



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 2024-28 NEP Batch

Department of Mechatronics Engineering

Rev: MC Course Structure/RIT/03/2024-28

B. Tech. in Mechatronics Engineering with Multidisciplinary Minor



K. E. Society's

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Curriculum Structure and Evaluation Scheme

To be implemented for 2024-28 NEP Batch

Department of Mechatronics Engineering

Rev: MC Course Structure/RIT/03/2024-28

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	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
MC2031	Analog and Digital Electronics	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
MC2051	Industrial Fluid Power	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
MC2071	Engineering Mechanics	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Multi-Disciplinary Minor-I	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
MC2511	Analog and Digital Electronics Lab	-	-	2	1	ISE	---	---	---	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
MC2572	Machine Drawing and CAD Modelling Lab	-	-	2	1	ISE	---	---	---	50	50
						ESE	---	---	---	50	50
MC2591	Engineering Mechanics Lab			2	1	ISE	---	---	---	100	50
MC2593	Python Programming Lab	-	-	2	1	ISE	---	---	---	50	50
						ESE	---	---	---	50	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=Unit Test Examination, ESE=End Semester Examination

Total Contact Hours/week : 28

Total Credits : 21





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Department of Mechatronics Engineering

Rev: MC Course Structure/RIT/03/2024-28

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 the 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 the next levels in Sem-III & IV. (No new entries in S. Y. B. Tech. Sem-III).





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Department of Mechatronics Engineering

Rev: MC Course Structure/RIT/03/2024-28

Class: S. Y. B. Tech.

Semester: IV

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)		
							Max.	Min. for passing	Max.	Min. for passing	
MC2021	Strength of Materials	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
MC2042	Microcontrollers and Embedded Systems	3	-	-	3	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	----
MC212	Robot Operating System	2	-	-	2	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		---
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
MC2542f	Workshop Practice – II	-	-	2	1	ISE	---	---		50	50
						ESE	---	---		50	50
MC262	Robot Operating System Lab	-	-	2	1	ISE	---	---		100	50
MC264	Future Skill Course -I *	-	-	-	1	ISE	---	---		100	50
	Professional Skill Development and Foreign Language	-	-	2	1	ISE	---	---		100	50
	TOTAL	18	-	10	24						
	TOTAL CONTACT HOURS	28									

ISE=In Semester Evaluation, UT=Unit Test Examination, ESE=End Semester Examination.

Total Contact Hours/week : 28 Total Credits : 24

*Students should opt following course: Introduction on Generative AI – Artificial intelligence and Machine Learning (15hr.). **Note 1.** 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. **Note 2.** ISE of Environment Science course will be the project on application of technology in environmental concerns. If student fails in ISE (i.e. project), he/she will not be eligible for ESE of the course.





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Department of Mechatronics Engineering

Rev: MC Course Structure/RIT/03/2024-28

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





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Department of Mechatronics Engineering

Rev: MC Course Structure/RIT/03/2024-28

Class: T. Y. B. Tech.

Semester: V

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks %)		Practical (Marks %)	
							Ma x.	Min. for Passing	Max.	Min. for passing
MC3012	Industrial Automation	2	-	-	2	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50		---	---
MC3032	Measurement, Sensors and Interfaces	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50		---	---
MC3152	System Dynamics and Control	2*	-	-	2	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50		---	---
	Program Elective Course-I	2**	-	-	2	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50		---	---
	Open Elective -I	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50		---	---
	Multi-Disciplinary Minor-III	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50		---	---
	Multi-Disciplinary Minor-IV	2	-	-	2	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50		---	---
MC3511	Industrial Automation Lab	-	-	2	1	ISE	---	---	50	50
						ESE	---	---	50	50
MC3532	Measurement, Sensors and Interfaces Lab	-	-	2	1	ISE	---	---	50	50
						ESE	---	---	50	50
MC3553	System Dynamics and Control Lab	-	-	2	1	ISE	---	---	100	50
SH3035	Scholastic Aptitude-I	2*	-	-	Audit	ISE	100	50 (P/NP)	---	---
MC357	MOOCS NPTEL/SWAYAM Courses	-	-	-	1	ISE	---	---	100	50
MC361	Industrial Training	-	-	-	1	ISE	---	---	100	50
MC363	Mini Project	-	-	6	3	ISE	---	---	100	50
TOTAL		17	-	12	25					
TOTAL CONTACT HOURS		29								

ISE=In Semester Evaluation, UT=Unit Test Examination, ESE=End Semester Examination, P=Pass, NP=Not Pass

Total Contact Hours/week : 30

Total Credits : 25

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

**Note: An extra one lecture should be added to the timetable.





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Program Elective-I

Sr. No	Course Code	Course Name	Domain
1.	MC3091	Condition Monitoring	Design & Manufacturing
2.	MC3111	Battery And Fuel Cell Technology	Advanced Mobility System
3.	MC3132	Industrial Organization and Management	Design & Manufacturing
4.	MC3093	Industrial Signal Processing	Intelligent Systems

Open Elective –I

Open Elective I 2024-28

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





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Rev: MC Course Structure/RIT/03/2024-28

Class: T. Y. B. Tech.

Semester: VI

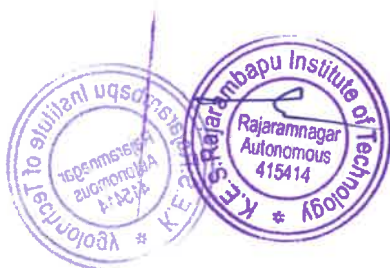
Course Code	Course	Teaching Scheme				Scheme	Evaluation Scheme				
		L	T	P	Credits		Theory (Marks %)		Practical (Marks %)		
							Max	Min. for passing	Max	Min. for passing	
MC3021	Machine Design	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
MC3241	Image Processing	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
MC3061	Research Methodology	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
	Program Elective-II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
	Open Elective-II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
	Multi-Disciplinary Minor-V	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
MC370	Industrial Robotics Simulation Lab	-	-	2	1	ISE	---	---	50	50	
						ESE	--	--	50	50	
MC3601	Image Processing Lab	-	-	2	1	ISE	---	---	50	50	
						ESE	---	---	50	50	
SH3065	Scholastic Aptitude-II	2*	-	-	Audit	ISE	100	50 (P/NP)	--	--	
MC364	Future Skill Course -II**	-	-	-	1	ISE	---	---	100	50	
MC366	Minor Project	-	-	12	6	ISE	---	---	100	50	
MC368	Seminar	-	-	-	Audit	ISE	100	50 (P/NP)	--	--	
	TOTAL	16	-	16	25						
	TOTAL CONTACT HOURS	32									

ISE=In Semester Evaluation, UT=Unit Test Examination, ESE=End Semester Examination. P=Pass, NP=Not Pass

Total Contact Hours/week : 32 Total Credits : 25

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

** Students should opt following course: RPA Design and Development (12hr.). (RPA-Robotic Process Automation)



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Rev: MC Course Structure/RIT/03/2024-28

Program Elective - II

Sr. No.	Course Code	Course	Domain
1.	MC3081	Finite Element Methods	Design & Manufacturing
3.	MC3121	Additive Manufacturing	Design & Manufacturing
4.	MC324	Digital Twin	Intelligent Systems
5.	MC3181	Wireless Sensor Network	Automation
6.	MC3201	Microelectromechanical Systems	Automation
7.	MC326	Fuzzy Logic & Neural Networks	Intelligent Systems
8.	MC328	Advanced Materials Science for Intelligent Engineering Systems	Intelligent Systems

Open Elective –II

Open Elective II			
Sr. No.	Course Code	Open Elective Subject Name	Offered by the department
1	OE3084	Material Management	Civil engineering Department
2	OE350	Operations Research	Civil Engineering
3	OE358	Plumbing (Water and Sanitation)	Civil Engineering
4	OE372	Industrial Safety	Electrical Engineering
5	OE342	Data Mining	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
6	OE368	AI for Agriculture	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
7	OE3401	Cyber Security	Computer Science and Information Technology
8	OE364	AI for Manufacturing	Computer Science and Information Technology
9	OE348	Information Technology Foundation Program	Computer Science and Engineering
10	OE366	AI for Cybersecurity	Computer Science and Engineering
11	OE3284	Supply Chain Management	Mechanical Engineering
12	OE3324	Entrepreneurship Development	Mechanical Engineering
13	OE3024	Reliability Engineering	Robotics & Automation
14	OE362	Flexible Manufacturing System	Robotics & Automation
15	OE344	Supply Chain Analytics	Mechatronics Engineering
16	OE346	Mobile Robotics	Mechatronics Engineering
17	OE352	Image Processing	Electronics & Telecommunication Engineering
18	OE354	Fuzzy Logic & Neural Network	Electronics & Telecommunication Engineering
19	OE356	Project Management	Mechanical Engineering
20	OE370	AI for Sustainability	Electronics & Telecommunication Engineering
21	OE3242	Marketing for Engineers	MBA





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Curriculum Structure and Evaluation Scheme

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Department of Mechatronics Engineering

Rev: MC Course Structure/RIT/03/2024-28

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. passing	for	Max.	Min. passing	for
MC4011	Design of Mechatronics System	2	-	-	2	ISE	20	40	40	---	---	
						MSE	30			---	---	
						ESE	50			---	---	
MC4031	Machine Learning for Mechatronics	3	-	-	3	ISE	20	40	40	---	---	
						MSE	30			---	---	
						ESE	50			---	---	
MC4051	Industrial Robotics	3	-	-	3	ISE	20	40	40	---	---	
						MSE	30			---	---	
						ESE	50			---	---	
	Program Elective Course-III	3	-	-	3	ISE	20	40	40	---	---	
						MSE	30			---	---	
						ESE	50			---	---	
	Program Elective Course-IV	3	-	-	3	ISE	20	40	40	---	---	
						MSE	30			---	---	
						ESE	50			---	---	
MC421	Industrial Electronics	3	-	-	3	ISE	20	40	40	---	---	
						MSE	30			---	---	
						ESE	50			---	---	
MC4591	Industrial Electronics Lab	-	-	2	1	ISE	--	---		50	50	
						ESE	--	---		50	50	
						MC4571	DCS Lab	-	-	2	1	ISE
ESE	--	---		50	50							
MC4511	Industrial Robotics Lab	-	-	2	1	ISE	--	---		50	50	
						ESE	--	---		50	50	
	Program Elective-IV Lab	-	-	2	1	ISE	--	---		50	50	
						ESE	--	---		50	50	
	TOTAL	17	-	08	21							
	TOTAL CONTACT HOURS	25										

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

Total Contact Hours/week: 25

Total Credits: 21





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Rev: MC Course Structure/RIT/03/2024-28

Program Elective-III

Sr. No.	Course Code	Course Name	Domain
1.	MC4091	Basics of Cloud Computing	Intelligent Systems
2.	MC4111	Machine Tool Design	Design & Manufacturing
3.	MC4151	Hybrid and Electric Vehicle	Advanced Mobility System
4.	MC4171	Industrial Engineering	Design & Manufacturing
5.	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.	MC4072	Building Automation	Automation

Program Elective-IV Lab

Sr. No.	Course Code	Course	Domain
1.	MC4551	Computer Network and Cyber Security Lab	Intelligent System
2.	MC467	Unmanned Aerial Vehicles Lab	Advanced Mobility System
3.	MC469	Building Automation Lab	Automation





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Choice based Internship Model

Model I: Industry Internship (II)

Class: Final Year B. Tech.

Semester: VIII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	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 Examination

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.





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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
	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.





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Rev: MC Course Structure/RIT/03/2024-28

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

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





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Department of Mechatronics Engineering

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Multidisciplinary Minor

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

Multidisciplinary Minor Baskets 24-28					
MDM Basket Name	Sr. No.	Course Code	Course Name	Semester	Offered 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	Environmental 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	EEMD305	Electrical Technology	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	Behavioral 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	



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	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	Kinematic & Dynamics for Robots	V	
	4	RAMD305	Robot Programming	V	
	5	RAMD302	Industrial Automation & Control	VI	





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





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Department of Mechatronics Engineering

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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.





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





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Rev: MC Course Structure/RIT/03/2024-28

**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.





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Rev: MC Course Structure/RIT/03/2024-28

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





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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 of 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 Examination

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





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Class: Final Year B. Tech.

Semester: VIII

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

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



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Class: - T.Y. B. Tech.	Semester-V	L	T	P	Credits
Course Code: MC3012	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,	05
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	05
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	05
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 Acquisition-Architecture-Remote terminal unit-Master terminal unit-Data Storage	05
5. DISTRIBUTED CONTROL SYSTEM	Evolution - Architectures - Comparison - Local control unit - Process interfacing issues - Communication facilities, Operator interfaces - Low level	04



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	and high-level operator interfaces - Operator displays - Engineering interfaces - Low-level and high-level engineering interface, Applications of DCS: Pulp and paper environment -Power plant - Petroleum - Refining environment,	
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References -

- Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Lucas, M.P., Distributed Control System, Van Nostrand Reinhold 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" Newness.



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DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - T.Y. B.Tech	Semester-V	L	T	P	Credits
Course Code: MC3032	Course Name: Measurement, Sensors and Interfaces	3	-	--	3

Course Description:

This course provides comprehensive knowledge of engineering measurement systems, industrial sensors, transducers, signal conditioning, sensor interfaces, data acquisition, and intelligent measurement technologies used in modern mechatronic systems. Students will develop the ability to select, interface, and evaluate sensors for industrial automation, robotics, autonomous systems, electric vehicles, healthcare, aerospace, and smart manufacturing. The course integrates engineering fundamentals with emerging technologies such as MEMS, smart sensors, Industrial IoT (IIoT), artificial intelligence, machine vision, wireless sensor networks, digital twins, and edge computing, enabling students to design reliable and intelligent measurement systems for Industry 4.0 applications.

Course Learning Outcomes:

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

1. Explain the principles of engineering measurement systems, instrumentation, calibration, measurement errors, uncertainty analysis, and performance characteristics of sensors.
2. Select and compare suitable sensors for measuring force, displacement, position, acceleration as per industrial requirements.
3. Select and compare suitable sensors for measuring temperature, pressure, and flow based on operating principles, characteristics, and industrial requirements
4. Analyze sensor characteristics, design signal conditioning circuits, and interface sensors with industrial communication protocols, and data acquisition systems.
5. 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	Fundamentals of Engineering Measurement and Instrumentation Introduction to Engineering Measurement, Measurement System Architecture, SI Units and International Standards, Static Characteristics, Dynamic Characteristics, Measurement Errors and Uncertainty, Calibration and Traceability, Engineering Metrology Fundamentals, Digital	06



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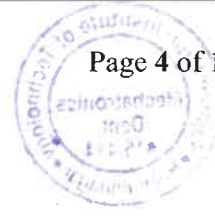
	Measurement Systems, Smart Metrology, Coordinate Measuring Machine (CMM).	
2	Sensors for force and Displacement Measurement Strain Gauge, Load Cell, Piezoelectric Force Sensor, Hydraulic Force Sensor, Pneumatic Force Sensor, Capacitive Force Sensor, Electrical Resistance Strain Gauge, Strain Gauge Configurations, Wheatstone Bridge for Strain Measurement, Potentiometer, Linear Potentiometer, LVDT, RVDT, Tactile Sensors	06
3	Sensor for Position, Distance and Acceleration Measurement Eddy Current Sensors, Capacitive Displacement Sensors, Optical Position, Accelerometers, Gyroscopes, Magnetostrictive Sensors, Hall Effect Sensors, Laser Sensors, IR Sensors and Ultrasonic Sensors – SONAR, RADAR, Optical Sensors - LIDAR, Optical Encoders- IMU	06
4	Sensors for Temperature, Pressure and Flow Measurement Thermocouples, Resistance Temperature Detectors (RTDs), Thermistors, Infrared (IR) temperature sensors, Piezoresistance sensors- working principle of bourdon tube, bellows and diaphragm.	06
5	Sensor Interfacing Amplification and filtering, Analog-to-Digital Conversion (ADC), Sensor interfaces, Noise reduction and error compensation. Role of sensor in IoT – Multichannel sensor interfacing- standards – Integrated Circuit Bus I2C – Serial Peripheral Interface (SPI)- Controller Area Network (CAN) Bus – Universal Transducer Interface (UTI), Data acquisition systems (DAQ), Analog and digital signal processing, Sensor fusion techniques	06
6	Case Studies and Real-World Applications: Robotics and automation systems, Autonomous vehicles, Biomedical applications, Health care, defense applications, agricultural applications, automobile sector, communication devices, home security.	06

References -

Text Books:

1. D. Patranabis, Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw-Hill Education, New Delhi, 2017.
2. D. V. S. Murty, Instrumentation and Measurement Principles, 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2019.
3. A. K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, 20th Edition, Dhanpat Rai & Co. (P) Ltd., New Delhi, 2021.
4. Ramon Pallás-Areny and John G. Webster, Sensors and Signal Conditioning, 3rd Edition, John Wiley & Sons, 2012.
5. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs and Applications, 6th Edition, Springer International Publishing, 2022.

Reference Books:



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DEPARTMENT OF MECHATRONICS ENGINEERING

1. Ernest O. Doebelin and Dhanesh N. Manik, Measurement Systems: Application and Design, 6th Edition, McGraw-Hill Education, 2019.
2. John G. Webster and Halit Eren (Editors), Measurement, Instrumentation, and Sensors Handbook, 2nd Edition, CRC Press, 2014.
3. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson Education, 2014.
4. C. S. Rangan, G. R. Sharma and V. S. V. Mani, Instrumentation Devices and Systems, 2nd Edition, Tata McGraw-Hill Education, 2003.
5. Bela G. Lipták, Process Measurement and Analysis, 4th Edition, CRC Press, 2003.
6. R. K. Jain, Mechanical and Industrial Measurements, 13th Edition, Khanna Publishers, New Delhi, 2018.



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DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - T.Y. B. Tech.	Semester-V
Course Code: MC3152	Course Name: System Dynamics and Control

L	T	P	Credits
2	-	-	2

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



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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
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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.



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DEPARTMENT OF MECHATRONICS ENGINEERING
Program Elective - I

Class: - T.Y. B. Tech	Semester-V	L	T	P	Credits
Course Code: MC3093	Course Name: Industrial Signal Processing	2	-	-	2

Course Description:

This course introduces the fundamentals of signal processing with emphasis on industrial measurement, monitoring, automation, and condition monitoring applications used in Mechatronics Engineering. Students will learn how sensor signals are acquired, processed, filtered, analyzed, and interpreted using digital techniques suitable for embedded and industrial automation systems. The course focuses on practical industrial applications rather than advanced mathematical derivations.

Course Learning Outcomes:

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

1. Explain the fundamentals of signals and signal conditioning techniques.
2. Apply signal acquisition and sampling techniques for industrial applications.
3. Analyze signals using time and frequency domain analysis methods.
4. Apply digital filtering techniques for signal processing applications.
5. Analyze embedded signal processing methods for industrial condition monitoring applications.

Prerequisite: Engineering Mathematics, Microprocessors and Embedded Systems, Basics of Sensor

Course Content		
Unit No.	Description	Hrs.
1	Fundamentals of Signals: Introduction to Signal Processing, Types of Signals, Signal Characteristics, Industrial Sensors and Signal Sources, Signal Conditioning, Industrial Applications in Mechatronics	06
2	Signal Acquisition: Signal Acquisition System, Data Acquisition Architecture, Sampling Theorem, ADC and DAC Fundamentals, Industrial DAQ Systems, Embedded Signal Acquisition, Sensor Interface using Microcontrollers	06
3	Time Domain Signal Analysis: Time Domain Representation, Signal Statistics – Mean, RMS, Variance, Standard Deviation, Peak Value, Crest Factor, Signal Energy, Correlation, Auto-correlation, Cross-correlation	06
4	Frequency Domain Analysis: Frequency Spectrum, Fourier Series (Concept), Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), Power Spectrum, Introduction of Spectrogram, Frequency Analysis of Machine Signals	06



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DEPARTMENT OF MECHATRONICS ENGINEERING

5	Digital Filtering and Signal Enhancement: Sources of Noise, Industrial Signal Noise, Moving Average Filter, Median Filter, Low Pass Filter, High Pass Filter, Band Pass Filter, Notch Filter, Selection of Filters for Industrial Applications	06
6	Industrial Applications of Signal Processing: Embedded Signal Processing Architecture, Signal Processing in Mechatronic Systems, Vibration Monitoring, Predictive Maintenance, Industrial IoT Signal Processing, Case Studies - Robotic Joint Monitoring, Conveyor Belt Monitoring	06

References -

Text Books:

- John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing, Pearson.
- Alan V. Oppenheim and Ronald W. Schaffer, Discrete-Time Signal Processing, Pearson.
- Steven W. Smith, The Scientist and Engineer's Guide to Digital Signal Processing.
- S. Salivahanan, C. Gnanapriya, Digital Signal Processing, McGraw-Hill.
- Richard G. Lyons, Understanding Digital Signal Processing, Pearson.

Reference Books:

- Digital Signal Processing: Principles, Algorithms and Applications is a widely used textbook on digital signal processing (DSP) by John G. Proakis and Dimitris G. Manolakis.
- *Discrete-Time Signal Processing* is a landmark textbook in digital signal processing (DSP) written by Alan V. Oppenheim and Ronald W. Schaffer,
- Mechanical Vibrations is a widely used engineering textbook on vibration analysis written by Singiresu S. Rao.



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DEPARTMENT OF MECHATRONICS ENGINEERING

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

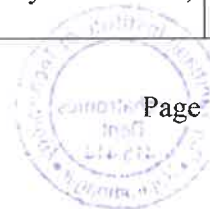
After successful completion of the course, students will be able to,

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



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5.	Signal Analysis Signal Conditioning- Signal Filtering, Signal Demodulation, measurement error, calibration Principle, 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.



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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:

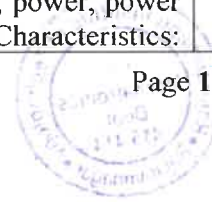
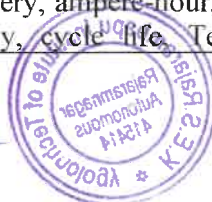
After successful completion of the course, students will be able to,

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:

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 vehicles, environmental analysis of electric vehicles, market scenario and government initiatives for electric vehicles.	04
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, ampere-hour, capacity, power, power density, energy density, efficiency, cycle life, Technical Characteristics:	04



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	Capacity, Discharge rate, State of Charge, State of Discharge, Depth of Discharge, Service Life, Shelf Life, Battery Pack Design.	
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 Nickel 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).



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Class:- T.Y. B. Tech.	Semester-V	L	T	P	Credits
Course Code : MC3132	Course Name : Industrial Organization and Management	3	-	--	3

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 objectives of the organization.

Course Learning Outcomes:

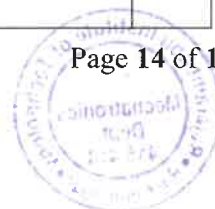
After successful completion of the course, students will be able to,

1. Explain the nature of the business environment and evaluate the influence of economic, political, technological, and global factors on industrial organizations.
2. Apply the principles of planning, organizing, and decision-making to solve basic industrial management problems.
3. Analyze human resource management practices, leadership styles, communication, motivation, and ethical business practices for effective organizational performance
4. Apply materials management and inventory control techniques to improve purchasing and resource utilization in industrial organizations.
5. Analyze marketing concepts, market research, and marketing strategies for business decision-making
6. Evaluate financial statements and apply engineering economics principles to support investment and managerial decision-making.

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	06
2.	Basic Functions of Management: Planning – Need, Objectives, Strategy, policies, Procedures, Steps in Planning, Decision making, Forecasting.	06



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	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 21 st 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	06
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	06
5.	Marketing Management: Marketing Concepts –Objective –Types of markets – Market Segmentation, Market strategy – 4 AP's of market, Market Research, Salesmanship, Advertising.	06
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)	06

References -

Text Books:

- 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.



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OPEN ELECTIVE – I

Class: - T.Y. B. Tech	Semester-V	L	T	P	Credits
Course Code: OE353	Course Name: Factory Automation	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. Recognize 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. Analyze 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



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6.	Case Study: Factory automation in manufacturing industry and Process Industry.	06
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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.



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Class: - T.Y. B. Tech	Semester- V	L	T	P	Credits
Course Code: OE355	Course Name: Cyber Physical Systems	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	06



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	(2013), Local Network Security for CPSs, Security and Privacy for Cloud-Interconnected CPSs, Case Study: Cyber security in Digital Manufacturing/Industry 4.0	
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References -

Text Books:

1. Principles of Cyber Physical Systems, Rajeev Alur, MIT Press, 2015
2. 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:

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



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DEPARTMENT OF MECHATRONICS ENGINEERING

Class: Third Year B. Tech. Civil	Semester: V	L	T	P	Credits
Course Code: CEMD301	Course Name: Infrastructure Engineering	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 its component parts.
5. Summarize the different offshore 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, NHAI, 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 surface drainage; PPP in Transport Sector	06
04	Airport Engineering	06



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	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. <u>Airport Lighting and Markings.</u>	
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.



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Class: - T. Y. B.Tech	Semester- V	L	T	P	Credits
Course Code: CSMD301	Course Name: Fundamentals of Database Systems	3	-	-	3

Course Description:

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

Course Learning Outcomes:

After Successful Completion of the course student will be able to,

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

Prerequisite:

A basic understanding of programming concepts (using languages such as JAVA or C++) and foundational knowledge of data structures and algorithms.



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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	6
2	Relational Model Structure of Relational Databases, Structured Query Language (SQL): Data Definition Language, Data Manipulation Language, Aggregate functions, Set Operations.	6
3	Integrity Constraints and Database Design Domain Constraints, Referential Integrity, Functional Dependencies, Decomposition, Normalization: 1NF, 2NF, 3NF	6
4	Data Storage and Indexes File Organization, Data Dictionary Storage, Indexing: B+ tree indexing and B tree indexing, Hashing: Static and Dynamic.	6
5	Basic of Transactions Concepts of transaction processing, ACID properties, Transaction states, Serializability, Testing for serializability.	6
6	Concurrency Control and Recovery System Lock-based protocols, Timestamp - based Protocols. Crash Recovery: Failure Classification, Log-Based Recovery, Checkpoints.	6

References –

Text Books:

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

Reference Books:

- Ramez Elmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, Pearson/Addison wesley.



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Class:- Third Year B. Tech.	Semester- V	L	T	P	Credits
Course Code : EEMD301	Course Name : Electrical Machines	3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

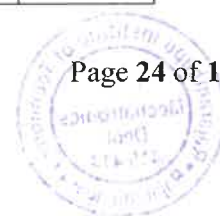
1. Describe behavior of dc machine.
2. Explain the working principle of 1-Phase and 3-Phase transformers.
3. Explain working of different induction motors.
4. Select the relevant electrical machines for different applications.
5. Interpret the relevant fractional horse power motor for different applications.

Prerequisite:

Basic Electrical Engineering, Engineering mathematics and Engineering physics.

Course Content

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



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	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, 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), Stepper 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



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DEPARTMENT OF MECHATRONICS ENGINEERING

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

Course Description:

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

Course Learning Outcomes:

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

1. Explain the principles of antenna and wave propagation.
2. Understand basic antenna parameters and their types.
3. Discuss the evolution, requirements, and challenges of 5G communication systems.
4. Understand and compare various communication techniques.
5. Communicate effectively on complex engineering topics related to modern communication techniques.

Prerequisite:

Knowledge of basic analog and digital communication.

Course Content

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



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5.	The 5G wireless Propagation Channels Channel modeling requirements, propagation scenarios, and challenges in the 5G modeling, Channel Models for mm-Wave MIMO Systems.	06
6.	Communication Techniques Fundamentals of Fiber Optics Communication, GSM, CDMA, LTE, Blue Tooth, WiFi, ZigBee, LoRA, RFID.	06

References -

Text Books:

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

Reference Books:

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



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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:

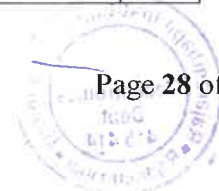
After successful completion of the course, students will be able to,

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 Tuple Relational Calculus, Structured Query Language (SQL), Joins.	06
3.	Integrity Constraints and Database Design Domain Constraints, Referential Integrity, Complex datatypes, Functional Dependencies, Pitfalls in Relational Database Design, Decomposition, Normalization	06
4.	Data Storage and Indexes File Organization, Data Dictionary Storage, Indexing: B+ tree indexing and B tree indexing, Hashing: Static and Dynamic.	06



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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.



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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, design for manufacturability, value engineering, concurrent engineering, reverse engineering, and prototyping. The course combines theoretical foundations with practical applications, including case studies. These tools and techniques are widely practiced in industry. Exposure to this course will add value to the students and make them industry-ready.

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 various prototyping techniques using reverse engineering and rapid prototyping.
5. Analyse the product development economics for a given project.

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:	06



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	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.	
5.	Prototyping Techniques: 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. 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
6.	Product Development Economics: Product development cash flow, NPV, economic analysis base -case model, sensitivity analysis and it's use for determining trade-off.	06

References: -

Text books: -

- Engineering Design Principles, Kenneth S. Hurst, Butterworth-Heinemann.
- Kathryn, 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.



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Class: - T.Y. B. Tech	Semester-V	L	T	P	Credits
Course Code: MCMD301	Course Name: Sensor and Instrumentation	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,

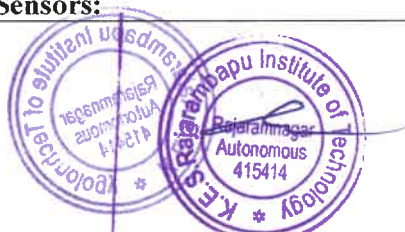
1. Explain the fundamental principles of various sensors and transducers.
2. Analyze the characteristics, advantages, and limitations of different sensor types.
3. Select and integrate sensors into mechatronic systems for real-time data acquisition and control.
4. Apply appropriate signal conditioning 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: Potentiometers, LVDT (Linear Variable Differential Transformer), Optical encoders, Inductive sensors.	06
3	Force and Pressure Sensors: Strain gauges, Load cells, Pressure transducers, Piezoelectric, Piezoresistive, and Capacitive Pressure Sensors, Ultrasonic Sensors Motion and Velocity Sensors:	06



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

References -

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.



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

Prerequisites:

- Basic knowledge of Probability theory and python programming.

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



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	Reasoning, Support vector Machines (SVM).	
5	Clustering Based Learning Types of clustering, K-means clustering algorithm, Advantages and disadvantages 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.



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Class: T.Y B. Tech.	Semester: V	L	T	P	Credits
Course Code: RAMD301	Course Name: Kinematics & Dynamics for Robots	3	-	--	3

Course Description:

This course provides a comprehensive introduction to the fundamental principles of robot kinematics and dynamics. Students will explore the mathematical models used to describe the motion of robotic systems, including both the kinematic and dynamic analysis required for designing and controlling robots. The kinematics portion of the course covers topics such as position, velocity, and acceleration in robotic systems, forward and inverse kinematics, and workspace analysis. Students will gain an understanding of how to model and control the motion of robotic arms, mobile robots, and other autonomous systems. The dynamics section delves into the forces and torques that cause robots to move, introducing Newton-Euler and Lagrangian formulations for modeling the dynamics of robotic manipulators and mobile platforms.

Course Learning Outcomes:

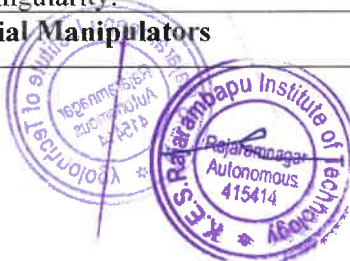
After successful completion of the course, students will be able to,

- CO1. Represent object using composite rotation matrix.
- CO2. Apply spatial transformation to obtain forward and inverse kinematics.
- CO3. Plan trajectories for the robot end effector.
- CO4. Perform Jacobian analysis of serial manipulators.
- CO5. Perform dynamic analysis using different robot formations

Prerequisite: Kinematics of Machines, Dynamics of Machines

Course Content

Unit No.	Description	Hrs
1.	Fundamental Concepts Robot Joints, Workspace analysis, work envelope of robots, Robot Coordinates, Robot Reference Frames, Frame Transformation, Translational Operator, Rotational Operator, Composite Rotation Matrix, Representation of Orientation using Roll, Pitch, Yaw angles and Euler Angles.	06
2.	Forward Kinematics Denavit-Hartenberg notations, link- joint parameter, D-H rules for coordinate assignment, Arm Equation, Forward kinematics of manipulators, Screw transformation	06
3.	Inverse Kinematics Decoupling technique, Inverse transformation Technique, Inverse kinematic analysis of robot with standard configurations, methods for solution of non-linear simultaneous equations, singularity.	06
4.	Jacobian Analysis of Serial Manipulators	06



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	Different Kinematics of rigid body, Different Kinematics of serial manipulators, screw coordinates and screw systems, Manipulator Jacobian Matrix, conventional Jacobian, Screw-Based Jacobian, and Transformations of screw coordinates. Relationship Between Two Methods, condition number, singularity analysis.	
5.	Trajectory Planning Introduction, Constraints and Path specifications, polynomial function, linear trajectory Function, Basic algorithm for generation of joint trajectory, joint interpolated trajectories, Cartesian path trajectory planning.	06
6.	Robot arm Dynamics & Parallel Robot Dynamics: Robot dynamics – Rigid body dynamics, Newton-Euler formation, Lagrange-Euler, formation, generalized D'Alembert equations of motion, Dynamic Analysis: Two mass statically and dynamically equivalent system, correction couple, static and dynamic force analysis of reciprocating engine mechanisms, Crank shaft torque, Introduction computer aided analysis.	06

References:

Text Book-

1. D. K. Pratihari, Fundamentals of Robotics, Narosa Publication.
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson Publishers, 2008
3. Reza N Jazar, Theory of Applied Robotics, Kinematics, Dynamics and Control, Spriger, Second Edition

Reference Books-

1. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009.
2. Richard D. Klafter, Thomas. A, Chri Elewski, Michael Negin, Robotics Engineering: An Integrated Approach, PHI Learning., 2009.
3. Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
4. Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993.
5. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, MIT Press., 2003.
6. Hartenberg and Denavit, "Kinematics and Synthesis of Linkages", McGraw Hill Book Co.
7. J. E. Shigley and J.J.Uicker Jr., Theory of Machines and Mechanism, McGraw Hill
8. Kelly R, Santibanez V and Loria A, —Control of Robot Manipulators in Joint Space, Springer, 2005.



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DEPARTMENT OF MECHATRONICS ENGINEERING

Class: Third Year B. Tech. Civil	Semester: V	L	T	P	Credits
Course Code: CEMD303	Course Name: Smart Cities & Sustainable Development	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

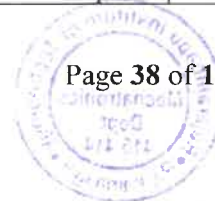
Course Learning Outcomes:

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

1. Discuss the concept of smart cities and ideologies of sustainable Development.
2. Analyze the different approaches toward smart cities on global level.
3. Evaluate the present state and approach of Smart city Mission in India.
4. Comprehend the concept of resilience and sustainable development and its measurement.
5. Study the present status of sustainable development in India.

Prerequisite: Basics of civil engineering

Course Content		
Unit No.	Description	Hrs
01	Introduction Smart cities concept, origin, ideology. Typologies and different meanings, Wired city, Virtual city, Intelligent city, Information city, Digital city. Characteristics of smart cities: smart economy, smart people, smart governance, smart mobility, smart environment, smart living Strategies and policies.	04
02	Critical evaluation of Smart City Concept Approaches towards smart cities in various countries. Smart city planning in advanced economies, economic, financial viability, social implications. Financial and economic viability of smart city. Critical evaluation of smart city development projects in India	04
03	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, retrofitting, redevelopment, Greenfield, Brownfield, pan-city. Governance and management special purpose vehicles.	04
04	Resilience and Sustainable Development Sustainable Development Introduction, Origin, Definition, three pillars of Sustainable Development, Critiques on Sustainable Development. The concept of	04



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	resilience: need and significance in the contemporary time, city preparedness, adaptations, risk reduction and mitigation. Climate change and resilience.	
05	Measurement of Resilience and Sustainability. The Theory and Measurement of Sustainability: Ideologies and Ethos of Sustainability, Indicators, Indicator Framework for Assessing Sustainability, Measurement Systems for Sustainable Urban Development: Concept Level (Broad) Measurement Systems,	04
06	Sustainability in India Sustainability in India: Need, Issues and Challenges, Urbanization in India, Sustainable Development in India, Sustainability Measurement and Rating Systems and Initiatives in India	04

References:

Text Books:

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

Reference Books:

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



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

Course Description:

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

Course Learning Outcomes:

After successful completion of the course, students will 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.

Prerequisite:

Basic understanding of programming concepts.

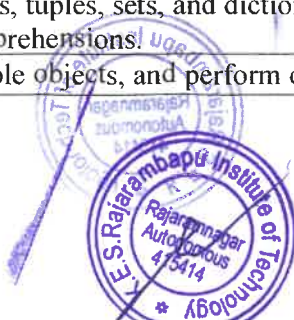


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Course Content		
Unit No.	Description	Hrs.
01.	Introduction to Python fundamentals: Python introduction, Python syntax, Python comments, Python variables, Python data types, Python numbers, Python casting, Python strings, Python Booleans, Python operators, Loops and Conditional Statement If-else, while, for, lambda, arrays, Python Iterators, Python scope	02
02.	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
03.	Classes and Objects: Classes, objects, parameterized and non-parameterized init constructor, object methods, self-parameter, association, Access modifiers: Private, public, protected	02
04.	OOP Concepts: Inheritance, Encapsulation, Polymorphism: overloading and overriding, abstraction: interface and abstract class	02
05.	File handling and Exception: File handling syntax, read files, write/create files, delete files, handling runtime exception and custom exception.	02
06.	Modules and Libraries Introduction, modules, using dir() function, Numpy, Pandas, Matplotlib, Seaborn, markers, line, labels, grid, subplots, scatter, bars, histograms, pie-charts	02

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

Course Content		
Expt. No	Description	Hrs
1.	Write Python programs using variables, data types, operators, input/output statements, type casting, and comments.	02
2.	Implement programs using if-else, nested if, while loop, for loop, break, continue, and pass statements.	02
3.	Perform string operations, slicing, string methods, user-defined functions, lambda functions, and scope of variables.	02
4.	Create and manipulate lists, tuples, sets, and dictionaries using various built-in methods and comprehensions.	
5.	Implement iterators, iterable objects, and perform operations on arrays.	02



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6.	Create classes and objects using constructors, object methods, and self parameter.	02
7.	Demonstrate public, private, and protected members along with association between classes.	02
8.	Implement single, multilevel inheritance, method overriding, and method overloading concepts.	02
9.	Develop programs using abstract classes, interfaces, encapsulation, and data hiding techniques.	02
10.	Perform file read/write/create/delete operations and implement runtime and custom exception handling.	02
11.	Create user-defined modules, use dir() function, and perform array operations using NumPy.	02
12.	Perform data manipulation using Pandas and create plots such as line chart, bar chart, histogram, scatter plot, pie chart, and subplots using Matplotlib/Seaborn.	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



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DEPARTMENT OF MECHATRONICS ENGINEERING

Class:- T.Y. B. Tech.	Semester-V	L	T	P	Credits
Course Code : EEMD305	Course Name : Electrical Technology	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:	02



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	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.	
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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



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Class: - T. Y. B. Tech ETC Engg.	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 Introduction, Signal Integrity, Software Design and Testing Methods, Phases of Software Design, Selection of Language for Software Development, Assemblers, Compilers, Simulators, Emulators.	04
5.	Electronic Product Testing Introduction, Environmental Testing, Temperature Testing, Thermal Modeling of Components, Humidity Testing, Electrical Overstress Testing, Altitude Testing,	04



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	Special Testing, Environmental Test Chambers and Rooms, Various Tests on Enclosures, EMI and EMC Related Testing, Importance of Standards, List of Some Standards.	
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:

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

Reference Books:

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



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DEPARTMENT OF MECHATRONICS ENGINEERING

Class:- T.Y. B. Tech	Semester-V	L	T	P	Credits
Course Code : CIMD303	Course Name : OOP using Java	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 Programmin

Course Content

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



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	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.	
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:



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



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Class: - T.Y. B. Tech.	Semester- V	L	T	P	Credits
Course Code: MEMD307	Course Name: Design and Prototyping	1	--	2	3

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,

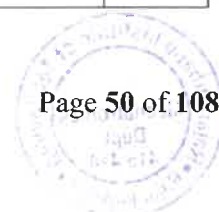
1. Use CAD software to create detailed CAD models and designs.
2. Explain the workflow and settings for effective additive manufacturing.
3. Simulate the 3D printing process to identify and correct potential issues before actual printing.
4. Print a 3D component based on CAD models.

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.	04
2.	Advanced Sketching Techniques: Using geometric constraints, Parametric sketching techniques, Practice exercises on complex shapes.	04
3.	Basic Part Design: Extruding and revolving sketches, Introduction to editing features like fillets, chamfers, and shells.	04
4.	Advanced Part Design: Applying advanced features and reference geometries, Transformation feature-Patterning, Scaling, Mirror, Creating assemblies from multiple parts.	04
5.	Introduction to Simulation in Additive Manufacturing: Basic principles of simulation for 3D printing, Setting up a simulation from a CAD model.	04
6.	Simulation for Material Optimization and Strength: Using simulation to predict material usage and optimize print parameters, analyzing results and making adjustments.	06



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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.	04
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 Schöffner, and Brian Garret.



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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,

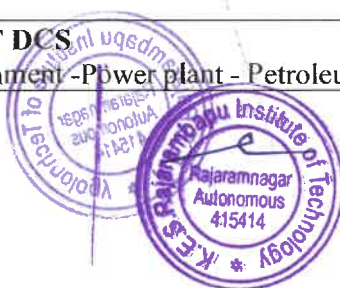
1. Explore the architecture of PLC and its functions.
2. Execute the various instructions and logic in PLC.
3. Develop the PLC program for various applications.
4. Design and develop the SCADA, DCS system for various applications.

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.	04
3.	APPLICATION OF PLC Traffic light control, 24-hour clock design, Automatic stacking process, temperature control, Automatic control of warehouse door,	04
4.	NETWORKING OF PLC AND SCADA Networking of PLCs-Data Communication-Fieldbus, PROFi bus, and Mod bus-OSI. Supervisory Control and Data Acquisition-Architecture.	04
5.	DISTRIBUTED CONTROL SYSTEM Architectures - Comparison - Local control unit, Operator interfaces - Low level and high-level operator interfaces - - Low level and high-level engineering interface	04
6.	APPLICATIONS OF DCS Pulp and paper environment -Power plant - Petroleum - Refining environment,	04



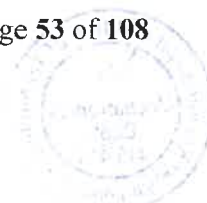
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	Wireless control system in challenging environments like welding shops, Introduction to Soft PLC.	
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References -

- Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Lucas, M.P., Distributed Control System, Van Nostrand Reinhold 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.



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Class: T. Y. B. Tech.	Semester- V	L	T	P	Credits
Course Code: AIMD303	Course Name: Business Intelligence	2	-	-	2

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.

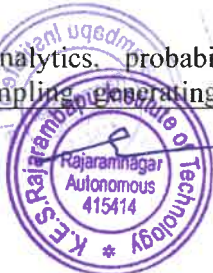
Course Description:

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.

Prerequisites:

1. Database Management Systems.
2. 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 inconsistency, transformations, standardizing, normalizing - min-max normalization, score standardization.	04
3	Inferential Statistics Role of probability in analytics, probability distributions and their characteristics. Need for sampling, generating samples, sampling and non-	04



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	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

1. James R Evans, "Business Analytics", Pearson.
2. Jiawei Han and Micheline Kamber, Morgan Kaufman, "Data Mining: Concepts and Techniques", ISBN 978- 81-312-0535-8.
3. R. N. Prasad, Seema Acharya, "Fundamentals of Business Analytics", ISBN: 978-81- 256-3203-2, Wiley-India – Types of Digital Data, OLTP-OLAP, Introduction to BI, data integration.
4. Business Analytics for managers, Wolfgang Jank–exploring and discovering, Data Modeling.

Reference Books:

5. Ken Black, "Applied Business Statistics: Making Better Business Decisions (English)", Wiley India.
6. Rob JHyndman, George Athanasopoulos, Otext, "Forecasting: Principles and Practices",



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Class: T. Y. B. Tech.	Semester: V	L	T	P	Credits
Course Code: RAMD305	Course: Robot Programming	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:

- CO1. Explain Robot programming ecosystem.
- CO2. Create reusable code for robot powered applications.
- CO3. Design a custom robot using programming.
- CO4. 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. Categories of Robot programming languages. Robot programming Language Structure. Functions in Robot programming Language.	03
2.	Robot Operating System (ROS): Introduction of ROS. Benefits of ROS. ROS history. Features of ROS. ROS applications. ROS1 and ROS2 comparison. ROS functionalities, ROS structure, Distribution, Tools, Architecture, Philosophy.	03
3.	Robot Operating System (ROS): ROS workspace, Nodes, Packages, Topics. The ROS Graph. ROS interface, Service	03
4.	Block-based coding Working of block-based coding, features of block-based coding, designing interface, block-based coding with robots. Block based programming languages.	03

List of experiments (Any 10)

Course Content		
Expt. No.	Description	Hrs.
1.	Introduction to Robot Programming (ROS)	02



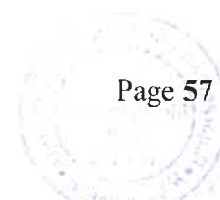
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2.	ROS Nodes, Topics, Services, Parameters, Launch Files	02
3.	ROS Workspace and ROS Package.	02
4.	Unified Robotic Description Format (URDF) for robot	02
5.	Links, Joints, Collisions, Inertia tags in the URDF file	02
6.	Launch file to Start the Robot 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:

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



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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:

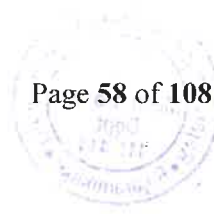
After successful completion of the course, students will be able to,

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.	Demonstrate the Elevator control using PLC.	02
9.	Demonstrate the speed control of DC motor using VFD.	02
10.	Demonstrate the HMI and SCADA programming.	02



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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,



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DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - T.Y. B. Tech .	Semester-V
Course Code: MC3532	Course Name: Measurement, Sensors and Interfaces 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:

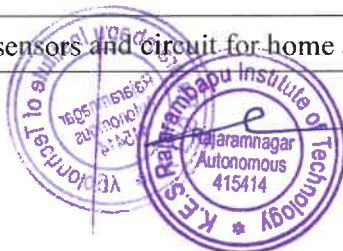
At the end of the course, students will be:

- CO1 Identify the sensors and transducers used for measuring engineering parameters in various applications.
- CO2 Design necessary signal conditioning circuits for various sensors.
- CO3 Perform measurement, calibration, and data acquisition using analog and digital sensors for engineering applications.
- CO4 Evaluate the performance of sensor-based measurement and interfacing systems based on experimental observations and application requirements.

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



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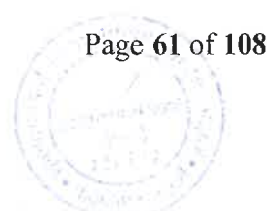
11.	Programing for temperature and pressure measurement for home automation system	02
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Textbooks:

- Bentley JP, "Principles of measurement systems", Pearson Publishers.
- Ernest, O. 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 Learning Pvt. Ltd



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Class: - T.Y. B. Tech	Semester-V	L	T	P	Credits
Course Code: MC3553	Course Name: System Dynamics and Control Lab	-	-	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:

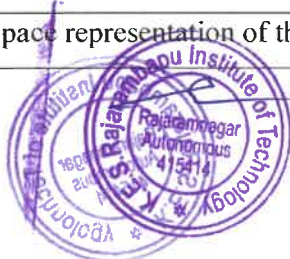
After successful completion of the course, students will be able to,

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



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10.	Determine the response of system with PID controller.	02
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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.



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DEPARTMENT OF MECHATRONICS ENGINEERING

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



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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	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



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	Total Hrs	42
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*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.



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Class: - T.Y. B. Tech	Semester-V	L	T	P	Credits
Course Code: MC357	Course Name: MOOCS/ NPTEL/ SWAYAM Courses	-	-	-	1

Course Description:

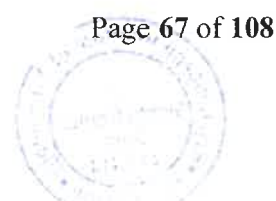
This course provides self-paced online learning opportunities through MOOCs platforms to strengthen technical knowledge and interdisciplinary skills in mechatronics engineering. It encourages independent learning, problem-solving, and continuous professional development.

Course Learning Outcomes:

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

1. Apply knowledge gained through MOOCs to enhance mechatronics engineering competencies.
2. Utilize online learning platforms and digital tools for self-directed technical learning.
3. Demonstrate professional, analytical, and problem-solving skills through MOOC-based assignments and activities.

Courses should be of a minimum of 4 weeks from the reputed MOOC platforms such as, SWAYAM, Course Era, etc. and **approved by Department.**



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Class: - T.Y. B. Tech	Semester-V	L	T	P	Credits
Course Code: MC361	Course Name: Industrial Training	-	-	--	1

Course Description:

At the end of the fifth/ sixth semester, each student would undergo four weeks Practical Training in an industry/ Professional organization / Research Laboratory/ Virtual training/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 VI 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 industrial training is done.

Prerequisite:

Basics of mechatronics engineering, good written and oral communication skills

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 Industrial training coordinator when you return to college

2. INDUSTRIAL TRAINING 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



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visiting the industry from time to time and got ratified on the day of his visit. Student's Diary and Industrial training 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. INDUSTRIAL TRAINING REPORT

After completion of Industrial training, 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 Industrial training Supervisor, TPO and Faculty Mentor. The Industrial training 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 INDUSTRIAL TRAINING

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

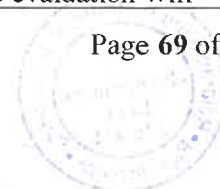
The industry will evaluate the students based on the Punctuality, eagerness to learn, Maintenance of Daily Diary and skill test in addition to any remarks.

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

Faculty Mentor of the institutes will make a surprise visit to the Industrial training 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 Industrial training 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



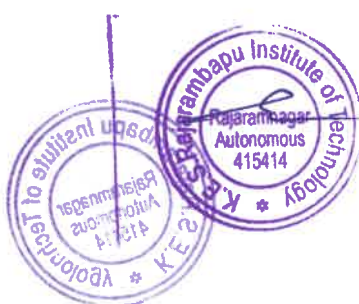
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be based on the following criteria: • Quality of content presented. • Proper planning for presentation. • Effectiveness of presentation. • Depth of knowledge and skills. • Attendance record, daily diary, departmental reports shall also be analyzed along with the Industrial training Report. Seminar presentation will enable sharing knowledge & experience amongst students & teachers and build communication skills and confidence in students

References –

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Class:-Third Year B. Tech.	Semester- V	L	T	P	Credits
Course Code: MC363	Course Name : Mini Project	-	-	6	3

Course Description:

This course provides students with an opportunity to integrate the concepts acquired from the foundational courses of the first four semesters through the design, development and validation of an engineering artefact. The project emphasizes systematic engineering design, analytical modelling, engineering calculations, experimentation, testing, validation and debugging. Students are expected to justify their design decisions using engineering principles, analyse the performance of the developed system through experimental evidence, and communicate their engineering work through professional documentation and presentations. The course develops engineering thinking, teamwork, project management, technical communication and lifelong learning skills, while laying a strong foundation for advanced project work.

Course Learning Outcomes:

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

CO1: Identify and formulate an engineering problem that requires integration of knowledge from multiple foundational courses in Mechatronics Engineering.

CO2: Analyze system requirements and design a feasible mechatronic solution by integrating mechanical, electronic, embedded, fluid power, and robotic subsystems.

CO3: Develop and implement a functional prototype, automation system, robotic application, or smart engineering solution using appropriate engineering tools and techniques.

CO4: Test, evaluate, and improve the performance of the developed system through experimentation, data analysis, and validation against specified requirements.

CO5: Demonstrate effective teamwork, project management, technical documentation, and communication skills through project execution, presentation, and reporting.

Prerequisite: Relevant foundational courses of respective program

Course Activities

Wee No	Description	Hrs
1	Course orientation, team formation, selection of project theme, identification of foundational courses, problem definition.	06
2	Requirement analysis, Foundation Integration Map, system architecture, project planning.	06
3	Engineering design, block diagrams, design calculations, component selection, Review-I (Theme Approval)	06



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4	Detailed design, modelling/simulation, subsystem development.	06
5	Prototype development, module testing, documentation, Review-II (Design & Architecture).	06
6	Completion of subsystem implementation, testing and debugging.	06
7	System integration, performance measurement, validation against design calculations, Review-III (Implementation).	06
8	Performance improvement, error analysis, debugging, documentation.	06
9	Final integration, experimental validation, preparation of technical report, Review-IV (Integration & Validation).	06
10	Completion of technical report, Foundation Integration Map, presentation preparation.	06
11	Mock presentation, demonstration, viva preparation, incorporation of suggestions.	06
12	Final demonstration, report submission, presentation, individual viva-voce and Final Review.	06

References -

Text Books:

- Author Name, Book Title, Publisher (Don't use Edition number and year of publication)

Reference Books:

Author Name, Book Title, Publisher (Don't use Edition number and year of publication)



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Class: - T.Y. B. Tech.	Semester-VI
Course Code: MC3022	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, image processing

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,

CO1 Analyze design requirements, material properties, loading conditions and failure criteria to formulate design specifications for machine elements.

CO2 Design machine components such as levers, bolted joints, welded joints, shafts, keys and springs by applying theories of failure and design standards.

CO3 Select appropriate rolling bearings and power transmission elements using design data books and manufacturers' catalogues for specified engineering applications.

CO4 Design spur gears considering strength, wear and dynamic loading for specified operating conditions.

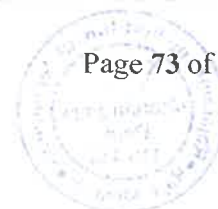
CO5 Evaluate machine components subjected to fluctuating loads using fatigue theories and recommend safe design against failure.

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



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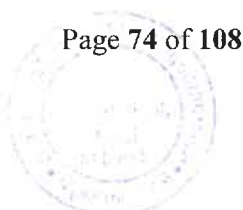
	B] Design of Bolted joint: Forms of screw threads, nomenclature, Design of Bolted joint subjected following conditions — i) Bolted joints in shear ii) Bolted joints subjected to load perpendicular to the axis of bolt C] Design of Welded Joint: Types of welded joints, Strength of parallel and fillet weld, 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:



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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.



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DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - T.Y. B. Tech.	Semester-VI
Course Code: MC241	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:	04



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	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.	
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- Rafael 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.



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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 Analysis of variance, regression analysis, Response surface methods for process optimization, SPSS/MINITAB/Design Expert software, modeling skills.	05



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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

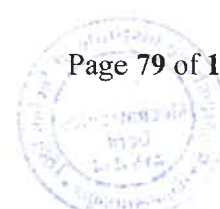
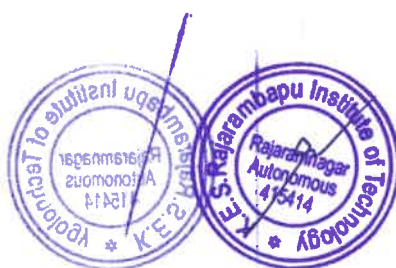
References -

Textbooks:

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

Reference Books:

1. Krishnswamy, K.N., Shivkumar, Appa Iyer and Mathiranjana 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 Wiley 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



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PROGRAM ELECTIVE – II

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



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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.
- Nitin S 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.



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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.	06



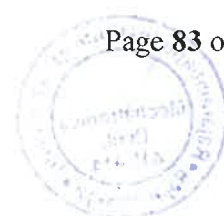
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	AM Processes: FDM of polymers, metals and ceramics, Laminated Object manufacturing, Shaped Deposition manufacturing, Sterolithography and liquid based systems, Laser Sintering technologies, 3-D Printing, Direct Metal Deposition, Electron and Laser beam technologies	
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



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Class:- T.Y. B. Tech	Semester- VI	L	T	P	Credits
Course Code : MC324	Course Name : Digital Twin	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, emphasizing **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 Discrete Industry,Data collection & analysis for product and production improvements,Automation Simulation.	06
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	06



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	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.	
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:

1. Uthayan Elangovan, Industry 5.0: The Future of the Industrial Economy, CRC Press, 2022
2. Christoph Jan Bartodziej, "The Concept Industry 4.0 an Empirical Analysis of Technologies and Applications in Production Logistics"

Reference Books:

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



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Class: - T.Y. B. Tech	Semester-VI	L	T	P	Credits
Course Code: MC3181	Course Name: Wireless sensor network	3	-	-	3

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. Analyze single node network architecture of WSN.
2. Classify routing and MAC layer protocol in WSN.
3. Develop specific requirement applications in wireless sensor networks.

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- Berkeley motes, WI FI motes, Bluetooth motes, programming challenges, node level software platforms, node level simulators, state centric programming.	06



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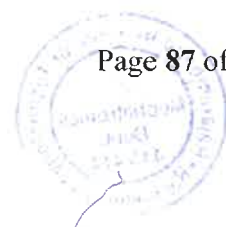
References -

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.



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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: 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,	06



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	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 O. Awadelkarim
- MEMS and microsystems: design, manufacture, and nanoscale engineering- Tai-Ran Hsu
- Micromachining -V.K.Jain, Narosa Publishing house



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Class: -T. Y. B. Tech	Semester-VI
Course Code: MC326	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 of 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	06



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	associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzman machine	
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. T.I. Kliryan- 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 Systeml - Prentice Hall.
2. J.Klin and T.A.Folger, —Fuzzy setsl University and information- Prentice Hall.
3. J.M.Zurada, —Introduction to artificial neural systemsl-Jaico Publication house.
4. VallusuRao and HayagvnaRao , —C++ Neural network and fuzzy logicl-BPB and Publication.



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Class:- T.Y.B.Tech.	Semester- VI	L	T	P	Credits
Course Code: MC328	Course Name: Advanced Materials Science for Intelligent Engineering Systems	3	-	--	3

Course Description:

This course introduces the fundamental and advanced concepts of engineering materials with a focus on modern mechatronics applications. It explores the relationships between material structure, processing, properties, and performance to enable informed material selection for engineering design. The course covers crystalline materials, material characterization techniques, advanced metallic materials, composites, polymers, ceramics, smart materials, electronic materials, nanomaterials, and sustainable materials. Emphasis is placed on materials used in robotics, automation, electric vehicles, aerospace, biomedical systems, sensors, MEMS, and additive manufacturing. Students will learn contemporary material selection methodologies considering performance, cost, reliability, and environmental sustainability. The curriculum promotes analytical thinking, innovation, and problem-solving skills required in product design and advanced manufacturing. Upon completion, students will be well prepared for careers in advanced engineering industries as well as higher studies and research in materials science, mechatronics, and allied engineering disciplines.

Course Learning Outcomes:

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

1. Explain crystal structures, defects, and characterization methods for engineering materials.
2. Select engineering materials considering mechanical, electrical, thermal, magnetic, environmental, and economic requirements.
3. Evaluate smart, functional, and nanomaterial used in intelligent engineering systems.
4. Apply material selection methodologies for robotics, EVs, automation, and MEMS.
5. Analyze recent research trends in advanced engineering materials.

Prerequisite:

1. Fundamentals of engineering materials, crystal structure, mechanical properties and manufacturing processes.
2. Fundamentals of semiconductors, electrical and magnetic properties of materials, and basic electronic materials.

Course Content

Unit No	Description	Hrs
1	Fundamentals of Advanced Engineering Materials and Material Characterization	06



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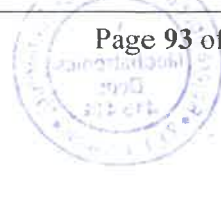
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	Introduction- Evolution of engineering materials, Material classification, Structure–Property–Processing–Performance relationship, Crystal Structure, Crystal systems, Crystal Defects, Characterization Techniques	
2	Metallic Materials and Lightweight Engineering Engineering Metals- Advanced steels , Stainless steels , Titanium alloys, Aluminum alloys, Magnesium alloys . Emerging Metallic Materials- High Entropy Alloys , Bulk Metallic Glasses, Superalloys	06
3	Composite, Polymer and Sustainable Materials Composite Materials- Reinforcement mechanisms, PMC, MMC, CMC, Sandwich composites, Honeycomb structures, Carbon fibre composites Engineering Polymers- Thermoplastics, Thermosets, Elastomers, High-performance polymers Sustainable Materials- Biopolymers, Natural fibre composites, Recyclable materials, Circular economy, Green manufacturing	06
4	Smart Materials and Functional Materials Smart Materials- Piezoelectric materials, Magnetostrictive materials, Shape Memory Alloys, Shape Memory Polymers Functional Materials- Electroactive polymers, Magnetorheological fluids, Electrorheological fluids , Self-healing materials , Self-cleaning coatings	06
5	Electronic, Energy and Nano Materials Electronic Materials- Conductors, Semiconductors, Dielectrics, Insulators Semiconductor Materials- Silicon, Germanium, Gallium Nitride, Silicon Carbide Energy Materials- Lithium-ion batteries, Solid-state batteries , Fuel cells, Hydrogen storage materials , Supercapacitors Nanomaterials- Carbon nanotubes, Graphene, MXenes , Quantum dots	06
6	Materials for Industry 5.0 and Future Technologies Advanced Manufacturing Materials- Additive manufacturing materials, Bio-inspired materials, Metamaterials, Gradient materials AI in Materials Engineering- Materials Informatics, Machine Learning for material discovery, Integrated Computational Materials Engineering (ICME) Material Selection- Ashby methodology, CES EduPack	06

References -

Text Books:

1. William D. Callister Jr. and David G. Rethwisch (Adapted by R. Balasubramaniam), Materials Science and Engineering, 2nd Indian Edition, Wiley India Pvt. Ltd., New Delhi, 2019.
2. V. Raghavan, Materials Science and Engineering: A First Course, 6th Edition, PHI Learning Pvt. Ltd., New Delhi, 2015.
3. Donald R. Askeland and Wendelin J. Wright, The Science and Engineering of Materials, 7th Edition, Cengage Learning India, New Delhi, 2016.
4. V. Raghavan, Physical Metallurgy: Principles and Practice, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.



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5. William F. Smith and Javad Hashemi, Foundations of Materials Science and Engineering, 5th Edition, McGraw-Hill Education (India), 2011.

Reference Books:

1. Michael F. Ashby and David R. H. Jones, Engineering Materials 1: An Introduction to Properties, Applications and Design, 4th Edition, Butterworth-Heinemann (Elsevier), 2011.
2. Michael F. Ashby and David R. H. Jones, Engineering Materials 2: An Introduction to Microstructures, Processing and Design, 4th Edition, Butterworth-Heinemann (Elsevier), 2012.
3. Michael F. Ashby, Materials Selection in Mechanical Design, 5th Edition, Butterworth-Heinemann (Elsevier), 2017.
4. M. F. Ashby, H. Shercliff and David Cebon, Materials: Engineering, Science, Processing and Design, 4th Edition, Butterworth-Heinemann (Elsevier), 2019.
5. S. O. Kasap, Principles of Electronic Materials and Devices, 4th Edition, McGraw-Hill Education, 2018.
6. M. Schwartz, Smart Materials, 2nd Edition, CRC Press, 2009.
7. Mel M. Schwartz, Encyclopedia of Smart Materials, John Wiley & Sons, 2002.
8. Krishan K. Chawla, Composite Materials: Science and Engineering, 3rd Edition, Springer, 2012.
9. C. Barry Carter and M. Grant Norton, Ceramic Materials: Science and Engineering, 2nd Edition, Springer, 2013.
10. Charles P. Poole Jr. and Frank J. Owens, Introduction to Nanotechnology, Wiley India, 2007.



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Class: - Third Year B. Tech	Semester-VI	L	T	P	Credits
Course Code: OE344	Course Name: Supply Chain Analytics	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.

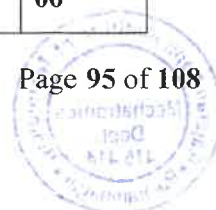
Course Learning Outcomes:

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: Introduction to Supply Chain Management, Evolution of Supply Chain Management, Analytics in Supply Chain Management, Supply Chain Planning, Different views of Supply Chain	06
2.	Supply chain drivers and obstacles:	06



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	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,	
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.



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Class: - T.Y. B. Tech.	Semester-VI	L	T	P	Credits
Course Code: OE346	Course Name: Mobile Robotics	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 include 1. 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.

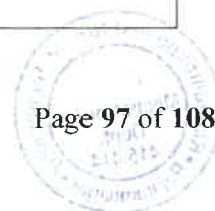
Course Learning Outcomes:

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



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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.



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Class - : Third Year B. Tech	Semester: VI	L	T	P	Credits
Course Code: MC370	Course Name: Industrial Robotics Simulation Lab	-	-	2	1

Course Description:

The Industrial Robotics Simulation Lab provides hands-on training in the simulation and offline programming of industrial robot using simulation software. Students learn to create, simulate, and validate robotic industrial applications in a virtual environment. The course emphasizes robot programming, path planning and cycle time analysis for industrial automation applications. It enables students to simulate real-world robotic systems and verify robot programs before actual deployment on industrial robots.

Course Learning Outcomes:

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

1. Explain the fundamentals of industrial robotic simulation
2. Examine Robot Work Cell and industrial robotic components in Simulation Software.
3. Develop industrial robotic applications using offline programming techniques.
4. Execute given application through simulation and offline robot programming.
5. Develop a report of simulated program for stated application.

Prerequisite: Basic knowledge computer, and mechanisms.

Course Content		
Expt. No.	Description	Hrs.
1.	Study of ROBOGUIDE Software Environment and creation of a Virtual Industrial Robot Work Cell including robot selection and cell configuration.	02
2.	Creation and configuration of Tool Center Point (TCP) and User Frames for accurate robot positioning and coordinate transformation.	02
3.	Study and implementation of Robot Jogging Methods in Joint, World, Tool, and User coordinate systems.	02
4.	Development of basic Teach Pendant (TP) Programs for point-to-point robot motion and motion instruction execution.	02
5.	Programming and simulation of Path-Based Robot Motions including linear, circular, and continuous path movements.	02
6.	Design and simulation of a Pick and Place Application using gripper control and object handling operations.	04
7.	Implementation of Automation Logic using digital inputs/outputs, sensors, and sequence control in robotic work cells.	04



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8.	Development and simulation of Advanced Industrial Robotic Application: Palletizing, machining operations.	04
9.	Case Study on Industrial Application for Robotic Simulation.	02

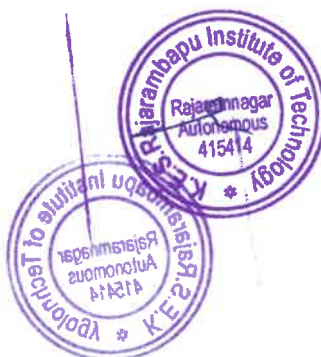
References –

Textbooks

1. Mikell P. Groover, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill Education.
2. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 4th Edition, Pearson Education.
3. R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw-Hill Education.

Reference Books

1. FANUC America Corporation, ROBOGUIDE Training Manual and User Documentation.
2. FANUC Robotics, Handling Tool Operator's Manual and Teach Pendant Programming Manual.



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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



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9.	To Computation of Mean, Standard Deviation, Correlation coefficient of the <u>given</u> Image.	02
10.	To Implementation of image restoring techniques.	02

Reference Books:

Textbook:

1. Digital Image Processing- Rafael 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.



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Class: - T.Y. B. Tech	Semester-VI	L	T	P	Credits
Course Code: SH3065	Course Name: Scholastic Aptitude-II	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,

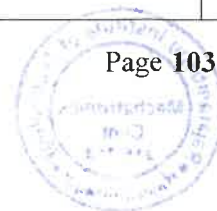
1. Develop a thorough conceptual understanding and develop a logical approach towards solving Aptitude and Reasoning problems.
2. Understand usage of basic aptitude terms of percentages, averages, ratios and applications of business aptitude terms of profits and interests
3. Develop a bridge in analogies,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



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	Head Start , Dead heat, defeat, 3 man participating in race, ratio related examples	
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 -

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



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Third Year (T.Y.) B.Tech. Syllabus (2024–28 Batch)
To be implemented for 2024-28 NEP Batch
DEPARTMENT OF MECHATRONICS ENGINEERING

Class: - T.Y. B. Tech	Semester- VI
Course Code: MC364	Course Name: Future Skill Course -II

L	T	P	Credits
-2*	-		1

Course Learning Outcomes:

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

1. Apply emerging industry skills and digital technologies for solving modern mechatronics engineering problems.
2. Utilize NASSCOM future skill tools/platforms for developing industry-oriented technical competencies.
3. Demonstrate self-learning, innovation, and professional skills through future skill-based activities and projects.

Course Content

- Future skill courses recommended by NASSCOM and approved by the Department of Mechatronics Engineering have to be completed by the students.
- The duration of the course should not be less than 15 hours.
- The student has to submit the course completion certificate as part of the course completion



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DEPARTMENT OF MECHATRONICS ENGINEERING

Class:- Third Year B. Tech.	Semester- VI	L	T	P	Credits
Course Code MC366	Course Name : Minor Project	-	-	12	6

Course Description:

The Minor Project provides students with an opportunity to apply the knowledge and skills acquired through multidisciplinary engineering courses to solve a defined engineering problem. Students are expected to identify a relevant engineering problem, analyse requirements, generate and evaluate alternative solutions, and develop an appropriate mechatronic system or engineering solution. The course emphasizes the integration of mechanical systems, electronics, sensors, actuators, control systems, programming and modern engineering tools. Students shall undertake systematic design, modelling, analysis, fabrication or implementation, testing and validation of the proposed solution. The project encourages innovation, engineering design, teamwork, project planning, sustainability, safety and professional ethics. Students shall justify their engineering decisions using appropriate calculations, simulations, technical standards and experimental evidence. The course also develops students' ability to document technical work, communicate engineering solutions and demonstrate the performance of the developed system through appropriate testing and validation..

Course Learning Outcomes:

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

- CO1:** Formulate and analyse a multidisciplinary engineering problem by integrating knowledge of mechanical, electronics, control and programming systems.
- CO2:** Design and develop a mechatronic system using appropriate engineering principles, modelling techniques, software tools and modern engineering practices.
- CO3:** Implement, test and validate the developed system through experimentation, data analysis and comparison with specified performance requirements.
- CO4:** Apply project planning, teamwork, engineering standards, sustainability, safety and professional ethics during project execution.
- CO5:** Prepare technical documentation and effectively communicate the engineering solution through reports, presentations, demonstrations and viva-voce.

Prerequisite: Relevant courses completed up to Semester V, including Industrial Automation, Measurement, Sensors and Interfaces, System Dynamics and Control, Industrial Automation Lab, Measurement, Sensors and Interfaces Lab, System Dynamics and Control Lab, and Mini Project.

Course Activities		
Week No	Description	Hrs



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1	Course orientation, project allocation, identification of engineering problem, literature survey, problem definition and project planning.	12
2	Requirement analysis, identification of functional and technical requirements, feasibility analysis and preparation of project specifications.	12
3	Concept generation, evaluation of alternative solutions, system architecture, block diagram and preliminary design.	12
4	Detailed engineering design, CAD modelling, circuit design, control strategy, software architecture and engineering calculations.	12
5	Component/material selection, procurement planning, simulation/modelling and preparation of detailed implementation plan.	12
6	Review-I: Problem Definition and Concept Design; finalization of design and commencement of system development.	12
7	Mechanical fabrication, circuit development, programming and subsystem implementation.	12
8	Subsystem integration, debugging, calibration and preliminary testing of the developed system.	12
9	System integration, module testing and verification of functional requirements.	12
10	Review-II: Design and Implementation Review; performance evaluation and refinement of the developed system.	12
11	Experimental testing under different operating conditions, data collection and performance analysis.	12
12	Validation of the system against design specifications, analysis of results and identification of design improvements.	12
13	Reliability, safety and sustainability assessment; optimization and final system refinement.	12
14	Review-III: Testing and Validation Review; comparison of theoretical/simulated and experimental results.	12
15	Preparation of engineering drawings, technical documentation, user manual, project records and final report.	12
16	Review-IV: Final Technical Review; final demonstration, presentation, individual viva-voce and submission of the final project report.	12

References - Text Books:

- Author Name, Book Title, Publisher (Don't use Edition number and year of publication)

Reference Books:

Author Name, Book Title, Publisher (Don't use Edition number and year of publication)



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Class: - T.Y. B. Tech	Semester-VI	L	T	P	Credits
Course Code: MC368	Course Name: Seminar	-	-	-	Audit

Course Description

This course provides exposure to recent trends, technologies, and research areas in mechatronics engineering through literature review and technical presentations. It enhances analytical thinking, presentation skills, and professional communication.

Course Learning Outcomes:

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

1. Analyze recent trends and technologies in mechatronics engineering through literature study.
2. Develop technical presentation, report writing, and communication skills.
3. Demonstrate analytical thinking and professional confidence through a seminar presentation.

At the end of the semester, a seminar presentation and its report in the prescribed format will be required from the students as part of course completion.

