report. The report typed on A4 sized sheets and bound in the prescribed format shall be submitted after approval by the Guide and endorsement of the Head of Department. It will be assessed for ISE by the evaluation committee appointed by the Head of the Department.