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 2023-27 NEP Batch
Department of Mechatronics Engineering
Rev: MC Course Structure /RIT/02/2023-27

B. Tech. in Mechatronics Engineering with Multidisciplinary Minor

K. E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

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

Curriculum Structure and Evaluation Scheme

To be implemented for 2023-27 NEP Batch

Department of Mechatronics Engineering

Rev: MC Course Structure /RIT/02/2023-27

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

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
							Max	Min. for passing	Max.	Min. for passing
MC2011	Engineering Mathematics for Mechatronics Engineering	3	-	-	3	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	---
						ESE	50	40	----	----
MC2031	Analog and Digital Electronics	3	-	-	3	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
MC2051	Industrial Fluid Power	3	-	-	3	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
MC2071	Engineering Mechanics	2	-	-	2	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
	Multi-Disciplinary Minor-I	3	-	-	3	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
MC2511	Analog and Digital Electronics Lab	-	-	2	1	ISE	----	----	50	50
						ESE	----	----	50	50
MC2531	Industrial Fluid Power Lab	-	-	2	1	ISE	----	----	50	50
						ESE	----	----	50	50
MC2551	Workshop Practice –I (Electrical Machines Lab)	-	-	2	1	ISE	----	----	100	50
MC2571	Machine Drawing and CAD Modelling Lab	-	-	2	1	ISE	---	---	100	50
MC2591	Engineering Mechanics Lab			2	1	ISE	---	----	100	50
MC2611	Technical Aptitude-I	-	-	2	1	ESE	----	----	100	50
	Professional Skills Development and Foreign Languages-I	-	-	2	1	ISE	----	---	100	50
	TOTAL	**14**	**-**	**14**	**21**					
	TOTAL CONTACT HOURS	**28**								

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II ESE = End Semester Exam.

Total Contact Hours/week : 28

Total Credits : 21

Technical Aptitude Courses : Engineering Mathematics for Mechatronics Engineering, Analog and Digital Electronics, Industrial Fluid Power, Engineering Mechanics.

Professional Skills Development and Foreign Languages-

Sr. No.	Subject Name		Course Code
1.	Professional Skills Development and Foreign Languages	Professional Leadership Skills	SH2634
2.		Interpersonal Skills	SH2614
3.		Innovation Tools and Methods for Entrepreneurs	SH2694
4.		Personal Effectiveness and Body Language	SH2594
5.		German Language-Level III	SH2734
6.		Japanese Language-Level III	SH2714

Note:

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

K. E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

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

Curriculum Structure and Evaluation Scheme

To be implemented for 2023-27 NEP Batch

Department of Mechatronics Engineering

Rev: MC Course Structure /RIT/02/2023-27

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

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks %) Max.	Theory (Marks %) Min. for passing		Practical (Marks %) Max. / Min.for passing
MC2021	Strength of Materials	3	-	-	3	ISE	20	40	40	--- / ---
						UT1	15			--- / ---
						UT2	15			--- / ---
						ESE	50	40		--- / ---
MC2041	Microcontrollers and Embedded Systems	2*	-	-	2	ISE	20	40	40	--- / ---
						UT1	15			--- / ---
						UT2	15			--- / ---
						ESE	50	40		--- / ---
MC2061	Kinematics & Dynamics of Machines	3	-	-	3	ISE	20	40	40	--- / ---
						UT1	15			-- / ---
						UT2	15			--- / ---
						ESE	50	40		--- / ---
MC2081	Manufacturing Technologies	3	-	-	3	ISE	20	40	40	--- / ---
						UT1	15			-- / ---
						UT2	15			--- / ---
						ESE	50	40		--- / ---
	Multi-Disciplinary Minor-II	3	-	-	3	ISE	20	40		--- / ---
						UT1	15			--- / ---
						UT2	15			--- / ---
						ESE	50	40		--- / ---
	Modern Indian Language	2	-	-	2	ISE	100	50	---	--- /
SH2174	Environmental Science	1	-	2	2	ISE	50	40	40	--- / ---
						ESE	50	40		--- / ---
MC2501	Microcontrollers and Embedded Systems Lab	-	-	2	1	ISE	---	---		50 / 50
						ESE	---	---		50 / 50
MC2521	Python Programming Lab	-	-	2	1	ISE	---	---		100 / 50
MC2541	Workshop Practice – II	-	-	2	1	ISE	---	----		100 / 50
MC2561	Technical Aptitude-II	-	-	2	1	ESE	---	----		100 / 50
	Professional Skills Development and Foreign Language	-	-	2	1	ISE	--	---		100 / 50
	TOTAL	**17+1***	**-**	**12**	**23**					
	TOTAL CONTACT HOURS	**30**								

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Exam.

Total Contact Hours/week : 30

Total Credits : 23

Technical Aptitude Courses : Strength of Material, Microcontrollers and Embedded Systems, Kinematics & Dynamics of Machines, Manufacturing Technologies

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

***One extra lecture to be allotted to Microcontrollers and Embedded Systems.**

Professional Skills Development and Foreign Languages-

Sr. No.	Subject Name		Course Code
1.	Professional Skills Development and Foreign Languages	Professional Leadership Skills	**SH2634**
2.		Interpersonal Skills	**SH2614**
3.		Innovation Tools and Methods for Entrepreneurs	**SH2694**
4.		Personal Effectiveness and Body Language	**SH2594**
5.		German Language –Level IV	**SH2644**
6.		Japanese Language – Level IV	**SH2624**

Sr. No.	Subject Name		Course Code
1	Modern Indian Language	मराठी भाषिक कौशल्यविकास	**SH202**
2		हिंदी कथा साहित्य एवं प्रयोजमुलक हिंदी	**SH204**

K. E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

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

Curriculum Structure and Evaluation Scheme

To be implemented for 2023-27 NEP Batch

Department of Mechatronics Engineering

Rev: MC Course Structure /RIT/02/2023-27

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

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for Passing		Max.	Min. for passing
MC3011	Industrial Automation	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
MC3031	Sensors and Instrumentation	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
MC3151	Control Engineering	2**	-	-	2	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
	Program Elective Course I	2	-	-	2	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
	Open Elective -I	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
	Multi-Disciplinary Minor-III	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
	Multi-Disciplinary Minor-IV	2	-	-	2	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
MC3511	Industrial Automation Lab	-	-	2	1	ISE	---	---	---	50	50
						ESE	---	---	---	50	50
MC3531	Sensors and Instrumentation Lab	-	-	2	1	ISE	---	---	---	50	50
						ESE	---	---	---	50	50
MC3552	Control Engineering Lab	-	-	2	1	ISE	---	---	---	100	50
SH3035	Scholastic Aptitude-I*	2	-	-	Audit	ISE	100	50 (P/NP)	--	--	
MC371	MOOCS NPTEL/SWAYAM Courses	-	-	-	1	ISE	---	---	---	100	
MC373	Industrial Training	-	-	-	1	ISE	---	---	---	100	50
MC375	Mini Project	-	-	2	1	ISE	---	---	---	100	50
	TOTAL	**20**	**-**	**8**	**24**						
	TOTAL CONTACT HOURS	**28**									

ISE=In Semester Evaluation, MSE=Mid Semester Examination, ESE=End Semester Examination, Pass, NP-Not Pass

Total Contact Hours/week : 28

Total Credits : 24

***Note**: Student should complete five days (30hrs.) of scholastic aptitude training program, organised by the institute.

****Note**: Extra One lecture should be added in a timetable.

Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

Rajarambapu Institute of Technology Mechatronics Dept. 415 414 Rajaramnagar

Program Elective-I

Sr. No	Course Code	Course Name	Domain
1.	MC3071	Data Base Management System	Intelligent Systems
2.	MC3091	Condition Monitoring	Design & Manufacturing
3.	MC3111	Battery And Fuel Cell Technology	Advanced Mobility System
4.	MC3131	Industrial Organization and Management	Design & Manufacturing

Open Elective –I

Sr. No.	Course Code	Open Elective Course 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

K. E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

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

Curriculum Structure and Evaluation Scheme

To be implemented for 2023-27 NEP Batch

Department of Mechatronics Engineering

Rev: MC Course Structure /RIT/02/2023-27

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

Course Code	Course	Teaching Scheme				Evaluation Scheme				
							Theory (Marks %)		Practical (Marks %)	
		L	T	P	Credits	Scheme	Max	Min. for passing	Max	Min. for passing
MC3021	Machine Design	3	-	-	3	ISE	20	40	---	---
						MSE	30	40	---	---
						ESE	50	40	---	---
MC3041	Power Electronics and Drives	3	-	-	3	ISE	20	40	---	---
						MSE	30	40	---	---
						ESE	50	40	---	---
MC3061	Research Methodology	2	-	-	2	ISE	20	40	---	---
						MSE	30	40	---	---
						ESE	50	40	---	---
	Program Elective-II	3	-	-	3	ISE	20	40	---	---
						MSE	30	40	---	---
						ESE	50	40	---	---
	Open Elective-II	3	-	-	3	ISE	20	40	---	---
						MSE	30	40	---	---
						ESE	50	40	---	---
	Multi-Disciplinary Minor-V	3	-	-	3	ISE	20	40	---	---
						MSE	30	40	---	---
						ESE	50	40	---	---
MC3241	Image Processing	2	-	-	2	ISE	20	40	---	----
						MSE	30	40	---	---
						ESE	50	40	---	---
MC3601	Image Processing Lab	-	-	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
MC3502	Workshop Practice – III	-	-	2	1	ISE	---	----	50	50
						ESE	--	--	50	50
MC3521	Power Electronics and Drive Lab	-	-	2	1	ISE	---	---	50	50
						ESE	---	---	50	50
MC362	Distributed Control System Lab	-	-	2	1	ISE	---	---	50	50
						ESE	---	---	50	50
SH3065	Scholastic Aptitude-II	2*	-	-	Audit	ISE	100	50 (P/NP)	--	--
MC3581	Capstone project -Phase I	-	-	2	1	ISE	----	----	100	50
	TOTAL	**21**	**-**	**10**	**24**					
	TOTAL CONTACT HOURS	**31**								

ISE=In Semester Evaluation, MSE=Mid Semester Examination, ESE=End Semester Examination. P=Pass, NP=Not Pass

Total Contact Hours/week : 31

Total Credits : 24

***Note**: Student should complete five days (30hrs.) of scholastic aptitude training program, organised by the institute.

Program Elective - II

Sr. No.	Course Code	Course	Domain
1.	MC3081	Finite Element Methods	Design & Manufacturing
3.	MC3121	Additive Manufacturing	Design & Manufacturing
4.	MC330	Digital Twin	Intelligent Systems
5.	MC3161	Industry 4.0 Technologies and IIOT	Design & Manufacturing & Intelligent Systems
6.	MC3181	Wireless Sensor Network	Automation
7.	MC3201	Microelectromechanical Systems	Automation
8.	MC332	Fuzzy Logic & Neural Networks	Intelligent Systems

Open Elective –II

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

K. E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

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

Curriculum Structure and Evaluation Scheme

To be implemented for 2023-27 NEP Batch

Department of Mechatronics Engineering

Rev: MC Course Structure /RIT/02/2023-27

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

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
MC4011	Design of Mechatronics System	2	-	-	2	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
MC4031	Machine Learning	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
MC4051	Industrial Robotics	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
	Program Elective Course-III	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
	Program Elective Course-IV	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40		---	---
MC4511	Industrial Robotics Lab	-	-	2	1	ISE	--	---	---	50	50
						ESE	--	---	---	50	50
MC4531	Circuit Simulation and PCB Design Lab	-	-	2	1	ISE	--	---	---	50	50
						ESE	--	---	---	50	50
	Program Elective-IV Lab	-	-	2	1	ISE	--	---	---	50	50
						ESE	--	---	---	50	50
MC4711	Capstone Project Phase II	-	-	6	3	ISE	--	---		50	50
						ESE	--	---		50	50
	TOTAL	**14**	**-**	**12**	**20**						
	TOTAL CONTACT HOURS	**26**									

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

Total Contact Hours/week : 26

Total Credits : 20

Program Elective-III

Sr. No.	Course Code	Course Name	Domain
1.	MC4071	Building Automation	Automation
2.	MC4091	Basics of Cloud Computing	Intelligent Systems
3.	MC4111	Machine Tool Design	Design & Manufacturing
4.	MC4151	Hybrid and Electric Vehicle	Advanced Mobility System
5.	MC4171	Industrial Engineering	Design & Manufacturing
6.	MC4191	Emerging Smart Materials for Mechatronics Applications	Design & Manufacturing

Program Elective-IV

Sr.No.	Course Code	Course	Domain
1.	MC4231	Computer Network and Cyber Security	Intelligent System
2.	MC433	Unmanned Aerial vehicles	Advanced Mobility System
3.	MC4271	VLSI Design	Automation

Program Elective-IV Lab

Sr. No.	Course Code	Course	Domain
1.	MC4551	Computer Network and Cyber Security Lab	Intelligent System
2.	MC4571	VLSI Design Lab	Intelligent System
3.	MC467	Unmanned Aerial Vehicles Lab	Advanced Mobility System

K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Curriculum Structure and Evaluation Scheme
To be implemented for 2023-27 NEP Batch
Department of Mechatronics Engineering
Rev: MC Course Structure /RIT/02/2023-27

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

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

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	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, students need to report to Institute mentors as and when required.
2] For online courses, lecture videos of each unit will be made available through college platforms to the students. For each unit there will be separate assignments. Students need to submit all assignments within a specified time.
Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam. Final exams will be held at college campus.

Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414 K.E.S.

Rajarambapu Institute of Technology Mechatronics Dept. 415 414 Rajaramnagar

Model II: Research Internship (RI)

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
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, MSE=Mid Semester Examination, ESE=End Semester Examination.

Total Contact Hours/week : -
Total Credits : 16

Note:

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

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

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

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.

Class: Final Year B. Tech. **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	-	-	2	ISE	25	40	40	-	-
						ESE	75	40		-	-
ED4044	Commercial Aspects of the Project (Online Course)	2	-	-	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	
		-	-	-	**16**						

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

Total Contact Hours/week : 04
Total Credits : 16

Note:

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

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

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

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

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

Multidisciplinary Minor

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

Multidisciplinary Minor Baskets					
MDM Basket Name	**Sr. No.**	**Course Code**	**Course Name**	**Semester**	**Offered by Department**
Construction Engineering	1	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	Environment 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	Electronic Product Design	V	
	5	ECMD302	Industrial Electronics	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	
Product Design and Development	1	MEMD203	Design Thinking	III	Mechanical Engineering
	2	MEMD204	Behavioural Engineering and Design	IV	
	3	MEMD305	Product Design Tools and Techniques	V	
	4	MEMD307	Design and Prototyping	V	
	5	MEMD304	Marketing and Business Fundamentals for New Products	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	
Robotics & Automation	1	RAMD201	Fundamentals of Robotics & Automation	III	Robotics & Automation
	2	RAMD202	Sensors and Actuators	IV	
	3	RAMD301	Kinematics & Dynamics for Robots	V	
	4	RAMD303	Robot Programming.	V	
	5	RAMD302	Industrial Automation & Control	VI	

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

B.Tech. in Mechatronics Engineering with Double Minor degree

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

Sr. No.	Semester	Course	Code
1	III	DM – I	MCDM3XXX
2	IV	DM – II	MCDM4XXX
3	V	DM – III	MCDM5XXX
4	VI	DM – IV	MCDM 6XXX
5	VII	DM – V	MCDM 7XXX
6	VIII	DM – VI	MCDM 8XXX

4.To select course platform, first preference must be given to NPTEL.
5.Other than NPTEL, courses from COURSERA and UDEMY platforms are allowed to register only in following cases,

a. If timeline of NPTEL course is not in line with timeline of academic calendar.
b. The suitable succeeding course in line with previous course is not available on NPTEL.
c. If any other unavoidable circumstances occur.

6.Platform and course selection must be as per the recommendation of BOS of the department.
7.Student will get the credits of respective DM course in following conditions,

d. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
e. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA(oral) exam.

8.While selecting online course, following points must be taken care of,

f. Selected course must be of basic or fundamental level.
g. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective) or in Multidisciplinary Minor (MDM)
h. Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for UDEMY, COURSERA courses.

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

B.Tech. in Mechatronics Engineering with Honor and Multidisciplinary Minor degree

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

Sr. No.	Semester	Course	Code
1	III	Honor - I	MCH3XXX
2	IV	Honor - II	MCH4XXX
3	V	Honor - III	MCH5XXX
4	VI	Honor - IV	MCH6XXX
5	VII	Honor - V	MCH7XXX
6	VIII	Honor - VI	MCH8XXX

4.To select course platform, first preference must be given to NPTEL.

5.Other than NPTEL, courses from COURSERA and UDEMY platforms are allowed to register only in following cases,

a. If timeline of NPTEL course is not in line with timeline of academic calendar.
b. The suitable succeeding course in line with previous course is not available on NPTEL.
c. If any other unavoidable circumstances occurs.

6.Platform and course selection must be as per recommendation of BOS.

7.Student will get the credits of respective Honor course in following conditions,

d. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
e. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA(oral) exam.

8.While selecting online course, following points must be taken care of,

f. Selected course must be of advanced level and not basic or fundamental level.
g. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective)

Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for COURSERA, UDEMY courses.

K.E. Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

Rajarambapu Institute of Technology Mechatronics Dept. 415 414 Rajaramnagar

B. Tech. in Mechatronics Engineering-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 Mechatronics Engineering Honors with Research and Multidisciplinary Minor degree Student need to earn total 188 Credits which consist 170 credits of regular Multidisciplinary Minor courses and 18 credits of Research courses.

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

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for passing		Max.	Min. for passing
REH401	Intellectual Property Rights (IPR)	-	-	-	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 Evaluation

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

K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Curriculum Structure and Evaluation Scheme
To be implemented for 2023-27 NEP Batch
Department of Mechatronics Engineering
Rev: MC Course Structure /RIT/02/2023-27

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

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
REH402	Research project phase - II	-	-	-	11	ISE			50	50
						ESE			50	
	TOTAL	-	-	-	**11**					

ISE = In Semester Evaluation, ESE = End Semester Evaluation

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech.**	Semester-V	**L**	**T**	**P**	**Credits**
Course Code: **MC3011**	Course Name: **Industrial Automation**	**3**	**-**	**--**	**3**

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,
1. Explore the architecture of PLC and its functions.
2. Execute the various instructions and logic in PLC.
3. Develop the PLC program for various applications.
4. 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,	**06**
2.	**INSTRUCTIONS** Timer instructions ON Delay, OFF Delay and Retentive Timers-UP Counter, DOWN Counter and UP down Counters, program control instructions - Data manipulating instructions-math instructions	**06**
3.	**APPLICATION OF PLC** Traffic light control, 24-hour clock design, Automatic stacking process, temperature control, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control	**06**
4.	**NETWORKING OF PLC AND SCADA** Networking of PLCs-Data Communication-Fieldbus, PROFI bus, and Mod bus-OSI Model types-OPC function. Supervisory Control and Data	**06**

	Acquisition-Architecture-Remote terminal unit-Master terminal unit-Data Storage	
5.	**DISTRIBUTED CONTROL SYSTEM** Evolution - Architectures - Comparison - Local control unit - Process interfacing issues - Communication facilities. Operator interfaces - Low level and high-level operator interfaces - Operator displays - Engineering interfaces - Low level and high-level engineering interface	**06**
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.	**06**

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-**V**
Course Code: **MC3031**	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. Explain the fundamental principles of various sensors and transducers.
2. Analyze the characteristics, advantages, and limitations of different sensor types.
3. Select and integrate sensors into mechatronic systems for real-time data acquisition and control.
4. Apply appropriate signal conditioning techniques to improve sensor output accuracy.
5. Develop mechatronic systems using appropriate sensors for 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:**	06

	Potentiometers, LVDT (Linear Variable Differential Transformer), Optical encoders, Inductive sensors.	
3	**Force and Pressure Sensors:** Strain gauges, Load cells, Pressure transducers, Piezoelectric, Piezoresistive, and Capacitive Pressure Sensors, Ultrasonic Sensors **Motion and Velocity Sensors:** Accelerometers, Gyroscopes, Proximity sensors, Hall Effect Sensors.	**06**
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 -

Textbooks:

1. Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill, 2nd Ed.
2. Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi, 2nd Ed.
3. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney,
4. Dhanpat Rai & Co, 2nd Ed.
5. Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt. Ltd, 07th Ed

Reference Books:

1. Measurement Systems by E.O. Doebelin, McGraw Hill, 06th Ed.
2. Process Measurement & Analysis by B.G. Liptak, CRC press, 04th Ed.
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, 02nd Ed.
5. Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers, 02nd Ed.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech.**	Semester-V
Course Code: **MC3151**	Course Name: **Control Engineering**

L	T	P	Credits
3	-	--	3

Course Description:
Control engineering is a diverse and rapidly expanding discipline which has become increasingly important in a wide range of industries. This course provides an advanced knowledge and skills in control and systems engineering, emphasizing modern theoretical developments and their practical application and give a sound fundamental understanding of the principles underlying the operation of control systems.

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

1. Design mathematical model for electrical, mechanical and electromechanical system.
2. Evaluate transient and steady state behaviour of systems using standard test signals.
3. Solve the linear and non-linear systems for absolute stability and relative stability.
4. Design a stable control system satisfying requirements of stability and reduced steady state error.
5. Analyse of control systems using the state space approach.

Prerequisite: None

Course Content

Unit No	Description	Hrs
1.	**Introduction and Classification of Control systems-** Introduction to control systems, Introduction to design process, classification of control system, Review of Laplace and inverse Laplace transform, transfer functions, modeling of mechanical, electrical, and electromechanical systems Block diagram reduction techniques, signal flow graph, Mason's gain formula, signal flow graph from block diagram.	**06**
2.	**Time Response Analysis:** Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants	**06**
3.	**Stability Analysis:** Stability of open loop and closed loop systems, Routh-Hurwitz criterion, Stability and performance analysis	**06**
4.	**Root Locus:** The root locus concept, Root locus construction rules, Sketching of Root Locus, effects of adding poles and zeros.	**06**

5.	**Frequency Response Analysis:** Introduction, Frequency domain specifications- Bode diagrams. Determination of Frequency domain specifications and Phase margin and Gain margin. Stability Analysis from Bode Plots. Polar Plots, Nyquist Plots Stability Analysis.	**06**
6.	**State Space Analysis of Continuous Systems:** Concepts of state, state variables and state model, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties, Concepts of Controllability and Observability.	**06**

Text Books:

- Control system engineering, Norman S Nise, John Wiley & Sons, Inc.
- J.Nagrath, M.Gopal, "Control System Engineering", New Age International Publishers.
- M.Gopal, "Control System – Principles and Design", Tata McGraw Hill.

Reference Books:

- Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India.
- Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison.
- Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING
Program Elective - I

Class: - **T.Y. B. Tech**	Semester-V
Course Code: **MC3071**	Course Name: **Database Management systems**

L	T	P	Credits
2	--	--	2

Course Description: The main aim of this course is students should understand the concept of DBMS and ER Modeling. Learn the techniques to find out the normalization and what actually the concept of Query optimization and relational algebra. This course will deal with some applying techniques for the concurrency control, recovery, security and indexing for the real time data.

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

1. Illustrate the design principles for database design, ER model and normalization.
2. Demonstrate the basics of query evaluation and heuristic query optimization techniques.
3. Apply Concurrency control and recovery mechanisms for the desirable database problem.
4. Compare the basic database storage structure and access techniques including B Tree, B+ Tress and hashing.
5. Review the fundamental view on unstructured data and its management.

Prerequisite: -NIL-

Course Content

Unit No	Description	Hrs
1.	**Database Systems Concepts and Architecture**: History and motivation for database systems -characteristics of database approach - Actors on the scene - Workers behind the scene - Advantages of using DBMS approach– Data Models, Schemas, and Instances– Three-Schema Architecture and Data Independence– The Database System Environment– Centralized and Client/Server Architectures for DBMSs– Classification of database management systems.	04
2.	**Data Modeling:** Entity Relationship Model: Types of Attributes, Relationship, Structural Constraints – Relational Model, Relational model Constraints - Mapping ER model to a relational schema - Integrity constraints.	04

3.	**Schema Refinement:** Guidelines for Relational Schema – Functional dependency; Normalization, Boyce Codd Normal Form, Multi-valued dependency and Fourth Normal form; Join dependency and Fifth Normal form.	**04**
4.	**Query Processing and Transaction Processing:** Translating SQL Queries into Relational Algebra - heuristic query optimization, Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions- Characterizing schedules based on recoverability - Characterizing schedules based on serializability	**04**
5.	**Concurrency Control and Recovery Techniques**: Two-Phase Locking Techniques for Concurrency Control, Concurrency Control based on timestamp, Recovery Concepts – Recovery based on deferred update and immediate update	**04**
6.	**Recent Trends – NoSQL Database Management**: Introduction, Need of NoSQL, CAP Theorem, different NoSQL data models: Key-value stores, Column families, Document databases, Graph databases	**04**

References -

Textbooks:

1. R. Elmasri S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 2015
2. Raghu Ramakrishnan, Database Management Systems, Mcgraw-Hill,4th edition,2015.

Reference Books:

1. A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 6th Edition 2010.
2. Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6th Edition,2012.
3. Pramod J. Sadalage and Marin Fowler, NoSQL Distilled: A brief guide to merging world of Polyglot persistence, Addison Wesley, 2012.
4. Shashank Tiwari, Professional NoSql,Wiley.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-V
Course Code: **MC3091**	Course Name: **Condition Monitoring**

L	T	P	Credits
2	-	--	2

Course Description:
This course offers students the most up-to-date methods for monitoring the health of machinery, including not only the more conventional noise and vibration monitoring but also more modern approaches based on signal processing, thermography, contaminants analysis, and acoustics. Those curious to learn more about condition monitoring would benefit greatly from this course. This course will provide students with a solid grounding in the principles and practical applications of Condition Monitoring data.

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

1. Explain the maintenance techniques for condition monitoring in industries.
2. Select the methods of vibration control.
3. Accumulate the data for analysis using vibration acquisition equipment.
4. Apply modern technologies for effective signal analysis and fault diagnosis.
5. Monitor and analyze the method of failure analysis used for different applications.

Prerequisite: Kinematics of Machines, Basics of Vibration

Course Content

Unit No	Description	Hrs
1.	**Introduction:** Introduction to Machinery Condition Monitoring, Future Needs, Principles of Maintenance- breakdown, preventive and predictive monitoring. Fault diagnostics prognostics, Bath Tub Curve.	04
2.	**Vibration Control:** Basics of vibration, free and forced response, vibration and shock isolation, basics of rotor dynamics, time domain analysis, frequency domain analysis, modulation and beats.	04
3.	**Vibration Monitoring Equipment:** Vibration Measurement Scheme, transducers, vibration pickups for displacement, velocity and acceleration measurement, frequency domain signal analysis-Fourier series, discrete Fourier transform, Fundamentals of Fast Fourier Transform.	04

4.	**Fault Diagnostics** Principles of Maintenance, Failure Modes Effects and Criticality Analysis, Fault Diagnostics and Prognostics, Basics of Machinery Vibration, Engineering Applications of Vibration, Rotor dynamics	**04**
5.	**Signal Analysis** Signal Conditioning- Signal Filtering, Signal Demodulation, measurement error, calibration Pinciple, Time Domain Signal Analysis, Frequency Domain Signal Analysis, FFT Analysis, Modulation and Sidebands, Envelope Analysis, Cepstrum Analysis, Order Analysis	**04**
6.	**Failure Analysis** Failures and failure analysis, Failure concepts and characteristics, Fault detection sensors, Data processing and signal analysis, Condition based maintenance principles, Fault analysis planning and system availability,	**04**

References -

Textbooks:

1. Rao J. S., Vibration Condition Monitoring, Narosa Publishing House.
2. Mohanty A. R., Machinery Condition Monitoring: Principles & Practices, Taylor & Francis group.

Reference Books:

1. Paresh Girdhar, Cornelius Scheffer, Practical machinery vibration analysis and predictive maintenance, Elsevier
2. Choudary K K., Instrumentation, Measurement and Analysis, Tata McGraw Hill.
3. Collacott, R. A., Mechanical Faults Diagnosis, Chapman and Hall, London.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-V
Course Code: **MC3111**	Course Name: **Battery And Fuel Cell Technology**

L	T	P	Credits
2	-	--	2

Course Description: This course gives insights into various electric & hybrid electric vehicles, their current market status along with the environmental assessment. Further the course highlights the various battery chemistries and fuel cell, differentiating their pros and cons. Additionally, the course focuses on various membranes and fuel used for different fuel cells along with the drive-line components architecture for electric, hybrid & fuel cell powered vehicles.

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

1. Explain the electric vehicle and hybrid vehicles technology, environmental and current status.
2. Justify Energy Storage Requirement in Hybrid and Electric Vehicles and elaborate the Battery Fundamental Characteristics
3. Discuss the construction, electrochemistry, technology, and applications of selected primary batteries.
4. Discuss the construction, electrochemistry, technology, and applications of selected Secondary batteries.
5. Evaluate different batteries or fuel cells in order to select a suitable battery or fuel cell for given application.
6. Select suitable, membrane, fuel (for fuel cell) and drive line for developing electric vehicles.

Prerequisite: Nil

Course Content

Unit No	Description	Hrs
1.	**Electric & Hybrid Vehicles: Background** Introduction, Driveline components, Torque and power characteristics comparison of engine and motor, Tractive effort and Ideal power curve, Hybrid Vehicle, Classification of hybrid vehicles, pros and cons of electric & hybrid	04

	vehicles, environmental analysis of electric vehicles, market scenario and government initiatives for electric vehicles.	
2.	**Battery** Energy Storage Requirement in Hybrid and Electric Vehicles, Battery based energy storage and analysis, Battery Fundamental Characteristics – free energy change, electromotive force of battery, ampre-hour, capacity, power, power density, energy density, efficiency, cycle life, Technical Characteristics: Capacity, Discharge rate, State of Charge, State of Discharge, Depth of Discharge, Service Life, Shelf Life, Battery Pack Design.	**04**
3.	**Battery Types** **Primary Batteries:** Construction and chemistry, Technology of Zinc-Air batteries, Zinc-HgO batteries, Zinc-Carbon, Zinc-Alkaline batteries, Lithium primary cells- liquid/soluble cathode cell, solid cathode cells- lithium manganese dioxide, lithium ferrous sulphide cells, solid electrolyte cells-lithium polymer electrolyte battery & applications of various batteries. Thermal Managements- Battery management System.	**04**
4.	**Secondary Batteries:** Construction, Chemistry & technology of maintenance free lead acid batteries (MFLA), valve regulated lead acid batteries (VRLA), absorbed glass mat lead acid battery (AGMLA), Comparison of lead acid battery and VRLA, construction, electrochemistry and applications of Nikel Cadmium batteries, Nickel-Metal hydride battery, nickel zinc battery. Lithium-ion batteries construction, chemistry and applications of liquid organic electrolyte cells, polymer electrolyte cells, lithium-ion cells, ultrathin lithium polymer cells (comparative account), Advance batteries for electric vehicles, sodium-beta and redox batteries. Battery Recycling, methods & environmental impacts.	**04**
5.	**Fuel Cells** Introduction, classification based on temperature and nature of electrolyte, working principal, components, and applications of alkaline fuel cells (AFC) – hydrogen-oxygen alkaline fuel cells, Molten carbonate fuel cells (MCFC), Polymer Electrolyte Membrane (PEM) fuel cells, Solid Oxide Fuel Cells (SOFC), direct methanol fuel cells.	**04**
6.	**Driveline Architecture, Membranes & Fuels for Fuel Cells:** Driveline Components of fuel cell powered vehicles, comparison of electric vehicles (pure & hybrid) and fuel cell vehicles drive-train topologies. Fast Charging Infrastructure. Membranes: Nafion – Polymer blends and composite membranes. Fuels: Hydrogen, methane, methanol – Sources and preparations, reformation process for hydrogen – Clean up and storage of fuel- use in cells.	**04**

Textbooks:

1. Dell, Ronal M Rand, David, 'Understanding Batteries', Royal Society of Chemistry.
2. M Aulice Scibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India.

Reference Books:

1. F.Barbir, 'PEM fuel cell: theory and practice', Elsevier, Burlington, MA
2. G.Hoogers, 'Fuel Cell Handbook', CRC, Boca Raton, FL.
3. Liu, H.,Principles of fuel cells, Taylor & Francis, N.Y.(2006).

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech.**	Semester-V
Course Code: **MC3131**	Course Name: **Industrial Organization and Management**

L	T	P	Credits
2	-	--	2

Course Description: The aim of the course is to give students theoretical insights and practical tools within the area of management and organization of industrial corporations. The course will provide students with different perspectives in order to understand the phenomena of management and organization and connect it to their future area of work. Further, this course will develop managerial skills to position different areas together to fulfill the objectives of the organization.

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

1. Recognize the factors that influence the business environment and visualize their effect on business.
2. Evaluate the scope and objectives of functional areas of business and their integration.
3. Formulate an effective and efficient solution for business problems.
4. Identify several ways in which financial accounting information is used to make business decisions.
5. Apply engineering economics principles for evaluation of a business.

Prerequisite: Not required

Course Content

Unit No	Description	Hrs
1.	**Overview of Business Environment:** Types of Businesses, Definition of Management **Business Environment-** Nature, scope and objectives of business, National & Global Perspective, Environmental Analysis and Forecasting, Factors Affecting the Business- Economic Environment, Political and government Environment, natural and Technological Environment, Business and Society, Industrial Policies and Regulations, Economic planning and Development, Global **Environment-** GATT/WTO and Global Liberalization, international Investments, Multinational Corporations, Globalization	04
2.	**Basic Functions of Management:**	04

	Planning – Need, Objectives, Strategy, policies, Procedures, Steps in Planning, Decision making, Forecasting. **Organizing** – Process of Organizing importance and principle of organizing, departmentation, Organizational relationship, Authority, Responsibility, Delegation and Span of control.	
3.	**Human Resource Management:** Nature, Purpose, Scope, Human resource planning, Policies, Recruitment procedure training and development, appraisal methods. **Leading** – Engineer as a leader, Engineer as a manager, leadership skills for 21st century, Communication process, Barriers, remedies, motivation, importance, Theories: Herzberg's theory, Maslow's theory, McGregor's theory, leadership styles. **Controlling** – Process, requirement for control management, accountability. Engineering Change Management, Ethical Business Practices	**04**
4.	**Materials Management**: Definition, Scope, advantages of materials management, functions of materials management, Purchase Objectives, 5-R Principles of purchasing, Functions of Purchase department, Purchasing cycle, Purchase policy & Procedure, Evaluation of Purchase Performance. Inventory Control	**04**
5.	**Marketing Management:** Marketing Concepts –Objective –Types of markets – Market Segmentation, Market strategy – 4 AP"s of market, Market Research, Salesmanship, Advertising.	**04**
6.	**Financial Management and Engineering Economics:** Introduction, Sources of finance, Financial Institutions, Financial statements, Balance sheet and P & L accounts. **Engineering Economics** – Introduction, Time value of money, Cash flows, Annuity, Depreciation, Investment decision for capital assets. (Numerical approach)	**04**

References -

Textbooks:

- M. T. Telsang, "Industrial and Business Management", S. Chand & Co.
- J. P. Bose, S. Talukdar, "Business Management", New Central agencies (P) Ltd.

Reference Books:

- Francis Cherunilam, "Business Environment", Himalaya Publishing House, James A. F. Stoner, R. Edward Freeman, "Management", Prentice Hall of India New Delhi.

- Gene Burton and Manab Thakur, "Management Today- Principles and Practice", Tata McGraw Hill Publishing Company, New Delhi.
- Koontz & O'Donnell, "Essentials of Management", McGraw-Hill Publication.
- Philip Kotler, "Marketing Management", Prentice Hall of India, New Delhi.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Open Elective-I

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 Learning 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. Analyse 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	06

	energy sources, government policies and incentives for renewable energy adoption.	
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* (Elsevier)

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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	06

	selection process, environmental indices and indicators for describing affected environment, Life cycle assessment.	
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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 networks (e.g. LAN,MAN,WAN), Common network terminologies (Topologies), Recent trends in network administration	6
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)	6

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)	6
4.	**Internet Services and Applications** Introduction to web services (HTTP,HTTP's), Email and messaging protocols (SMTP, IMAP), File Transfer Protocol (FTP)	6
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	6
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	6

References:

Text Books:

- Seffrey S. Beasley and Piyasat Nilkaew "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".

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS 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 of employees: Information system-designing barriers, Strategies; Marketing and communicating-training and planning.	**06**
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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** Introduction, Operating system layer, Protection, Processes and threads, Communication and invocation, Operating system architecture, Virtualization at the operating system level.	**07**
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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**	06

	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.	
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'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS 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	06

	thermal Power Generation - Fundamentals of Solar Photovoltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications	
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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,	06

	characteristics, Nernst equation, relation of the fuel consumption versus current output	
5.	**Membranes &Fuels for Fuel Cells** Membranes: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments. 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.	**06**
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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:
After completion of this course, students will be able to:
1. Explain the concepts of network connected embedded devices.
2. Identify and summarize different components required for IOT applications.
3. Analyse the system through Data Analytics tools.
4. 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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS 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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS 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,	06

	Aggregation, abstract classes, generalization as extension and restriction, multiple inheritance, metadata, candidate keys and inheritance.	
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

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 Learning 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	06
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.	06

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).	**06**
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.	**06**
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)	**06**
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. Case study on Ethical Considerations.	**06**

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)

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING
Multidisciplinary Minor - III

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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 the data
2. Identify various protocols, issues, and techniques related to transaction management for a consistent & 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. Experiment 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 andNormalization 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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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**	06

	1-Phase Induction motor: 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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS 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. Describe the basic antenna parameters and their types.
3. Discuss the evolution, requirements, and challenges of 5G communication systems.
4. Explain and compare various communication techniques.
5. Illustrate effectively 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:

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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. 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 principles 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	Description	Hrs
1	**Introduction to Database Concepts:** Purpose of Database Systems, Data abstraction, Data Models, Entities and Entity sets, Mapping Constraints, E-R Diagram, Reducing E-R Diagrams to Tables, Generalization and Aggregation.	06
2	**Relational Model:** Structure of Relational Databases, the Relational Algebra, the TupleRelational Calculus, Structured Query Language (SQL), Joins.	06
3	**Integrity Constraints and Database Design:** Domain Constraints, Referential Integrity, Complex datatypes, Functional	06

	Dependencies, Pitfalls in Relational Database Design, Decomposition, Normalization	
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", McGraw Hill 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 Data Storage".

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech.**	Semester-V
Course Code: **MEMD305**	Course Name: **Product Design Tools and Techniques**

L	T	P	Credits
3	--	--	3

Course Description:
This course introduces students to the fundamental and advanced tools and techniques used in product design, focusing on engineering principles, and design for manufacturability, value engineering, concurrent engineering, reverse engineering, and prototyping. The course will combine theoretical foundations with practical applications, including case studies.

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

1. Explain the basic principles of engineering design.
2. Design products for ease of manufacturing and assembly.
3. Apply value engineering and concurrent engineering principles in product design.
4. Apply reverse engineering on a product.
5. Apply various prototyping techniques, including rapid prototyping technologies.

Unit No	Description	Hrs.
1	**Principles of Engineering Design:** Introduction to engineering design, Introductory principles – Iteration, Compromise, Complexity, Responsibility, Simplification., Problem identification, Creativity, Concept selection, Embodiment, Modelling, Detail design, Design management, Information gathering.	06
2	**Design for Manufacturability, Assembly and Sustainability:** Overview of DFM and DFA principles, Case studies of DFM and DFA, Techniques and Tools for DFM and DFA, Techniques to simplify manufacturing processes, Tools for assessing and optimizing assembly processes, Environmental Considerations in Manufacturability and Assembly, Introduction to sustainable design and environmental impact, Tools for environmental assessment, including life-cycle analysis.	06
3	**Value Engineering:** Introduction, Nature and Measurement of Value, The Value Analysis Job Plan, Steps to Problem-Solving and Value Analysis, Value Analysis Tests, Value Engineering Idea Generation Check-list, Cost Reduction Through Value Engineering, Case Study on Tap Switch Control Assembly, The Methodology, Benefits of Value Engineering, Material and Process Selection in Value Engineering.	06

4	**Concurrent Engineering:** Introduction to Concurrent Engineering, Fundamentals of CE, Need and basic principles of CE, Benefits of implementation of CE, Introduction to various integrating mechanisms, forming of CE team. Teamwork: Interfacing of manufacturing and design, selection of key techniques and methodologies, selection of CE tools.	**06**
5	**Reverse Engineering:** Scope and tasks of RE, Process of duplicating, Definition and use of Reverse Engineering, Reverse Engineering as a Generic Process, Cognitive approach to RE, Integration of formal and structured methods in reverse engineering.	**06**
6	**Modern Prototyping Techniques:** Traditional prototyping methods, additive manufacturing (3D printing), subtractive manufacturing (CNC machining), Rapid prototyping applications. AM process chain, Classification of AM processes, Design for AM, Post Processing	**06**

References:-

Text books:-

- Engineering Design Principles, Kenneth S. Hurst, Butterworth-Heinemann.
- Katheryn, A. Ingle, Reverse Engineering, McGraw-Hill.
- Product Design for Manufacture and Assembly, G. Boothroyd, CRC Press Inc.
- Product Design and Manufacturing, A.K. Chitale and R.C. Gupta, PHI Learning Private Limited, Delhi.
- Chua Chee Kai, Leong Kah Fai, Rapid Prototyping: Principles & Applications, World Scientific.

Reference Books:

- Linda Wills, Reverse Engineering, Kluiver Academic Publishers.
- Larry W. Zimmerman, Glen D. HartVan Nostrand Reinhold, Value Engineering: A Practical Approach for Owners, Designers, and Contractors, SAVE International.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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. Explain 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:**	06

	Potentiometers, LVDT (Linear Variable Differential Transformer), Optical encoders, Inductive sensors.	
3	**Force and Pressure Sensors:** Strain gauges, Load cells, Pressure transducers, Piezoelectric, Piezoresistive, and Capacitive Pressure Sensors, Ultrasonic Sensors **Motion and Velocity Sensors:** Accelerometers, Gyroscopes, Proximity sensors, Hall Effect Sensors.	**06**
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:

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

Reference Books:

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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, Algorithmsand 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, RegressionMethods,	08

	Simple liner regression, Regression Model, Multiple Regression, Polynomial regression, Generalized linear models, Logistic regression	
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 and Francis Publication

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: **T.Y. B. Tech.**	Semester-V
Course Code: **RAMD301**	Course Name: **Kinematic & Dynamics for Robots**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides an opportunity for the students of other engineering programs to learn kinematic and dynamic analysis of the robots. The fundamental concepts of mechanisms and methods of mechanism design and selection are introduced. The course covers the concepts of kinematic and dynamic analysis of robots such as forward kinematics, inverse kinematics and robot dynamics. The robot gripers, manipulators, their dynamic analysis and workspace analysis is also covered in the course. The course outcomes will ultimately help to perform synthesis of mechanisms and kinematic and dynamic analysis of different robots for various applications.

Course Outcomes:
After completion of this course, the student will be able to -
1. Select the type of mechanism for robotic applications
2. Perform kinematic analysis and synthesis of mechanisms.
3. Perform forward and inverse kinematics of robots
4. Perform workspace analysis for different types of robots
5. Design robot manipulators based on dynamic analysis
6. Perform forward and inverse dynamics of robots

Prerequisite: Kinematics of Machines, Dynamics of Machines

Course Content

Unit No	Description	Hrs
1	**Fundamental Concepts:** Kinematic Links, kinematics pair, types of constrained motion, Kinematic chain, Degrees of freedom, mechanisms, inversion of mechanism, position and orientation of rigid body, Linear and angular velocity of links, Velocity propagation, synthesis of mechanisms	06
2	**Forward Kinematics:** Robot kinematics, D-H representations and displacement matrices for standard robot configurations, The ARM equation, Forward kinematics of manipulators up to 6 degrees of freedom, representation of forward kinematic equations. Direct	06

	kinematic analysis for Four axis, SCARA Robot and three, five and six axis Articulated Robots.	
3	**Inverse Kinematics:** Inverse kinematic analysis of robot with standard configurations, methods for solution of non-linear simultaneous equations, singularity analysis, Inverse kinematic solution of Robots - Inverse kinematics of four axis SCARA robot and three and five axis Articulated robot.	**06**
4	**Workspace Analysis:** Workspace analysis, work envelope of a Four axis SCARA robot and five axis articulated robot, workspace fixtures, the pick and place operations, Joint space technique – continuous path motion, Interpolated motion, straight line motion and Cartesian space technique in trajectory planning,	**06**
5	**Robot End Effectors:** Classification of the Robot End effectors- tools and grippers, selection and Design consideration of the gripper, mechanical grippers, vacuum grippers, magnetic grippers, adhesive grippers, RCC grippers, gripper force analysis, Materials for hostile operation of gripper. Tools used as end effectors- welding gun, spray gun, drilling tool etc., Tool center point (TCP)	**06**
6	**Manipulator Dynamics:** Kinetics of rigid bodies – Work energy principle, Linear and angular momentum, conservation laws, Forward Dynamics and Inverse Dynamics, Spatial description and transformations, Dynamic parameters identification, Newton-Euler formation, Lagrange-Euler formation, Dynamic model of simple manipulator structures , Dynamic model of a Two-axis planar robot	**06**

References:

Text Book-

- Groover M.P., Weiss M., Nagel R.N., Odrey N.G., "Industrial Robotics Technology-Programming and Applications", McGraw Hill Book Co
- S. K. Saha, Introduction to Robotics 2nd edition, TATA McGraw Hills Education, 2014.
- S.S.Ratan , Theory of Machines, Tata McGraw Hill

Reference Books-

- Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009.
- Richard D. Klafter, Thomas. A, Chri Elewski, Michael Negin, Robotics Engineering: An Integrated Approach, PHI Learning., 2009.
- Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
- Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993.

- Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, MIT Press., 2003.
- John J. Craig, Introduction to Robotics Mechanics and Control, Third Edition, Pearson, 2008.
- Hartenberg and Denavit, "Kinematics and Synthesis of Linkages", McGraw Hill Book Co.
- J. E. Shigley and J.J.Uicker Jr., Theory of Machines and Mechanism, McGraw Hill
- Kelly R, Santibanez V and Loria A, —Conrol of Robot Manipulators in Joint Space, Springer, 2005.
- John J. Craig, Introduction to Robotics, 3rd Edition, Addison Wesley, ISE 2008

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING
Multidisciplinary Minor – IV

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.
1	**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**
2	**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	**04**

	and economic viability of smart city. Critical analysis of smart city development projects in India	
3	**Smart City Mission in India:** 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**
4	**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**
5	**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**
6	**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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

L	T	P	Credits
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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

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 turbines- horizontal axis and vertical axis. Wind power integration into grid-power system , grid connected PV systems	**02**
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

References -

Text Books:

- Ashfaq Husain, Electric Machines, Dhanpat Rai & Co
- V K Mehta, Principle of Electric Machine, S Chand Publication

Reference Books:

- P. S. Bimbhra , Electrical Machinery, Khanna Publishers
- B.L.Theraja and A.K.Theraja, Electrical Technology, S Chand Publication

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T. Y. B. Tech.**	Semester-V
Course Code : **ECMD303**	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,
1. Elaborate product design processes.
2. Explain various aspects of PCB design.
3. Differentiate product-testing methods.
4. Create various documents for the product.

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

Course Content

Unit No	Description	Hrs
1	**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
2	**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
3	**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
4	**Hardware and software Design and Testing Methods :**	04

	Introduction, Signal Integrity, Software Design and Testing Methods, Phases of Software Design, Selection of Language for Software Development, Assemblers, Compilers, Simulators, Emulators.	
5	**Electronic Product Testing :** Introduction, Environmental Testing, Temperature Testing, Thermal Modeling of Components, Humidity Testing, Electrical Overstress Testing, 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.	**04**
6	**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:

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

Reference Books:

- Walter C Bosshart, Printed Circuit Board design and technology, Tata McGraw Hill
- Clyde Coombs ,Handbook of Printed Circuit, MCGraw Hill publication
- M.G. Loveday, Electronic testing and fault diagnosis, Longman 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:**	02

	Polymorphism: Method overloading (Compile time Polymorphism), Method overriding (Run time Polymorphism), Inheritance, super, this, static and final keywords, Abstraction, Interface, Garbage collection.	
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech.**	Semester- **V**
Course Code: **MEMD307**	Course Name: **Design and Prototyping**

L	T	P	Credits
2	--	--	2

Course Description:
This course provides students with practical experience in computer-aided design (CAD), focusing on sketching, part design, and the simulation and execution of additive manufacturing processes. Students will engage in hands-on activities that culminate in the 3D printing of their designed components.

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

1. Use CAD software to create detailed CAD models and designs.
2. Explain the workflow and settings for effective additive manufacturing.
3. Simulate the 3D printing process to identify and correct potential issues before actual printing.
4. Print a 3D component based on CAD models.

Prerequisites: Basic knowledge of engineering drawing and design principles

Course Content

Unit No	Description	Hrs.
1	**Introduction to CAD and Sketcher Basics:** Overview of CAD software, Basic operations and navigation, creating simple sketches and applying dimensions.	02
2	**Advanced Sketching Techniques:** Using geometric constraints, Parametric sketching techniques, Practice exercises on complex shapes.	02
3	**Basic Part Design:** Extruding and revolving sketches, Introduction to editing features like fillets, chamfers, and shells.	02
4	**Advanced Part Design:** Applying advanced features and reference geometries, Transformation feature-Patterning, Scaling, Mirror, Creating assemblies from multiple parts.	02
5	**Introduction to Simulation in Additive Manufacturing:**	02

	Basic principles of simulation for 3D printing, Setting up a simulation from a CAD model.	
6	**Simulation for Material Optimization and Strength:** Using simulation to predict material usage and optimize print parameters, analyzing results and making adjustments.	**02**
7	**Preparing for 3D Printing:** Converting CAD models to printable files (slicing), Selection of materials, Hands-on setup and initialization of 3D printers, sample 3D Printing of Components, Techniques for cleaning and finishing 3D printed parts.	**02**
8	**Project - 3D Printing of Components:** Selection of component, CAD design, simulation, 3D printing of designed parts, Post-Processing and Evaluation of Printed Components.	**06**

References:-

Text books

- Engineering Design and Graphics with SolidWorks by James D. Bethune
- Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing by Ian Gibson, David Rosen, and Brent Stucker.

Reference Books:

- The 3D Printing Handbook: Technologies, design and applications" by Ben Redwood, Filemon Schöffer, and Brian Garret.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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,

1. Explore the architecture of PLC and its functions.
2. Execute the various instructions and logic in PLC.
3. Develop the PLC program for various applications.
4. 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, program control instructions.	**04**
3	**Application of PLC :** Parking process, Temperature control, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control	**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-Remote terminal unit-Master terminal unit.	**04**
5	**Distributed Control System :**	**04**

	Evolution - Architectures - Comparison - Local control unit - Process interfacing issues. Operator interfaces - Low level and high level operator interfaces - Engineering interfaces - Low level and high-level engineering interface	
6	**Applications of DCS :** Pulp and paper environment -Power plant 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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

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

Prerequisite: 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.	04

	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.	
4	**Data Warehousing:** What is a data warehouse, need for a data warehouse, architecture, data marts, OLTP vs OLAP, Multidimensional Modeling: Star and snow flake schema, Data cubes, 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 and cube 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) , Wiley India
- Forecasting: Principles and Practices, Rob JHyndman, George Athanasopoulos, Otext

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: **T. Y. B. Tech.**	Semester: **V**
Course Code: **RAMD303**	Course**: Robot Programming.**

L	T	P	Credits
1	--	2	2

Course Description:
This course provides a comprehensive introduction to robot programming techniques and control strategies. Students will learn how to program robots to perform various tasks autonomously and interact with their environment using robot operating system.
This course covers Robot programming fundamentals, motion planning and control, Robot simulation and testing.

Course Outcomes:
After the successful completion of this course, the student should be able to:
1. Explain Robot programming ecosystem.
2. Create reusable code for robot powered applications.
3. **Design a custom robot using programming.**
4. Simulate and control the robot using ROS.

Prerequisite: Knowledge in C++ and/or Python Programming language. Linux, Robot kinematics and Dynamics.

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction:** Robot Programming: Methods of robot programming, Lead through method. Robot program as a path in space, Methods of defining positions in space, Motion interpolation, branching.	**03**
2	**Robot programming languages:** Categories of Robot programming languages. Modes of operation of robot programs. Requirements for a standard robot language, Robot programming Language Structure, Elements of Robot programming Language. Functions in Robot programming Language.	**03**
3	**Robot Operating System (ROS):** ROS functionalities, ROS structure, Distribution, Tools, Architecture, Philosophy, workspace, Nodes, Packages, Topics. The ROS Graph.	**03**
4	**Block-based coding:**	**03**

	Working of block-based coding, features of block-based coding, designing interface, block-based coding with robots. Block based programming languages. Robot Programming using teach Pendant for various applications	

List of experiments (Any 10)

Course Content		
Expt. No.	**Description**	**Hrs.**
1	Introduction to Robot Programming (ROS).	**02**
2	ROS Nodes, Topics, Services, Parameters, Launch Files	**02**
3	ROS Workspace and ROS Package.	**02**
4	Unified Robotic Description Format (URDF) for robot	**02**
5	Links, Joints, Collisions, Inertia tags in the URDF file	**02**
6	Launch file to Start the Robot State Publisher with URDF (XML)	**02**
7	XML using Python launch files	**02**
8	Make the URDF Compatible with Xacro.	**02**
9	Functions with Xacro Macros.	**02**
10	Motion in ROS.	**02**
11	Computer vision in ROS with open CV	**02**
12	Connecting Hardware with ROS	**02**

References Books:

- Robot Operating System for Absolute Beginners by Lentin Joseph
- Programming Robots with ROS Morgan Quigley, Brian Gerkey, and William D. Smart.
- M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing, Prentice-Hall.
- S. K. Saha, Introduction to robotics, The McGraw Hill Company.
- K.S. Fu; Gonzalez, R.C. & Lee, C.S.G, Robotics-Control, Sensing, Vision and Intelligence, McGraw Hill.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech.**	Semester-V	**L**	**T**	**P**	**Credits**
Course Code: **MC3511**	Course Name: **Industrial Automation Lab**	-	-	**2**	**1**

Course Description:
-To provide a clear view on Programmable Logic Controllers (PLC)
-To learn the various methods involved in automatic control and monitoring

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

1. Develop the PLC program for the implementation of logic gates
2. Develop the PLC program for controlling the parameters and applications like Pressure, bottle filling, cylinder actuation and elevator control.
3. Develop the PLC program for various applications like identifying the necessity of using Supervisory Control and Data Acquisition (SCADA) for complex projects.
4. Develop HMI, SCADA program for various applications.

Prerequisite: Fundamentals of Sensor and Instrumentation

Course Content

Experiment No	Description	Hrs
1.	Develop RS logic software implementation of logic gates	**02**
2.	Demonstrate the various instructions of PLC like Ton,Toff, using RS logic software	
3.	Demonstrate the Automatic level and flow control using PLC	**02**
4.	Demonstrate the Car parking Programme using PLC	**02**
5.	Demonstrate the traffic light Programme using PLC	**02**
6.	Demonstrate the staircase lightning Programme using PLC	**02**
7.	Demonstrate the Bottle filling process using PLC	**02**
8.	Identify I/O module for automate the cylinder sequencing using simple pneumatic direct control valve.	**02**
9.	Choose the special I/O for speed control of DC motor using PLC.	**02**

10.	Demonstrate the HMI and SCADA programming.	**02**

References –

1. Petruzella Frank D., Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi
2. Webb, John W. Programmable Logic Controllers: Principles and Application, Fifth edition, Prentice Hall of India, New Delhi.
3. Bolton , "Programmable Logic Controllers" Newnes,

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech .**	Semester-V
Course Code: **MC3531**	Course Name: **Sensors and Instrumentation Lab**

L	T	P	Credits
-	-	2	1

Course Description:
To get hands on experience to measure the analog and digital signals using various sensors. This laboratory also provides the knowledge of data analysis to acquire using Lab View Software.

Course Learning Outcomes:
At the end of the course, students will be:
1. To understand tem1s and sensors used in engineering applications.
2. Able to design necessary signal conditioning circuits for various sensors.

Prerequisite: Nil

Course Content

Experiment No	Description	Hrs
1.	Measurement of displacement using linear and rotary sensors	02
2.	Measurement of speed using rotary sensors	02
3.	Force measurement using strain gauge.	02
4.	Pressure measurement system using sensors.	02
5.	Temperature measurement using RTD or thermocouples	02
6.	Study of humidity measurement	02
7.	Vibration and acceleration measurement using piezoelectric sensor	02
8.	Design of complete signal condition circuit for temperature and pressure	02
9.	Study of data acquisition systems and interfacing sensors with computer.	02
10.	Study of various sensors and circuit for home automation	02
11.	Programing for temperature and pressure measurement for home automation system	02

Textbooks:

- Bentley JP, "Principles of measurement systems", Pearson Publishers.
- Ernest, 0. Doebelin, "Measurement Systems Applications and Design", Tata McGraw Hill.

Reference Books:

- Patranabis, D., "Principles of Industrial Instrumentation", Tata McGraw-Hill.

Murty, D. V. S., "Transducers and Instrumentation", PHI Leaming Pvt. Ltd

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-V
Course Code: **MC3552**	Course Name: **Control Engineering lab**

L	T	P	Credits
-	-	2	1

Course Description:
A major factor in the rapid advancement of engineering in recent decades, automatic control is now ubiquitous and indispensable. Following the Second World War, the concept of feedback control was born. Blind aero plane landings, robotics design, computer numerical control (CNC) and direct numerical control (DNC) systems, and jet engine control are only a few instances of some of the complex examples of modern control systems based on automatic control. These days, to keep up with the ever-increasing needs of industries, it's necessary to use a combination of mechanical, electrical, and electronic instrumentation applications.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Develop transfer function of block diagrams using MATLAB.
2. Analyze response of control systems to various input conditions.
3. Design a control system using root locus method.
4. Prepare state space representation for given control system using various programming methods.

Prerequisite: No

Course Content

Experiment No	Description	Hrs
1.	Different Toolboxes in MATLAB, Introduction to Control Systems Toolbox.	02
2.	Determine transpose, inverse values of given matrix.	
3.	Determine the transfer function for given closed loop system in block diagram representation.	02
4.	Determine the time response of the given system subjected to any step signal.	02
5.	Determine the time response of the given system subjected to any step impulse and ramp signal.	02
6.	Plot the pole-zero configuration in s-plane for the given transfer function.	02
7.	Plot unit step response of given transfer function and find delay time, rise time, peak time and peak overshoot.	02

8.	Plot root locus of given transfer function, locate closed loop poles for different values of k.	**02**
9.	Determine the State Space representation of the given transfer function.	**02**
10.	Determine the response of system with PID controller.	**02**

References- Text Books:

- R Anandnatarajan, P. Ramesh Babu, Control System Engineering, SciTech Publication.
- F.H. Raven, Automatic Control Engineering, Tata McGraw Hill Publication.

Reference Books:

- Anand Kumar, Control Systems, Prentice Hall Publi.
- K Ogata, Modern Control Systems, Prentice Hall Publi.
- B.C. Kuo, Automatic Control Systems, Willey India Ltd. Prentice Hall Publication,
- D. Roy and Choudhari, Automatic Control Engineering, Orient Longman Publication. Calcutta.
- R. A. Barapate, Feed Back Control Systems.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-V
Course Code: **SH3035**	Course Name: **Scholastic Aptitude-I**

L	T	P	Credits
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, the 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,
1. Develop a thorough conceptual understanding and develop a logical approach towards solving Aptitude and Reasoning problems.
2. Understand usage of basic aptitude terms of percentages, averages, ratios and applications of business aptitude terms of profits and interests
3. Develop a bridge in analogies, series and visualizing directions.
4. Apply various short cuts & techniques to manage speed and accuracy to get equipped for various competitive and campus recruitment exams.

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.	**03**

3.	**Average, Allegations** Weighted average, Concept of average speed & allegation, Applications of Average & mixture allegation.	**03**
4.	**Ratio & Proportion** Comparison of Ratio & fraction, Properties of Ratio & Proportion, Mean Proportion. Joint ratio	**03**
5.	**Profit & Loss** Same selling price different Cost Price, Same cost price different selling price Concept of false scale.	**03**
6.	**Simple interest -Compound interest** Basics, Difference between SI CI, Conversion Periods, Depreciation.	**03**
7.	**TRW, Pipes & Cisterns** Time, Rate and Work-Unitary Method, LCM Method, Calculation of remuneration. Pipes & Cisterns -Concept of negative work, LCM Method.	**03**
8.	**Blood Relations** Blood Relations -Symbols, generation of tree diagram, types of questions-pointing towards person, tree based, coded blood relation.	**03**
9.	**Numerical Analogy** Basics, Relation between two numbers, numerical	**03**
10.	**Pattern, Step Completion** Image completion, Mirror images, Water images, input-Output	**03**
11.	**Series Completion** Types of series, Number series pattern, Letter series, Alphanumeric series,	**03**
12.	**Direction Sense** Basics, shadow based concept, Concept of local time zone (IST,GMT, Longitude, Latitude), Problems on local time difference, Coded direction sense	**03**
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	**03**
	Total Hrs	**42**

*1 Extra lecture will be conducted.

References –

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: T.Y. B. Tech	Semester - V
Course Code: **MC371**	Course Name: **Massive Open Online Course (MOOC)**

L	T	P	Credits
-	-	-	01

Course Description:
Online courses offered through platforms like NPTEL, SWAYAM, and NASSCOM provide opportunities to deepen the understanding of advanced electronics concepts and technologies to Electronics & Telecommunication Engineering students. These courses focus on critical domains such as circuit design, signal processing, embedded systems, communication technologies, and emerging fields like IoT and AI. 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 lifelong 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 electronics & telecommunication engineering.
2. Analyze electronics engineering problems using mathematical and engineering fundamentals.
3. Design solutions for electronics-based systems using modern engineering tools and platforms.
4. Apply programming and simulation techniques to develop and test electronic circuits and systems.
5. Demonstrate the ability to engage in independent and self-directed learning

Note:

1. Student will get the credits of respective course in following conditions,
   a. In case of course selected from NPTEL/SWAYAM/ NASSCOM platforms, students have to complete the timely assignments, PASS the exam and secure the certificate.
   b. In case of course selected from other than NPTEL/SWAYAM/ NASSCOM, students have to secure the certificate and appear for VIVA (oral) exam conducted by department.
2. Preference should be given to NPTEL course.
3. While selecting online course, following points must be taken care of,
   a. Selected course must be of advanced level and not basic or fundamental level.
   b. Contents of the course neither be covered in any of the course offered in regular curriculum nor listed in any elective (open or program elective courses)

c. Duration of each online course must be of at least FOUR weeks for NPTEL, minimum 15 to 20 hours for NASSCOM and 30-35 hours for other platforms.

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
MOOCs on Coursera
https://www.coursera.org
4. MOOCs on edX
https://www.edx.org
5. MIT Open CourseWare
https://ocw.mit.edu

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-V
Course Code: **MC373**	Course Name: **Industrial Training**

L	T	P	Credits
-	-	--	2

Course Description:
At the end of third/ fourth semester, each student would undergo four weeks Practical Training in an industry/ Professional organization / Research Laboratory/ Virtual Internship/online course with the prior approval of the Head of the department and submit a written typed report along with a certificate from the organization. The report will be evaluated during Semester -V by a Department Program Committee (DPC) to be appointed by the Director- Principal/ Principal of the college who will evaluate students.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Apply the Technical knowledge in real industrial situations.
2. Formulate Technical reports/projects.
3. Develop and refine oral and written communication skills.
4. Explain the activities and functions of business professionals.
5. Discuss knowledge of the industry in which the internship is done.

Prerequisite:
Basics of mechatronics engineering, good written and oral communication

Description

1. EXPECTATIONS FROM STUDENTS:
Students are expected to:
1. Arrive at work as scheduled, ready to work, and stay for the agreed upon time
2. Present yourself in a professional manner at all times, including being appropriately dressed for your workplace
3. Communicate any concerns with your supervisor and the internship coordinator in a timely manner and respectfully
4. Demonstrate enthusiasm and interest in what you are doing; ask questions and take initiative as appropriate
5. Complete and submit assigned tasks by designated timelines. Meet all deadlines
6. Participate in assigned meetings at work and with the internship coordinator when you return to college

2. INTERNSHIP REPORT -STUDENT'S DIARY/ DAILY LOG

The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and got ratified on the day of his visit. Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.
- Adequacy & quality of information recorded.
- Drawings, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

3. INTERNSHIP REPORT

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, TPO and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria: i. Originality. ii. Adequacy and purposeful write-up. iii. Organization, format, drawings, sketches, style, language etc. iv. Variety and relevance of learning experience. v. Practical applications, relationships with basic theory and concepts taught in the course.

4. MONITORING & EVALUATION OF INTERNSHIP

The industrial training of the students will be evaluated in three stages:

a) Evaluation by Industry.
b) Evaluation by faculty supervisor on the basis of site visit(s).
c) Evaluation through seminar presentation/viva-voce at the Institute.

a) Evaluation by Industry

The industry will evaluate the students based on the Punctuality, eagerness to learn, Maintenance of Daily Diary and skill test in addition to any remarks.

b) Monitoring/ Surprise Visit By TPO/ Staff/ Faculty Mentor

Faculty Mentor of the institutes will make a surprise visit to the internship site, to check the student's presence physically, if the student is found absent without prior intimation to the T & P Cell, entire training will be cancelled. Students should inform the TPO, faculty mentor as well as the industry supervisor at least one day prior to availing leave by email. Students are eligible to avail 1-day leave in 4 weeks and 2 days leave in 6 weeks of the internship period apart from holidays and weekly offs.

c) Evaluation through Seminar Presentation/Viva-Voce at the Institute

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria: • Quality of content presented. • Proper planning for presentation. • Effectiveness of presentation. • Depth of knowledge and skills. • Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report. Seminar presentation will enable sharing knowledge & experience amongst students & teachers and build communication skills and confidence in students

References –

AICTE INTERNSHIP POLICY: GUIDELINES & PROCEDURES

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - T.Y. B. Tech	Semester-
Course Code: **MC375**	Course Name: **Mini Project**

L	T	P	Credits
-	-	2	1

Course Description:
During the semester, students will complete a mini project that involves the full development cycle of a system or application. The project will consist of four main phases: problem analysis, solution design, building and testing (which may involve software, hardware, or both), and finally, demonstration and reporting. Students are expected to deliver a functional design that meets the specifications of the assigned project and to clearly demonstrate their learning through both implementation and documentation. Every mini project should be aligned with at least any one of the Sustainable Development Goals (SDG) and should be clearly mentioned in the synopsis and final report as well as during all assessments.

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

1. Select title of mini-project and formulate its objectives correctly mentioning SDGs addressed.
2. Develop, simulate and implement the system by complying with desired technical specifications
3. Analyze and synthesize obtained results in theoretical and practical context
4. Present findings in logical order
5. Write a report to document the findings

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech.**	Semester-**VI**
Course Code: **MC3021**	Course Name: **Machine Design**

L	T	P	Credits
3	-	--	3

Course Description:
Design of Machine Elements is offered as the core course at the fifth semester of Mechatronics Engineering undergraduate program and consists of six chapters. The first chapter focuses on customers need, Basic design procedure, requirement of machine element and material selection. Second chapter deals with Design of machine elements against static loading like lever, bolted and welded joints. Design of shaft, keys and springs are dealt with in the third chapter. The next chapter deals with bearing selection. Fifth chapter deals with design and selection power transmission elements. 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. Identify the customers need, formulate the problem and draw the design specifications.
2. Apply the theories of failure for designing the machine elements.
3. Design a simple machine component like levers, bolted & welded joints, shafts, keys and springs.
4. Select a bearing and power transmission elements for given application
5. Design a spur gear for a given application
6. Design a component against fluctuating load.

Prerequisite:
Knowledge of courses like Strength of Material and material science.

Course Content

Unit No	Description	Hrs
1.	**Design for Static Load:** Introduction to the design process, factors influencing machine design, selection of materials based on mechanical properties, Direct, Bending and torsional stress equations, Impact and shock loading, calculation of principal stresses for various load combinations, factor of safety, theories of failure.	06
2.	**Design of simple machine part and joints** A) Design of Levers	06

	B] Design of Bolted joint: Forms of screw threads, nomenclature, Design of Bolted joint subjected following conditions — i) Bolted joints in shear ii) Bolted joints subjected to load perpendicular to the axis of bolt C] Design of Welded Joint: Types of welded joints, Strength of parallel and fillet weld, strength of eccentrically loaded welded joints, weld subject to bending moment, torsional moment.	
3.	**Design of shaft, keys and spring:** Design of solid & hollow shafts on strength and rigidity basis, transmission & line shafts, splined shafts, Design of square and flat keys. Various types of springs and their applications, Design of Helical, Compression springs, Design of Helical tension springs	**06**
4.	**Bearings:** **A] Rolling Contact Bearings:** Types of rolling contact bearings, Designation, static and dynamic load carrying capacities, Stribeck's equation, Equivalent bearing load, load life relationship, selection of bearing life, Selection of rolling contact bearings from manufacturers catalogue. **B] Basic terminologies and Selection of Sliding Contact Bearings** **C] Basic terminologies and Selection of Hydro-dynamic bearing**	**06**
5.	**Design of Power Transmission Elements:** **A] Spur gear** Number of teeth and face width, construction details of gear wheel, force analysis, Beam strength (Lewis) equation, velocity factor, service factor load correction factor, effective load on gear. Wear strength (Buckingham's) equation, estimation of module based on beam and wear strength. Estimation of dynamic tooth load by velocity factor and Buckingham's equation, Gear selection procedure. **B] Selection of flat belt, V belt**	**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, Cumulative damage in fatigue failure, Soderberg & Goodman diagram.	**06**

References -
Textbooks:

1. Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. ltd.

2. Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
3. Bhandari V.B, Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
4. Juvinal R.C, Fundamentals of Machine Components Design, John Wiley and Sons.

Reference Books:

1. Behrooz Mashadi, David Crolla, Vehicle Powertrain Systems, A John Wiley & Sons, Ltd
2. Crolla, David Automobiles Power trains and Automobiles Dynamics, A John Wiley &Sons, Ltd
3. David A Crolla, Automotive Engineering Powertrain, Chassis System and Vehicle Body, Elsevier B H New York, London, Oxford.
4. Lack P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
5. Willium C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
6. P. Kannaiah, Design of Transmission SCIETCH Publications Pvt Ltd.
7. C.S. Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learning Pvt. Ltd.
8. D.K. Aggarwal& P.C. Sharma, Machine Design, S.K Kataria and Sons.
9. P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learning Pvt. Ltd.
10. Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
11. K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers.
12. Design Data - P.S.G. College of Technology, Coimbatore.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: **T.Y. B. Tech**	Semester: **VI**	L	T	P	**Credits**
Course Code: **MC3041**	Course Name: **Power Electronics and Drives**	3	-	-	3

Course Description:
This course provides the basic knowledge of power electronic devices and power converters like AC to DC, DC to DC and DC to AC. It also provides the skills of analysis and modeling of different converters and drives. Use of modern power electronics for speed control of different electrical drives is also discussed.

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

1. Explain the characteristics, ratings and applications of power devices.
2. Calculate the performance parameters of the converters and drives.
3. Analyze the operation of power electronics converters and drives.
4. Design power converters to meet the given requirements.

Prerequisite: Basic electronics, Circuit analysis and Linear algebra.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Power Semiconductor Devices** Power Electronic System, Power semiconductor devices: characteristics and ratings of power diode, power BJT, Power MOSFET, IGBT, SCR, DIAC, TRIAC, GTO, types of power electronic circuits, series and parallel connections of the devices, SCR protections.	**06**
2	**Converter Fed DC Drives** Phase control principle, Analysis of series and separately excited DC motor with single phase and three-phase converters – waveform, performance parameters, performance characteristics, Operation with freewheeling diode, Dual converter fed DC drives.	**06**
3	**Chopper Fed DC Drives** Introduction about chopper, control strategy, Class A, B, C, D and E chopper-controlled DC motor drive – performance analysis, Chopper based implementation of braking methods, Multi-phase chopper.	**06**
4	**Induction Motor Drives**	**06**

	Voltage Source Inverters, induction motor drives- Steady state equivalent circuit and phasor diagram with variable frequency supply, v/f control and constant air gap flux control of induction motor drive, field weakening operation of induction motor drive.	
5	Gate drive circuits: MOSFET Gate drive, BJT Base drives, optocoupler, pulse transformer, Thyristor Firing circuits. UJT, Programable UJT, Case studies using Gate drives circuits	**06**
6	**DC motor, Stepper Motors and BLDC Motors, Servo motor** DC motors introduction, Principle of operation- induced emf, Torque equation characteristics, Application of shunt, series, compound motors. Constructional features, principle of operation, modes of excitation and speed control of stepper motor. Constructional features, principle of operation and speed control of BLDC motor.Constructional features, principle of operation of SERVO motor.	**06**

References-

Textbooks:

- M. H. Rashid, Power Electronics Circuits Devices and Applications, PHI
- P. S. Bhimbra, Power Electronics, Khanna Publication
- Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia.
- Vedam Subramanyam, "Electric Drives – Concepts and Applications", McGraw Hill.

Reference Books:

- M. D. Singh and K. B. Khanchandani, Power Electronics, TMG
- P. C. Sen, Power Electronics, S. Chand publication
- Ned Mohan, T. Undeland & W. Robbins, Power Electronics Converters Application and Design, John Willey & Sons

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-**VI**	L	T	P	**Credits**
Course Code: **MC3061**	Course Name: **Research Methodology**	2	-	--	2

Course Description: This course is designed to help students develop the research skills required to competently undertake and complete research projects. It will provide students with the training required to develop the skills to review and critically analyze literature on topics related to their research projects, justify the rationale for research, develop effective research designs for their projects, understand the role of theories in research, and learn to write research proposals. Students will acquire skills in both qualitative and quantitative research techniques and learn to report research findings (empirical work) with implications and draw conclusions.

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

1. Select on the literature in the field, analyze and interpret research evidence published on a topic to establish a suitable research problem/issue or opportunity to explore further.
2. Design the research study using a suitable paradigm, associated methodologies and methods of data collection and analysis.
3. Write a research proposal (research blueprint) describing the topic.
4. Demonstrate the ability to use the statistical software to solve problems.

Prerequisite:
Basic knowledge of statistics.

Course Content

Unit No	Description	Hrs
1.	**Overview of research** Definition of research and characteristics of research; Types of research. A group discussion on what is research.	**02**
2.	**Literature survey** Importance of literature review, types of literature review, selection of the review topic, searching for the literature, analyzing and synthesizing the literature, writing the review report.	05
3.	**Data Analysis using Statistical tools for analysis**	05

	Analysis of variance, regression analysis, Response surface methods for process optimization, SPSS/MINITAB/Design Expert software, modeling skills.	
4.	**Creativity in Research**, report preparation with Latex and white smoke, Group discussion on Ethics in Research, Plagiarism check.	02
5.	**Design of experiments** Strategy of experimentation, Statistical design of experiments, replication, randomization and blocking. Guidelines for designing experiments, Factorial designs. Factorial designs. The two-factor factorial design, Statistical analysis of factorial design, Taguchi design.	05
6.	**Intellectual Property** Introduction to IPR; Overview & Importance; IPR in India and IPR abroad; Patents; their definition; granting; infringement; searching & filing; Utility Models an introduction; Copyrights; their definition; granting; infringement; searching & filing, Trademarks, role in commerce, importance, protection, registration; domain names; Department specific research discussions	05

References -

Textbooks:

1. Kothari C.K. (2004) 2/e, Research Methodoloy – Methods and Techniques (New Age International, New Delhi).

Reference Books:

1. Krishnswamy, K.N., Shivkumar, Appa Iyer and Mathiranjan M. (2006) Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
2. Gupta, Santosh (2005) Research Methodology and Statistical Techniques, Deep and Deep Publications.
3. Douglas C. Montgomery, Design and analysis of experiments, John Willey and Sons, New York.
4. Tapan Bagchi, Taguchi Methods Explained: Practical steps to robust design, Prentice Hall.
5. Phillip J. Ross, Taguchi Techniques for quality engineering, TATA McGraw Hill
6. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006
7. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi , 2010

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING
PROGRAM ELECTIVE - II

Class: - **T.Y. B. Tech**	Semester-**VI**
Course Code: **MC3081**	Course Name: **Finite Element Methods**

L	T	P	Credits
3	-	--	3

Course Description:
This course introduces finite element methods for the analysis of solid, structural, fluid, field, and heat transfer problems. Steady-state, transient, and dynamic conditions are considered. Applications include finite element methods, modeling of problems, and interpretation of numerical results.

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

1. Apply the finite element method for solid mechanics and Heat transfer problems to develop the models.
2. Solve problems in one-dimensional structures including trusses and beams.
3. Formulate FE characteristic equations for two-dimensional and three-dimensional problems.
4. Analyze field problems like heat transfer and torsion by deriving element matrices and applying FEM formulations.

Prerequisite:

Course Content

Unit No	Description	Hrs
1.	**Introduction**-Basic Steps in FEM Formulation – Review of various approximate methods – Variational approach and weighted residual approach – application to structural mechanics problems.	06
2.	**One-Dimensional Problems-** Finite element formulation for 1-D problems, elimination method, penalty method, computer implementation and case studies.	06
3.	**Trusses and Beams-** Introduction, fem formulation, plane trusses, Beam element-selection of nodal d. o. f., determination of shape functions, element matrices.	06
4.	**Two-Dimensional Problems-** Finite element formulation for 2-D problems, constant strain triangle, various elements, iso parametric, sub parametric and super parametric elements, interpolation functions, computer implementation and case studies.	06
5.	**Field Problem**-Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems.	06

6.	**Three Dimensional Problems**-Finite element formulations for 3-D problems, mesh preparation, hexahedral elements, shell elements and case studies.	06

Text Books:

- Tirupathi. R. Chandrupatla and Ashok D. Belegundu,"Introduction to Finite Elements in Engineering",Pearson Higher Education Publication.
- Singiresu S. Rao, "The Finite Element Method in Engineering", Elsevier Publication.
- Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi.

Reference Books:

- Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and applications of finite element analysis", John Wiley and Sons, Inc.
- Larry J Segerlind, "Applied Finite Element Analysis", John Wiley and Sons, Inc.
- Young W. Kwon, Hyochoong Bang, "The Finite Element Method Using MATLAB", CRC Press.
- NitinS Gokhale, Sanjay S. Deshpande and Sanjeev V.Bedekar, "Practical Finite Element Analysis", Finite to Infinite Publisher.
- Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T. Y. B. Tech.**	Semester-**VI**	**L**	**T**	**P**	**Credits**
Course Code: **MC3121**	Course Name: **Additive Manufacturing**	**3**	--	--	**3**

Course Description:
The course, Additive Manufacturing Systems, deals with various aspects of additive, subtractive, and joining processes to form three-dimensional parts with applications ranging from prototyping to production. Additive manufacturing (AM) technologies fabricate three-dimensional (3D) parts using layer-based manufacturing processes directly from computer-aided-design (CAD) models. Direct digital manufacturing (DDM) or rapid manufacturing (RM) is the use of AM technologies in direct manufacturing of end-use parts. In this course, you will learn about a variety of AM and other manufacturing technologies, their advantages and disadvantages for producing both prototypes and functional production quality parts, and some of the important research challenges associated with using these technologies.

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

1. Recognize the Importance of AM technologies in Manufacturing.
2. Classify and select additive manufacturing processes for a given application.
3. Design for manufacturing of AM and conduct Process Analysis
4. Identify software issues related to additive manufacturing process.
5. Select the suitable method for Post-processing of AM parts
6. Identify the Applications of AM in Automobile, Aerospace, and Bio-medical etc.

Prerequisite: This subject open to all mechanical engineering students having knowledge of basic manufacturing processes and materials. Students having interest in advance manufacturing techniques can opt this subject.

Course Content

Unit No.	Description	Hrs
1.	**1.1. Basic principles of Additive Manufacturing:** Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM **1.2. Additive Manufacturing process chain:** Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and clean up, post processing.	**06**

2.	**Classification of AM processes:** Classification of AM, Liquid polymer system, discrete particle system, molten material systems, and solid sheet system. AM Processes: FDM of polymers, metals and ceramics, Laminated Object manufacturing, Shaped Deposition manufacturing, Sterolithography and liquid based systems, Laser Sintering technologies, 3-D Printing, Direct Metal Deposition, Electron and Laser beam technologies	06
3.	**Design for Additive Manufacturing:** Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc. Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms	06
4.	**Guidelines for process selection:** Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control, Software issues in Additive Manufacturing, problems with STL file, STL file manipulation.	06
5.	**Post Processing:** Support Material removal, Surface texture improvement, accuracy improvements, Aesthetic improvements, preparation for use as a pattern, Property enhancement.	06
6.	**Additive Manufacturing Applications:** Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries.	06

References –

- Chua Chee Kai, Leong Kah Fai, Rapid Prototyping: Principles & Applications, World Scientific.
- Ian Gibson, David W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.
- Ali K. Kamrani, Emand Abouel Nasr, Rapid Prototyping: Theory & Practice, Springer.
- D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:- **T.Y. B. Tech**	Semester-**VI**
Course Code: **MC330**	Course Name: Digital Twin

L	T	P	Credits
3	-	--	3

Course Description:
This course introduces the fundamental principles and technologies behind **Digital Twin (DT)** systems and their transformative role in modern industry. Students will explore how digital replicas of physical assets are created, monitored, and optimized using real-time data and simulation tools. The course covers DT applications in **discrete** and **process industries**, including integration with control systems like PLC, SCADA, and DCS. Students will also gain exposure to **Industry 5.0** concepts, emphasising **human-machine collaboration**, smart automation, and the ethical use of digital technologies. Through case studies, tools, and simulations, learners will understand how Digital Twins drive innovation, predictive maintenance, and sustainable manufacturing across sectors.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Analyze the basics concepts in digital twin
2. Recognize the concepts in digital twin in a discrete and process Industry.
3. Obtain the knowledge in industry 5.0
4. Apply the advantages in industry 5.0 with various applications.

Prerequisite:
Computer Programming Basics,Basics of Control Systems,Industrial Automation.

Course Content

Unit No	Description	Hrs
1.	**Unit I – Introduction** Digital Twin – Definition, types of Industry and its key requirements, Importance, Applications of Digital Twin in process, product, and service industries,History of Digital Twin-Digital Twin Technology (DTT) role in industrial innovation,Technologies/tools enabling Digital Twin – Virtual CAD Models, Control Parameters, Real-time Systems.	06
2.	**Unit II – Digital Twin in a Discrete Industry** Basics of Discrete Industry,Trends in the discrete industry, Control system requirements in a discrete industry,Digital Twin of a Product,Digital Thread in	06

	Discrete Industry,Data collection & analysis for product and production improvements,Automation Simulation.	
3.	**Unit III – Digital Twin in continuous & Hybrid Industries** Overview of Continuous and Hybrid Manufacturing Systems,Digital Twin of a Process-Simulation of process variables and control systems,Real-time monitoring and predictive diagnostics,Integration of SCADA, PLC, and DCS with Digital Twin,Energy management using DT.Case studies in chemical, oil & gas, and pharmaceutical industries.	**06**
4.	**Unit IV – Industry 5.0** Industrial Revolutions Overview, Industry 5.0 – Definition and Principles, Applications in Process and Discrete Industries, Benefits and Challenges of Industry 5.0, Smart Manufacturing and Human-Robot Collaboration, Internet of Things 5.0, Industrial Gateways,Introduction to Cognitive Systems 5.0.	**06**
5.	**Unit v: Advantages of Digital Twin** Improvement in product quality, production process, process Safety, identify bottlenecks and improve efficiency, achieve flexibility in production, continuous prediction and tuning of production process through Simulation, reducing the time to market.	**06**
6.	**Unit VI- Tools and Emerging Trends** Overview of Digital Twin tools: ANSYS, Siemens NX, PTC ThingWorx, MATLAB,Emerging Trends- Cyber security and ethical concerns in DT systems,Human Digital Twins in healthcare and personalized services,Digital Thread and Twin-to-Twin communication.	**06**

References -

Text Books:

- Uthayan Elangovan, Industry 5.0: The Future of the Industrial Economy, CRC Press,
- Christoph Jan Bartodziej, "The Concept Industry 4.0 an Empirical Analysis of Technologies and Applications in Production Logistics"

Reference Books:

- Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things"
- Ulrich Sendler, "The Internet of Things, Industries 4.0 Unleashed"

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-**VI**	**L**	**T**	**P**	**Credits**
Course Code: **MC3161**	Course Name: **Industry 4.0 Technologies and IIoT**	3	-	--	3

Course Description:
This course provides a comprehensive exploration of Industry 4.0 technologies and the Industrial Internet of Things (IIoT), which are revolutionizing the landscape of modern manufacturing and industrial processes. Students will delve into the fundamental principles, core technologies, and practical applications of Industry 4.0, gaining the knowledge and skills necessary to navigate the complexities of the fourth industrial revolution.

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

1. Recognise the role of Industry 4.0 and its historical evolution.
2. Identify and describe the core technologies that underpin Industry 4.0, including IoT, Big Data, Cloud Computing, and Cyber-Physical Systems.
3. Analyze the components of smart manufacturing systems, including digital twins, additive manufacturing, robotics, and automation.
4. Investigate the fundamental concepts and architectures of IIoT.
5. Analyze the role of sensors, communication protocols, and data analytics in IIoT implementations.

Prerequisite:
Manufacturing basics

Course Content

Unit No	Description	Hrs
1.	**Overview of Industry 4.0 and Industrial Internet of Things**-Industry 4.0-Definition and evaluation of Industry 4.0, Industrial Internet, Applications of Industry 4.0, IIoT-Prerequisites of IIoT, Basics of CPS, CPS and IIoT, Applications of IIoT Industry 4.0 environment and design principles.	**06**
2.	**Core Technologies of Industry 4.0-** Introduction to core technologies-Artificial Intelligence (AI), Additive Manufacturing (3D Printing), Blockchain Technology, Big Data Analytics,	**06**

	Robot Process Automation (RPA), Cloud Computing, Virtual Reality (VR), Augmented Reality (AR)and Mixed Reality (MR).	
3.	**Big Data & Analytics-** A Brief Introduction to Big Data Analytics, Introduction to 6C CPS Architecture, 6C CPS Architecture - Level 1 – Collection, 6C CPS Architecture - Level 2 – Conversion, 6C CPS Architecture - Level 3 – Cyber, 6C CPS Architecture - Level 4 – Customization, 6C CPS Architecture - Level 5 – Cognition, 6C CPS Architecture - Level 6 – Configuration.	**06**
4.	**Introduction to Smart Factory**-Characteristics of a Smart Factory-Feature 1 – Connected, Feature 2 – Optimized, Feature 3 – Transparent, Feature 4 – Proactive, Feature 5 - Agile	**06**
5.	**Industrial Internet of Things: Basics**- IIoT and Industry 4.0 – IIC, Industrial Internet Systems- Design of industrial internet systems- Impact of industrial internet- Benefits of industrial internet, Industrial sensing- Traditional sensing- Contemporary sensing, Industrial Processes- Features of IIoT for industrial processes- Industrial plant–The future architecture	**06**
6.	**Cloud Computing in Industry 4.0-** Necessity of cloud computing, Cloud computing and IIoT, Industrial cloud platform providers, SLA for IIoT, Fog Computing-Fog computing for IIoT- Applications of fog and their solutions.	**06**

References -

Textbooks/ Reference Books:

1. Introduction to Industrial Internet of Tings and Industry 4.0-Sudip Misra Chandana Roy Anandarup Mukherjee

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-**VI**
Course Code: **MC3181**	Course Name: **Wireless sensor network**

L	T	P	Credits
3	-	--	3

Course Description: Course Description: A wireless sensor network consists of a compact low power sensor device which collects and passes the information via wireless networks to achieve a targeted action. The purpose of this subject is to provide a comprehensive and symmetrical introduction of the fundamental concepts, major issues and effective solutions in wireless sensor networking. The syllabus covers networking issues, including network architecture design, medium access control, synchronization, energy efficiency, network security and sensor network standards.

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

1. CO1: Describe the architecture and components of wireless sensor networks.
2. CO2: Identify key applications of WSNs in various domains.
3. CO3: Explain sensor node technologies and their classifications.
4. CO4: Analyze wireless transmission methods and MAC protocols.
5. CO5: Demonstrate basic knowledge of sensor node hardware and simulation tools..

Prerequisite: Basic knowledge of communication systems and sensors.

Course Content

Unit No	Description	Hrs
1.	**Introduction of wireless sensor networks:** Introduction, background of sensor network technology, basic sensor network architecture.	06
2.	**Application of wireless sensor networks:** Range of applications, home control, building automation, industrial automation, medical applications, sensor and robots, reconfigurable sensor networks, highway monitoring, military applications, civil and environmental engineering applications.	06
3.	**Wireless sensor technology:** Sensor node technology, hardware and software, sensor taxonomy, WN operating environment, WN trends.	06
4.	**Wireless transmission technology:** Radio technology, propagation and propagation impairments, modulation, available wireless technologies, campus applications, MAN/WAN applications.	06

5.	**MAC protocols for wireless sensor networks:** Fundamentals of MAC protocols, performance requirements, common protocols for WSNs, schedule -based protocols, random access-based protocols.	**06**
6.	**Sensor node hardware:** sensor node hardware- Berkley motes, WI FI motes, Bluetooth motes, programming challenges, node level software platforms, node level simulators, state centric programming.	**06**

References -

Text Books:

1. Holger Karl & Andreas Willig, "Protocols and architectures for wireless sensor networks", John Wiley publication.
2. Kazem Sohraby, Daniel Minoli & Taieb Znati, "Wireless sensor networks- technology, protocols and applications" John Wiley publication.

Reference Books:

1. Feng Zhao & Leonidas J Guibas, "Wireless sensor networks- An Information processing approach', Elsevier publication.
2. Anna Hac, "Wireless sensor network designs", John Wiley publication.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech.**	Semester-**VI**	**L**	**T**	**P**	**Credits**
Course Code: **MC3201**	Course Name: **Microelectromechanical Systems (MEMS)**	**3**	**-**	**--**	**3**

Course Description:
MEMS stands out as one of the most promising technologies for the 21st Century, holding the potential to reshape both industrial and consumer products through the fusion of silicon-based microelectronics and micromachining technology. Its methodologies and microsystem-based devices wield the power to significantly impact our daily lives and societal norms. This course offers a comprehensive overview of the MEMS field, with a focus on its commercial applications and fabrication techniques. Additionally, it delves into the spectrum of MEMS sensors and actuators, exploring the phenomena they can detect or influence, while also addressing the primary challenges confronting the industry.

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

1. Discuss the fundamentals, characteristics, and applications of MEMS and Microsystems across various domains.
2. Identify and select specific material for manufacturing of MEMS and its packaging.
3. Analyze and select the different techniques in MEMS technology as per requirement of application.
4. Compare and choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process.
5. Design and develop MEMS solutions tailored to meet the requirements of diverse applications.
6. Design packaging solutions for MEMS devices based on specified criteria and application needs.

Prerequisite:
Knowledge of material science, fundamentals of electronics and instrumentation techniques.

Course Content

Unit No	Description	Hrs
1.	**Introduction of MEMS:**	**06**

	Microelectromechanical Systems (MEMS) and Microsystems, Typical MEMS and Microsystem products, Evaluation of Microfabrication, Microsystem and microelectronics, the multidisciplinary nature of microsystem design and manufacture, Microsystems and miniaturization, Application of Microsystems in the automotive industry, applications of Microsystems in other industries.	
2.	**Materials for MEMS** Material selection, classification, and characteristic features. Substrate and wafers, active substrate materials, silicon as a substrate material, silicon compounds, silicon piezo-resistors, gallium arsenide, quartz, piezoelectric crystals, polymers, packaging materials.	**06**
3.	**Fabrication of MEMS** Photolithography, Ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition sputtering, deposition by epitaxy, etching. Introduction to scalability and challenges related to MEMS.	**06**
4.	**Surface Micromachining for MEMS** Surface micromachining processes for MEMS fabrication. Inspection, quality control and microscopic analysis of the micro machined products. MEMS based sensors & actuators: Working Principle, sensitivities. Latest applications of those actuators in cell phones, biomedical instrumentation, and aerospace technology case studies.	**06**
5.	**MEMS types and their applications** Mechanical MEMS, Strain and pressure sensors, Accelerometers etc., Electromagnetic MEMS, Micromotors, Wireless and GPS MEMS, Magnetic MEMS, SQUID magnetometers, Optical MEMS, Thermal MEMS, thermo-mechanical and thermo-electrical actuators, Peltier heat pumps.	**06**
6.	**Packaging of MEMS** Packaging issues related to MEMS, Reliability assessment and measurement techniques for MEMS, precision, accuracy, uncertainties of MEMS based devices, exposure to distribution fitment for predicting the performance.	**06**

References -

Text Books:

- MEMS, N. P. Mahalik, Tata McGraw-Hill Publications, 2007
- MOEMS: Micro-Opto-Electro-Mechanical Systems, M. Edward Motamedi, SPIE Publications, 2005

Reference Books:

- MEMS: Introduction and Fundamentals by Mohamed Gad-el-Hak
- MEMS mechanical sensors by Stephen Beeby

- Microsensors, MEMS, and smart devices by Julian W. Gardner, V. K. Varadan, Osama 0. Awadelkarim
- MEMS and microsystems: design, manufacture, and nanoscale engineering- Tai-Ran Hsu
- Micromachining -V.K.Jain, Narosa Publishing house

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: -**T. Y. B. Tech**	Semester-**VI**
Course Code: **MC332**	Course Name: **Fuzzy Logic and Neural Network**

L	T	P	Credits
3	--	--	3

Course Description:
To master the various fundamental concepts of fuzzy logic and artificial neural networks. This will help you to get sufficient knowledge to analyze and design the various intelligent control systems.

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

1. Understand the basic concept of fuzzy sets, fuzzy logic & defuzzification.
2. learn basics of Artificial Neural theory and programming of Microprocessors.
3. analyze various techniques in feedback and feed forward Neural networks.
4. Understand the principle of competitive neural networks and Adaptive resonance theory.
5. learn the architecture and algorithm of Cognitron, Neo cognitron The concepts of fuzzy associative memory and fuzzy systems

Prerequisite:
Students should have,

1. Fundamental of Computing

Course Content

Unit No	Description	Hrs.
1.	FUNDAMENTALS OF FUZZY LOGIC Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements- union intersection-combination of operation- general aggregation operations- fuzzy relations-compatibility relations-orderings- morphisms- fuzzy relational equations-fuzzy set and systems.	06
2.	ARCHITECTURE OF NEURAL NETWORKS Architectures: motivation for the development of natural networks-artificial neural networks-biological neural networks-area of applications-typical Architecture-setting weights-common activations functionsBasic learning rules- Mcculloch-Pitts neuron- Architecture, algorithm, applications-single layer net for pattern classification- Biases and thresholds, linear separability - Hebb'srule- algorithm -perceptron - Convergence theorem-Delta rule.	06

3.	BASIC NEURAL NETWORK TECHNIQUES Back propagation neural net:standard back propagation-architecture algorithm- derivation of learning rulesnumber of hidden layers--associative and other neural networks- hetro associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzman machine	**06**
4.	COMPETITIVE NEURAL NETWORKS Neural network based on competition: fixed weight competitive nets- Kohonenself organizing maps and applications-learning vector quantization-counter propagation nets and applications adaptive resonance theory: basic architecture and operation-architecture, algorithm, application and analysis of ART1 & ART2	**06**
5.	SPECIAL NEURAL NETWORKS Cognitron and Neocognitron - Architecture, training algorithm and application-fuzzy associate memories, fuzzy system architecture- comparison of fuzzy and neural systems	**06**
6.	Applications Neural network applications: Process identification, control, fault diagnosis and load forecasting.	**06**

References-

Textbook:

1. T1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
2. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition.
3. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.
4. Introduction to Neural Networks using MATLAB 6.0 - S.N.Sivanandam, S.Sumathi, S.N.Deepa, TMH

Reference Books:

1. Bart Kosko, —Neural network and Fuzzy System‖ - Prentice Hall.
2. J.Klin and T.A.Folger, —Fuzzy sets‖ University and information- Prentice Hall.
3. J.M.Zurada, —Introduction to artificial neural systems‖-Jaico Publication house.
4. VallusuRao and HayagvnaRao , —C++ Neural network and fuzzy logic‖-BPB and Publication.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Open Elective-II

Class: **T. Y. B. Tech.**	Semester: **VI**
Course Code: OE3024	Course: **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	06

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	06
3	**Reliability Allocation** Definition, reliability allocation techniques, equal apportionment, AGREE method, ARINC method, feasibility of objectives apportionment technique, minimum effort method	06
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	06
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,	06
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	06

References –

Text Books:

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

Reference Books:

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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	**06**

	standards. Codification, Nature, process, methods and advantages of codification.	
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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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. **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.	**06**
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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** 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.	**05**
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.

Rajarambapu Institute of Technology Mechatronics Dept. 415 414 Rajaramnagar

K.E.S. Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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 applications will be surveyed.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Compare various conceptions of data mining as evidenced in both research and application
2. Apply Classification and Clustering techniques for real time problems
3. Characterize the various kinds of patterns that can be discovered by association rule mining
4. Analyze web mining techniques for structured/un-structured data patterns
5. 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:**	06

	Decision Trees, Bayesian Classification, Rule-Based Classification, Neural Network-Based Algorithms, Support Vector Machines, Classification by Association Rule Analysis, Nearest Neighbor Classifier	
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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **Third Year 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.

Course Content

Unit No.	Description	Hrs
1.	**Understanding of Supply Chain:**	06

	Introduction to Supply Chain Management, Evolution of Supply Chain Management, Analytics in Supply Chain Management, Supply Chain Planning, Different views of Supply Chain	
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:

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

Reference Books:

2) logistics and supply chain management, Christopher martin, Pearson Education Asia.

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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, wheeled 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:

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

Reference Books:

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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	6
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.	6
3	**Programming Paradigm**	6

	Introduction of Programming Paradigm, Coding Standards, Best Practices, , Introduction to code optimization, Modular approaches through Functions, Testing and Debugging	
4	**Object Oriented Concepts** Introduction to Object Oriented Programming, C versus C++, Features of OOP, Constructor, Destructor, Inheritance, Polymorphism.	6
5	**Relation Database Management** Introduction, ER modelling, SQL Queries	6
6	**Project Management** Project Management Concepts, Project Management Activities, Project Estimation, Project Planning and Scheduling, Project Risk Management, Project Execution and Monitoring, Project Communication Management, Project Management Tools, Project Monitoring and Tools	6

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:-**Third Year 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:**	06

	Transportation Problem and its variants- Unbalanced, Maximization, Restrictions on route.	
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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:

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

Reference Books:

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: **-T.Y. B. Tech**	Semester-**VI**	**L**	**T**	**P**	**Credits**
Course Code: **OE354**	Course Name: **Fuzzy Logic and Neural Network**	**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	**06**

	Composition, Value Assignments, Problems based on relation and composition.	
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** What is soft computing? Differences between soft computing and hard computing, Biological Neural Networks, The Journey of Neural Networks, Activation Function, Soft Computing constituents.	**06**
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:

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

Reference Books:

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:-**T.Y. B. Tech**	Semester-**VI**	**L**	**T**	**P**	**Credits**
Course Code : **OE356**	Course Name :**Project Management**	**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	**06**

	& risks for sustainable opportunities. National Cost-Benefit Analysis, Financing Sustainable Opportunities.	
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:-**Third Year B. Tech.**	Semester-VI	**L**	**T**	**P**	**Credits**
Course Code : **OE358**	Course Name :**Plumbing (Water and Sanitation)**	**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, 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,	**06**
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:- **T.Y. B. Tech.**	Semester- Vi	**L**	**T**	**P**	**Credits**
Course Code : **OE362**	Course Name : **Flexible Manufacturing Systems**	**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 Learning 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:

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

Reference Books:

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

Rajarambapu Institute of Technology Mechatronics Dept. 415 414 Rajaramnagar

K.E.S. Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:-	Semester-
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,

1Describe fundamental concepts of cybersecurity, AI, and key frameworks.
2Use Python and machine learning tools for basic malware and anomaly detection tasks.
3Examine and differentiate AI techniques for threat detection, intrusion detection, and network security operations.
4Design 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 Al concepts, Intersection of Cyber Security and Artificial Intelligence (AI), Applications of Al 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	06

	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	
3	**AI-Powered Threat Detection and Malware Analysis** Security Innovation for Threat Detection, Behavioral Analytics with Al,Al for Intrusion Detection systems (IDS), Threat Hunting and Detection Intelligence, Adversarial Attack Detection and Mitigation, Basics of malware analysis techniques, Automated malware detection and classification, Introduction to tools using Al for malware analysis, Dynamic and Static Analysis, Al-Powered Sandboxing	**06**
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 Al, Automated OSINT and Social Engineering with Al, Vulnerability scanning and prioritization, Dashboard development for vulnerability intelligence, Introduction to Open-source bug hunting barriers, Applications of Al Fuzzing in bug bounty, Al-Assisted Exploitation and Attack Simulations, Al 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 Al tools, Hands-on: Use ELK Stack (Elasticsearch, Logstash, Kibana) for log analysis, Governance through responsible Al frameworks in cybersecurity, The future of Al 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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:- **T. Y. B.Tech Engg**	Semester-II	**L**	**T**	**P**	**Credits**
Course Code : **OE370**	Course Name :**AI for Sustainability**	**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 economical 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**	**06**

	Supervised, unsupervised, reinforcement learning, Introduction to Neural networks and deep learning, Tools and frameworks for AI: Python, TensorFlow, Scikit-learn	
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** 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	**06**
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:

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

Reference Books:

1. 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
2. Klaus Schwab "The Fourth Industrial Revolution", Crown Publishing Group
3. Peter Dauvergne "AI in the Wild: Sustainability in the Age of Artificial Intelligence", MIT Press
4. Srikanta Patnaik, Siddhartha Bhattacharyya, Nilanjan Dey (Eds.), "Smart Intelligent Computing and Applications", Springer

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:- **Third Year 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:
1. Philip Kotler, Kevin Lane Keller – "Marketing Management" Pearson Publications – 15th Edition – 2019.
2.Rajan Saxena – "Marketing Management", The McGraw-Hill Companies Publication – 3rd Edition - 2017
Reference Books:
1. Vijay Prakash Anand, "Marketing Management – An Indian Perspective" Wiley India Pvt. Ltd. 2019.
2. Joel R. Evans, Berry Berman - "Marketing Management" 1st Edition 2018.
3. James C. Anderson James A. Narus Das Narayandas, Business Market Management: Understanding, Creating, and Delivering Value, Prentice Hall; 3rd Edition, 2018.
4. Stephen Wunker, Capturing New Markets: How Smart Companies Create Opportunities Others Don't, McGraw-Hill Education; 1st Edition, 2017.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING
Multidisciplinary minor – V

Class: **T. Y. B. Tech.**	Semester: **VI**
Course Code : **CEMD302**	Course Name: **Environmental 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
1	**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

2	**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
3	**Sewage and Storm Water Collection system :** 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,	06
4	**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
5	**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
6	**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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. 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: Power system, Renewable energy sources, power system economics

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	06

	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.	
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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: -**T.Y. B. Tech.**	Semester-**VI**
Course Code : **ECMD302**	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:** 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.	**06**
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:

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

Reference Books:

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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:

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

Reference Books:

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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T. Y. B. Tech.**	Semester-**VI**
Course Code:**MEMD304**	Course Name: **Marketing and Business Fundamentals for New Products**

L	T	P	Credits
3	--	--	3

Course Description:
In this course, students will learn and understand essential principles and strategies required for successfully launching new products in today's competitive market landscape. From understanding consumer behavior to developing effective branding strategies, students will gain the knowledge and skills necessary to navigate the complexities of bringing innovative products to market.

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

1. Explain product positioning and branding strategies for new products
2. Analyse market trends and consumer behaviour to identify opportunities for new product development.
3. Develop pricing strategies and cost estimation techniques for new products
4. Explain the basics of intellectual property rights and patents in the context of new product development
5. Design distribution channels and sales strategies designed for a new products
6. Create effective marketing communication plans and launch strategies for new products.

Course Content		
Unit No	**Description**	**Hrs.**
1	**Product Positioning and Branding Strategies:** Understanding the concept of product positioning, Identifying target markets and audience segmentation, Crafting a compelling brand identity, Developing brand positioning strategies, Case studies and real-world examples of successful branding campaigns.	**06**
2	**Market Analysis and Segmentation:** Conducting market research to identify opportunities and threats, Analysing market trends and consumer behaviour, Segmentation techniques for targeting specific market segments, Assessing market competition and differentiation strategies, Utilizing data analytics tools for market analysis	**06**
3	**Pricing Strategies and Cost Estimation:**	**06**

	Factors influencing pricing decisions, Cost estimation methods for new product development, Pricing strategies: skimming, penetration, value-based pricing, etc., Pricing psychology and consumer perceptions, Pricing models and simulations	
4	**Basics of Intellectual Property Rights and Patents :** Understanding intellectual property rights (IPR), Overview of patents, trademarks, copyrights, and trade secrets, Importance of protecting intellectual property for new products, Patent application process and requirements, Case studies on patent infringement and legal implications	**06**
5	**Distribution Channels and Sales Strategies:** Exploring various distribution channels: direct vs. indirect, Channel selection and management, Developing sales strategies and distribution plans, Sales forecasting and performance measurement, Building partnerships and alliances for distribution	**06**
6	**Marketing Communication and Launch Strategies:** Crafting effective marketing messages and communication channels, Integrated marketing communication (IMC) strategies, Planning and executing product launches, Leveraging digital marketing tools and social media platforms, Measuring the success of marketing campaigns and adjusting strategies accordingly	**06**

References: -

Textbooks:

2. Saxena, Marketing Management: Text and Cases.
3. Rao, V.S.P., & Saxena, Marketing Management: Indian Cases.
4. Beri, G.C. Indian Marketing: Text and Cases.
5. Gandhi, M.K., Kumar, A., & Mowen, J.C. Marketing: Concepts and Cases.

Reference Books:

- Kotler P. and Keller K.L, Marketing Management.
- Crawford C.M. and Di Benedetto C.A, New Products Management.
- Armstrong G. and Kotler P, Principles of Marketing.
- Ries, The Lean Startup: How Today's Entrepreneur use Continuous Innovation to Create Radically Successful Businesses.
- Boone L.E. and Kurtz D.L, Contemporary Marketing.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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, 1st edition,.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

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

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:
After successful completion of the 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.

Prerequisite: Basic knowledge of logical reasoning, Probability theory.

Course Content

Unit No	Description	Hrs
1	**Introduction:** The four categories of definitions of AI, Concept of rationality, TheAI 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, Applicationdomains 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:**	06

	Propositional logic, predicate logic, Resolution, Resolution in proportional logic and predicate logic,Clause form, unification algorithm.	
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

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: **T. Y. B. Tech.**	Semester-**VI**
Course Code: **RAMD302**	Course Name: **Industrial Automation & Control**

L	T	P	Credits
3	-	-	3

Course Description:
This course offers a comprehensive overview of industrial automation systems, emphasizing their design, components, and applications in various industries. Students will learn about fundamentals of industrial automation, programmable logic controllers (PLCs), PLC programming, material handling and distributed control systems (DCS).

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

1. Explain need, basic elements, and systems of industrial automation.
2. Develop PLC programming for various applications.
3. Discuss various material handling and identification technologies.
4. Explain basics of DCS and its interfacing.

Prerequisite: NIL

Course Content		
Unit No.	**Description**	**Hrs**
1	**Fundamentals of Industrial Automation** Need of automation, Types of Automation: fixed /programmable /flexible automation, Automation principles and strategies. Basic elements of automated systems: power, program and control, Advanced automation functions: Safety monitoring, Maintenance and Repair diagnostics, Error detection and recovery, Levels of automation.	**06**
2	**Transfer Lines and Automated Assembly** Fundamentals, Configurations, Transfer mechanisms, storage buffers, control, applications, Analysis of transfer lines with and without storage buffers. Assembly Automation: Types and configurations, Parts delivery at workstations.	**06**
3	**Fundamentals of PLC** Programmable Logic Controller (PLC)- Block diagram of PLC, PLC architecture and programming languages (Ladder Logic, Function Block Diagram, etc.), Basic instruction sets, Input/output modules. Networking of PLC, Overview of safety of PLC with case studies.	**06**

4	**PLC Programming** Basic instructions (AND, OR, NOT, Timer, Counter, etc.), Programming techniques (branching, looping, etc.), Program control instructions, PLC applications like motor control, light control etc.	**06**
5	**Material handling and Identification Technologies** The material handling function, Types of Material Handling Equipment, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/Retrieval Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing. Product identification system: Barcode, RFID etc.	**06**
6	**Distributed Control System** Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.	**06**

References –

Text Books:

- M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing, Prentice-Hall.

Reference Books:

- Webb, John W. Programmable Logic Controllers: Principles and Application, Prentice Hall of India, New Delhi.
- Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Lucas, M.P., Distributed Control System, Van Nonstrandreinhold Co. NY.
- Amber G.H & P.S. Amber, Anatomy of Automation, PrenticeHall.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: **T.Y. B. Tech.**	Semester – **VI**
Course Code: **MC3241**	**Course Name: Image processing**

L	T	P	Credits
2	--	--	2

Course Description:
Image processing and Computer vision– This course introduces core concepts and applications of Image Processing and Computer Vision, combining mathematical foundations, algorithms, and software tools. It equips undergraduates with theoretical knowledge and practical skills in visual data analysis, focusing on real-world applications like object recognition, motion tracking, depth estimation, and medical imaging

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Understand 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 and Computer vision.

Prerequisite: Basic knowledge of Linear Algebra and programming language.

Course Content		
Unit No	**Description**	**Hrs**
1.	**Digital Image Fundamentals:** Definition of Digital Image Processing, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition.	04
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	04

3.	**Image Segmentation and Morphological Image Processing:** Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region oriented segmentation.Dilation, Structuring element decomposition, The Erosion, Dilation and Erosion, Opening and closing, The hit or miss transformation.	**04**
4.	**Computer vision Fundamentals:** Definition of computer vision, Computer Vision Techniques, edge detection techniques , corner and interest point detection, texture.	**04**
5.	**Shapes and Regions:** Binary shape analysis , object labeling and counting, size Filtering, distance functions, skeletons and thinning, deformable shape Analysis, boundary tracking procedures ,active contours,shape models and shape recognition, centroidal profiles,handling occlusion ,boundary length Measures, boundary descriptors ,chain codes.	**04**
6.	**3D Vision and Motion** Methods for 3D vision – projection schemes, shape from shading , photometric stereo, shape from texture, shape from focus, point-based representation, volumetric representations, 3D object recognition APPLICATIONS: Photo album, Face detection, Face recognition.	**04**

Reference Books:

Textbook:

1. Digital Image Processing- Rafel C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010
2. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI
3. Learning (Indian Edition), 2009.

Reference Books:

4. Fundamentals of Digital Image Processing- A K. Jain, Pearson 2004.
5. Image Processing analysis and Machine vision with Mind Tap by Milan Sonka and Roger Boile, Cengage Publications, 2018.N. P. Bali, Ashok Saxena and N. Ch. S. N. Iyengar, A Textbook of Engineering Mathematics, Laxmi Publications, New Delhi, 6th edition, 2004.
6. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities,
7. Elsevier (Academic Press), 2013.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:- **T.Y. B. Tech.**	Semester-**VI**
Course Code : **MC3601**	Course Name :**Image Processing Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This lab course provides hands-on experience with image processing and computer vision techniques, including image enhancement, segmentation, feature extraction, and object recognition using MATLAB and LabVIEW. Students tackle real-world problems such as motion tracking and depth estimation, developing practical skills for industry applications, research, and advanced studies in the field.

Course Learning Outcomes:
1. Develop programs to perform basic read and write operations for displaying grayscale images.
2. Implement vision programs to convert 2D arrays into grayscale images and perform image manipulations like rotation.
3. Demonstrate the relationships between pixels in an image through programming techniques.
4. Analyze and compute histogram values, and display histograms for both grayscale and color images.

Prerequisite: Matlab and Basics of programming.

Course Content

Experiment No	Description	Hrs
1.	To create a program to display grayscale image using read and write operation.	02
2.	To create a vision program to convert a 2D array into a grayscale image.	02
3.	To create a program to rotate an image.	02
4.	Implementation of Relationships between Pixels.	02
5.	To create a vision program to find histogram value and display histogram of a grayscale and color image.	02

6.	To create a vision program for Non-Linear Filtering technique using edge detection.	**02**
7.	To display of bit planes of an Image.	**02**
8.	To implementation of image restoring techniques.	**02**
9.	To Computation of Mean, Standard Deviation, Correlation coefficient of the given Image.	**02**
10.	To Implementation of image restoring techniques.	**02**

Reference Books:

Textbook:

1. Digital Image Processing- Rafel C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010
2. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.

Reference Books:

3. Fundamentals of Digital Image Processing- A K. Jain, Pearson 2004.
4. Image Processing analysis and Machine vision with Mind Tap by Milan Sonka and Roger Boile, Cengage Publications, 2018.N. P. Bali, Ashok Saxena and N. Ch. S. N. Iyengar, A Textbook of Engineering Mathematics, Laxmi Publications, New Delhi, 6th edition, 2004.
5. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 2013.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech .**	Semester-**VI**
Course Code: **MC3502**	Course Name: **Workshop Practice III**

L	T	P	Credits
-	-	2	1

Course Description:
Advanced Machining Lab course is designed to impart the knowledge of CNC programming to students. In this Lab Course, students are taught about the CNC Machines, programming Codes (G-Code and M-Code), how to write program and simulate& modify the same on CNC Simulation Software. Students are taught how to perform set-up operation for a particular CNC Program on CNC machine. Students are taught to perform different CNC Turning and Milling Operations

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

1. Develop CNC program and simulate it on CNC Simulation Software/training kit for a given job.
2. Perform Set-up operation for CNC Turning Operations.
3. Perform Set-up operation for CNC Milling Operations.
4. Perform Set-up operation for ECM Machine
5. Perform Set-up operation for EDM Machine.

Prerequisite:
Good understanding of conventional and non-conventional machining operations, machining tools and lathe machine, milling machines.

Course Content

Experiment No	Description	Hrs
1.	Introduction to CNC Machines and CNC Programming Codes.	02
2.	Programming & Simulation for CNC Turning and Milling Operations.	02
3.	Set-up for Stepped Turning and Tapered Turning Operations.	02
4.	Producing Stepped Turning job on CNC Turning Machine.	02
5.	Set-up operation for Milling Operations.	02
6.	Producing Surface or End Finished job with CNC Milling Machine.	02

7.	Producing Slotted job with CNC Milling Machine.	**02**
8.	Set up operation and hands on experience for ECM Machine.	**02**
9.	Set up operation and hands on experience for EDM Machine.	**02**
10.	Set up operation and hands on experience for EDM Machine.	**02**

References -

- Mikell P. Grover, Automation, Production Systems and Computer- Integrated Manufacturing, Pearson Education, New Delhi.
- P. Radhakrishnan and S. Subramanyan,CAD/CAM/CIM, Willey Eastern Limited New Delhi.
- P. Grover, and Enory W. Zimmers Jr. CAD/CAM, Mikell Pearson Education, New Delhi.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech .**	Semester-**VI**
Course Code: **MC3521**	Course Name: **Power Electronics Lab**

L	T	P	Credits
-	-	2	1

Course Description:
The course provides practical knowledge of power devices, power converters, control circuits and drives by conducting experiments. It aims to develop students' ability of analyzing the performance of the converters, interpreting the results and writing the report on the conduction of experimentation.

Course Learning Outcomes: After completion of this course, students will be able to
1. Measure the parameters of power electronic devices, converters and drives.
2. Analyze the operation of the various converters and drives.
3. Plot the characteristics/responses.
4. Interpret the results of the experimentation.
5. Write report on the conduction of experimentation. and create and demonstrate the mini project

Prerequisite: Basic electronics, Circuit analysis and Linear algebra.

Course Content

Experiment No	Description	Hrs
1.	Study of characteristic SCR, MOSFET and IGBT	02
2.	To obtainVI characteristic of SCR	02
3.	To obtainVI characteristic of Diac/Traic	02
4.	Single phase fully controlled converter with R load	02
5.	Single phase fully controlled converter fed DC separately excited motor	02
6.	Three phase semicontrolled converter fed DC shunt motor	02
7.	Three phase fully controlled converter fed separately excited DC motor	02
8.	Chopper fed DC Drive (series motor)	02
9.	V/F control of three phase induction motor	02

10.	Study of speed tarque characteristics of BLDC motor.	02
11.	Study of SERVO motor.	02

References -

Textbooks:

- M. H. Rashid, Power Electronics Circuits Devices and Applications, PHI
- P. S. Bhimbra, Power Electronics, Khanna Publication
- Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia.
- Vedam Subramanyam, "Electric Drives – Concepts and Applications", McGraw Hill.

Reference Books:

- M. D. Singh and K. B. Khanchandani, Power Electronics, TMG
- P. C. Sen, Power Electronics, S. Chand publication
- Ned Mohan, T. Undeland & W. Robbins, Power Electronics Converters Application and Design, John Willey & Sons

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class:- **T.Y. B. Tech .**	Semester-**VI**
Course Code: **MC362**	Course Name: **DCS Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This laboratory course provides hands-on experience with Distributed Control Systems (DCS), focusing on industrial automation, process control, and system integration. Students will learn to configure DCS hardware, interface field devices, implement PID control loops, design HMI/SCADA systems, and analyze real-time data. The lab emphasizes practical skills in automation, communication protocols, and fault handling in process industries.

Course Learning Outcomes:

1. **Describe** the architecture and functional components of a Distributed Control System (DCS), including controllers, I/O modules, HMIs, and communication networks. *(Level: Understand)*
2. **Apply** appropriate methods to interface sensors and actuators with DCS hardware for real-time data acquisition and control. *(Level: Apply)*
3. **Implement** and **tune** basic process control loops such as PID controllers using DCS software tools to regulate parameters like temperature or flow. *(Level: Apply)*
4. **Design** HMI/SCADA interfaces to visualize, monitor, and control DCS-based processes effectively. *(Level: Create)*
5. **Analyze** alarm conditions, fault scenarios, and system responses to ensure proper event handling and improve system reliability. *(Level: Analyze)*
6. **Evaluate** the performance of DCS-based automation for batch processes or energy management, and suggest improvements for system efficiency and safety. *(Level: Evaluate)*

Prerequisite:
Knowledge of basics of controllers like PLC.

Course Content

Experiment No	Description	Hrs
1.	**Introduction to DCS Architecture and Components**-Understand the basic architecture, components, and operation of a DCS including controllers, I/O modules, HMI, and field devices.	02

2.	**Interfacing Field Devices with DCS**-Learn how to connect and configure sensors and actuators (e.g., RTDs, pressure transmitters) with a DCS system.	**02**
3.	**Developing a PID Control Loop in DCS**-Implement and tune a PID controller within the DCS environment to control process parameters like temperature, flow, or level.	**02**
4.	**Analog and Digital I/O Configuration and Testing**-Configure and test analog and digital inputs/outputs using DCS software tools and hardware modules.	**02**
5.	**SCADA-HMI Integration with DCS**-Design and configure an HMI screen using SCADA software to monitor and control DCS-based processes.	**02**
6.	**Alarm Management and Event Handling**-Configure alarms and event logging in the DCS, and simulate fault conditions to observe system behavior.	**02**
7.	**Network Communication using Modbus/Profibus Protocol**-Study and implement communication between DCS and field devices using industrial protocols like Modbus RTU/TCP or Profibus.	**02**
8.	**Redundancy in Distributed Control Systems**-Study redundancy concepts by simulating controller or communication failures and evaluating system response.	**02**
9.	Batch Process Automation using DCS-Implement a simple batch process (like mixing tank) and automate it using DCS logic and recipe management.	**02**
10.	Energy Monitoring and Control using DCS-Monitor power/energy consumption of loads and apply control strategies via DCS for optimization.	**02**

Text Books:

1. **Distributed Control Systems: Fundamentals, Functionality and Applications** **Author**: M. Chidambaram **Publisher**: CRC Press.
2. **Process Control: Principles and Applications, Author**: Surekha Bhanot **Publisher**: Oxford University Press
3. **Industrial Automation: Hands-on, Author**: Frank Lamb **Publisher**: McGraw-Hill Education

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-**VI**
Course Code: **SH3065**	Course Name: **Scholastic Aptitude-II**

L	T	P	Credits
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,

1. Develop a thorough conceptual understanding and develop a logical approach towards solving Aptitude and Reasoning problems.
2. Understand usage of basic aptitude terms of percentages, averages, ratios and applications of business aptitude terms of profits and interests
3. Develop a bridge in analogies, series and visualizing directions.
4. 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.	03

3.	**Boat & Streams** Upstream case, Downstream case , Perpendicular movement	03
4.	**Races** Head Start , Dead heat,defeat,3 man participating in race, ratio related examples	03
5.	**Permutation & Combination** Difference between P & C, Theorems of Permutation Theorems of Combination, Counting numbers of squares & rectangles, Triangle	03
6.	**Probability** Introduction, Range of Probability, Sum & Product Rule, Coins, Dice, Cards, Bags & Balls	03
7.	**Geometry** Triangles, Quadrilaterals, Circles, Polygons	03
8.	**Mensuration** Cube, Cuboid, Cylinder, Cone Sphere, Prism	03
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	03
10	**Calendar** Leap year, Odd day concept, Month code, century codes, Same Calendar concept, Finding day or date (Box method)	03
11	**Seating Arrangement** Type of arrangements, Types of information, Data extraction, Linear-Non Linear movement, Advance movement	03
12	**Complex Arrangement** Combination of 2 or more topics, Scheduling of events/months/Days/Years/ lectures, Seating arrangement, Tabular arrangement, Checklist method, Tabular Method (comparison)	03
13	**Data Sufficiency** Two statements, Five options, Blood relation, Direction sense, Seating arrangement, Coding decoding, Order, ranking / Comparison, Syllogism, Complex arrangement, Puzzles, Ages, Calendar	03
14	**True False Statement** Types of statements, matrix pattern, Comparison between different elements, Questions based on no. of persons and statements	03

References -

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.

K. E. Society'
Rajarambapu Institute of Technology, Sakharale
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Third Year B. Tech Syllabus
To be implemented for 2023-27 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - **T.Y. B. Tech**	Semester-**VI**
Course Code: **MC3581**	Course Name: **Capstone Project Phase-I**

L	T	P	Credits
-	-	2	01

Course Description:
The capstone project is designed to encourage students to think critically, solve challenging problems, and develop skills such as oral communication, public speaking, research skills, media literacy, teamwork, planning, self-sufficiency, or goal setting. In most cases, the projects are also interdisciplinary, in the sense that they require students to apply skills or investigate issues across many different subject areas or domains of knowledge. Capstone projects also tend to encourage students to connect their projects to community issues or problems, and to integrate outside-of-school learning experiences. Ultimately, a capstone project represents new work and ideas and allows the student to demonstrate the knowledge and skills they have gained during their college career. The students in a group of not more than FOUR will work under the guidance of the project supervisor on the project undertaken by them.
The project work may consist of,
1. To search and select an appropriate topic for capstone project work, in view of innovations, new products, and solutions to long-standing problems.
2. A comprehensive and up-to-date survey of literature related to the study of a phenomenon or product.
3. Prepare and refine project proposal to the point where the student should demonstrate that it is worthy of the undertaking and should be completed in the time available.
4. Prepare a well-defined project plan with a budget linked to project activities and outcomes.
5. Apply appropriate methodology to solve critical engineering problems.
6. Design and development of equipment, components, and test setup.
7. Conduct the experiment and test products and processes for various parameters and interpret the results obtained.
8. Write the technical report.
The objective is to prepare the students to examine any design or process or phenomenon from all angles, to encourage the process of independent thinking and working, and to expose them to industry. Also, to provide students with an opportunity of integrating and apply knowledge from different disciplines of mechatronics engineering to conduct an engineering project that is open-ended and requires team collaboration for its completion.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Convert an open-ended problem statement into a statement of work or a set of design

specifications
2. Identify the literature gap by conducting a survey of several available literature in the preferred field of study
3. Decompose problem/task into subtasks, prioritizes subtasks, and establishes a timetable and milestones by which progress may be evaluated.
4. Select and apply the appropriate design of experiments, experimental setup, models, or simulation technique for the project task.
5. Collaborates with team members of diverse backgrounds and perspectives to achieve a common goal.
6. Produce usable documents of record regarding the design process and design state and communicate effectively.

Prerequisite:
1. In-depth understanding of all the subjects learned so far.
2. Two weeks of in-plant training must be completed.

Course Content
Students should complete the following work during semester-VI Literature survey, problem identification, synopsis preparation, project blueprint, design of experiments, experimental setup, and models.

Course Assessment-
Projects will be evaluated using Rubrics that assess

- Proposal of Project work completed in all aspects
- Interim progress presented during the Phase -1
- The written report for part-I
- The oral presentation for part-1
- Interpersonal Skills Rubric for part-1

The performance of each student will be assessed individually together with the team's overall performance by the supervisor, Group chairman, and committee by using the rubrics provided in Appendices A and B. The project committee should consist of at least four academic staff with the project supervisor. The average scores of all supervisors for each rubric are combined using the following percentages to get a weighted average grade point.

Synopsis Proposal Rubrics	50%
Interim Progress Assessment, Interpersonal Skills Rubric - Phase I	50%