



K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)
Syllabus for B.Tech. Robotics & Automation
 To be Implemented for 2025-29 NEP Batch
Department of Robotics & Automation

Class: S. Y. B. Tech. (Robotics & Automation)

Semester: III

Course Code	Course	Teaching Scheme						Evaluation Scheme						
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)		Practical (Marks %)			
									Max.	Min. for Passing	Max.	Min.	for Passing	
RA2171	Electric Drives and Control	2	-	-	36	60	2	ISE	20	40	40	----	----	
								UT1	15			----		
								UT2	15			----		
								ESE	50			40	----	
RA203	Engineering Mechanics	2	-	-	36	60	2	ISE	20	40	40	----	----	
								UT1	15			----		
								UT2	15			----		
								ESE	50			40	----	
RA205	Sensors and Instrumentation	3	-	2	72	120	4	ISE	20	40	40	----	----	
								UT1	15			----		
								UT2	15			----		
								ESE	50			40	----	
RA207	Analog and Digital Electronics	3	-	-	54	90	3	ISE	20	40	40	----	----	
								UT1	15			----		
								UT2	15			----		
								ESE	50			40	----	
RA209	Materials and Manufacturing Technology	3	-	-	54	90	3	ISE	20	40	40	----	----	
								UT1	15			----		
								UT2	15			----		
								ESE	50			40	----	
	Multidisciplinary Minor - I	3	-	-	54	90	3	ISE	20	40	40	----	----	
								UT1	15			----		
								UT2	15			----		
								ESE	50			40	----	
RA211	Engineering Mechanics Lab.	-	-	2	6	30	1	ISE	----	----		100	50	
RA213	Analog and Digital Electronics Lab.	-	-	2	6	30	1	ISE	----	----		100	50	
RA215	Object Oriented Programming Lab.	-	-	2	6	30	1	ISE	----	----		50	50	
								ESE	----	----		50	50	
RA2191	Robotics Technology Lab	-	-	2	6	30	1	ISE	----	----		50	25	
								ESE	----	----		50	25	
RA221	Manufacturing Processes and Practices	-	-	2	6	30	1	ISE	----	----		100	50	
	Professional Skills Development and Foreign Languages	-	-	2	6	30	1	ISE	----	----		100	50	
	TOTAL	16	-	14	342	690	23							
	TOTAL CONTACT HOURS	30												

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

Total Contact Hours/week : 30

Total Credits : 23





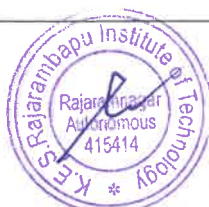
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Professional Skills Development and Foreign Languages Courses

Sr. No.	Course Name	Course Code
1	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 – III	SH2734
6	Japanese Language – III	SH2714

Note:

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



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Department of Robotics & Automation

Class: S. Y. B. Tech. (Robotics & Automation)

Semester: IV

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)		Practical (Marks %)		
									Max.	Min. for Passing	Max.	Min. for Passing	
RA222	Mathematics of Engineering for Robotics & Automation	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15				
								ESE	50			40	---
RA204	Strength of Materials	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15				
								UT2	15				
								ESE	50			40	---
RA206	Control Systems	3	-	2	72	120	4	ISE	20	40	40	---	---
								UT1	15				
								UT2	15				
								ESE	50			40	---
RA208	Robot Kinematics	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15				
								UT2	15				
								ESE	50			40	---
RA224	Robot Standards and Ethics	2	-	-	36	60	2	ISE	20	40	40	---	---
								UT1	15				
								UT2	15				
								ESE	50			40	---
	Multidisciplinary Minor - II	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15				
								UT2	15				
								ESE	50			40	---
RA210	Machine Drawing Lab.	-	-	2	6	30	1	ISE	---	----		50	25
								ESE					50
SH2175	Environmental Science	1	-	2	24	60	2	ISE	50	40	40	---	---
								ESE	50			40	---
RA226	Industrial Robotics Technology	-	-	2	6	30	1	ISE				50	25
								ESE	---			----	50
RA220	Massive Open Online Courses (MOOC)	-	-	-	30	30	1	ISE	---			100	50
RA228	Python Programming Lab	-	-	2	6	30	1	ISE	---			100	50
	Professional Skills Development and Foreign Languages	-	-	2	6	30	1	ISE	---			100	50
	TOTAL	18	-	12	392	750	25						
	TOTAL CONTACT HOURS	30											



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

Total Contact Hours/week : 30

Total Credits : 25

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





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Professional Skills Development and Foreign Languages Courses

Sr. No.	Course Name	Course Code
1	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 – IV	SH2644
6	Japanese Language – IV	SH2624





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Class: T. Y. B. Tech. (Robotics & Automation)

Semester V

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)		Practical (Marks %)		
									Max.	Min. for Passing	Max.	Min. for Passing	
RA321	Industrial Automation	2	-	-	36	60	2	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50			---	---
RA303	Design of Machine Elements	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50			---	---
	Program Elective - I	2	-	-	36	60	2	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50			---	---
	Open Elective - I	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50			---	---
	Multidisciplinary Minor - III	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50			---	---
RA323	Programmable Logic Controllers and SCADA	2	-	-	36	60	2	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50			---	---
	Multidisciplinary Minor - IV	1	-	2 [#]	24	60	2	ISE	---	---	---	50	25
								ESE	---	---	---	50	25
RA313	PLC & SCADA Lab.	-	-	2	6	30	1	ISE	50	40	40	---	---
								ESE	50	40	40	---	---
RA325	Industrial Automation Lab.	-	-	2	6	30	1	ISE	---	---	---	100	50
RA327	Engineering Analysis Lab	-	-	2	6	30	1	ISE	---	---	---	100	50
RA319	Summer Internship	-	-	-	6	30	1	ISE	---	---	---	100	50
RA329	Massive Open Online Course (MOOC)	-	-	-	30	30	1	ISE	---	---	---	100	50
RA331	Mini Project	-	-	6	18	90	3	ISE	---	---	---	100	50
SH3034	Scholastic Aptitude-I	1	-	2			Audit						
	TOTAL	17			366	750	25						
	TOTAL CONTACT HOURS	30+3*											





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Total Contact Hours/week : 33

Total Credits : 25

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



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Program Elective – I:

Sr. No.	Course Code	Course
1	RA305	Product Lifecycle Management
2	RA307	Wireless Sensors Networks for Robotics
3	RA309	Data Structures and Algorithms
4	RA311	Mechatronic System Design

Open Elective I 2025-29

Sr. No.	Course Code	Open Elective Subject Name	Offered by the department
1	OE3411	Energy Audit and Management	Electrical Engineering
2	OE3431	Data Science	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
3	OE3105	Network Administration	Computer Science and Engineering
4	OE3065	Environmental Impact Assessment	Civil Engineering
5	OE3382	Disaster Management	Civil Engineering
6	OE3651	Distributed Systems	Computer Science and Information Technology
7	OE3611	Object Oriented Modeling and Design	Computer Science and Information Technology
8	OE3471	New Product Design & Development	Mechanical Engineering
9	OE3491	Non-Conventional Energy Sources	Mechanical Engineering
10	OE3045	Renewable Energy Sources	Robotics & Automation
11	OE3631	Robotics Engineering & Applications	Robotics & Automation
12	OE3531	Factory Automation	Mechatronics Engineering
13	OE3551	Cyber Physical System	Mechatronics Engineering
16	OE3571	Internet of Things	Electronics & Telecommunication Engineering
17	OE3591	Drone Technology	Electronics & Telecommunication Engineering
18	OE3511	Hydrogen Fuel Cell Technology	Mechanical Engineering

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Class: T. Y. B. Tech. (Robotics & Automation)

Semester: VI

Course Code	Course	Teaching Scheme						Credits	Evaluation Scheme					
		L	T	P	TW+SL	Total thr.	Scheme		Theory (Marks %)		Practical (Marks %)			
									Max.	Min. for Passing	Max.	Min. for Passing		
RA302	Microcontrollers and Embedded systems	3	-	-	54	90	3	ISE	20	40	40	---	---	
								UT1	15			---	---	
								UT2	15			---	---	
								ESE	50			---	---	
RA304	Research Methodology	2	-	-	36	60	2	ISE	20	40	40	---	---	
								UT1	15			---	---	
								UT2	15			---	---	
								ESE	50			---	---	
	Program Elective - II	3	-	-	54	90	3	ISE	20	40	40	---	---	
								UT1	15			---	---	
								UT2	15			---	---	
								ESE	50			---	---	
	Open Elective - II	3	-	-	54	90	3	ISE	20	40	40	---	---	
								UT1	15			---	---	
								UT2	15			---	---	
								ESE	50			---	---	
	Multidisciplinary Minor - V	3	-	-	54	90	3	ISE	20	40	40	---	---	
								UT1	15			---	---	
								UT2	15			---	---	
								ESE	50			---	---	
RA316	Programming and Simulation Lab	-	-	4	8	60	2	ISE	---	---	---	50	50	
								ESE	---			50	50	
RA318	Microcontrollers and Embedded Systems Lab	-	-	2	6	30	1	ISE	---	---	---	100	50	
RA326	Advanced Manufacturing Lab.	-	-	2	6	30	1	ISE	---	---	---	50	50	
SH3164	Scholastic Aptitude- II	1	-	2	-	-	Audit	ISE	100	50 (P/NP)	---	----		
RA332	Minor Project	-	-	12	144	180	6	ISE	---	---	---	100	50	
	Total	17	-	24	416	720	27							
	Total contact hours	32+3*												

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

Total Contact Hours/week : 35

Total Credits : 24

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

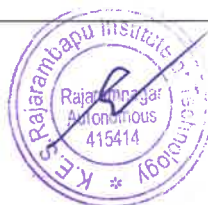
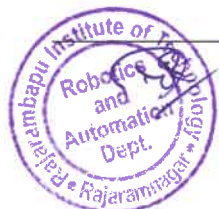


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Program Elective – II:

Sr. No.	Course Code	Course
1	RA306	Operations Research
2	RA308	Communication System
3	RA310	Cyber Security for Industrial Automation
4	RA312	Mobile Robotics

Open Elective II			
Sr. No.	Course Code	Open Elective Subject Name	Offered by the department
1	OE3721	Industrial Safety	Electrical Engineering
2	OE3421	Data Mining	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
3	OE3681	AI for Agriculture	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
4	OE3481	Information Technology Foundation Program	Computer Science and Engineering
5	OE3661	AI for Cybersecurity	Computer Science and Engineering
6	OE3085	Materials Management	Civil Engineering
7	OE3501	Operations Research	Civil Engineering
8	OE3581	Plumbing (Water and Sanitation)	Civil Engineering
9	OE3402	Cyber Security	Computer Science and Information Technology
10	OE3641	AI for Manufacturing	Computer Science and Information Technology
11	OE3285	Supply Chain Management	Mechanical Engineering
12	OE3325	Entrepreneurship Development	Mechanical Engineering
13	OE3025	Reliability Engineering	Robotics & Automation
14	OE3621	Flexible Manufacturing System	Robotics & Automation
15	OE3521	Image Processing	Electronics & Telecommunication Engineering
16	OE3541	Fuzzy Logic & Neural Network	Electronics & Telecommunication Engineering
17	OE3701	AI for Sustainability	Electronics & Telecommunication Engineering
18	OE3441	Supply Chain Analytics	Mechatronics Engineering
19	OE3461	Mobile Robotics	Mechatronics Engineering
20	OE3561	Project Management	Mechanical Engineering
21	OE3243	Marketing for Engineers	MBA



Class: Final Year B. Tech. (Robotics & Automation)

Semester: VII

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)		Practical (Marks %)		
									Ma x.	Min. for Passing	Ma x.	Min. for Passing	
RA401	Hydraulics and Pneumatics	3	-	-	54	90	3	ISE	20	40	---	---	
								MSE	30		---	---	
								ESE	50		---	---	
RA439	Industrial Engineering	3	-	-	54	90	3	ISE	20	40	---	---	
								MSE	30		---	---	
								ESE	50		---	---	
RA455	AI & ML for Robotics	2	-	-	36	60	2	ISE	20	40	---	---	
								MSE	30		---	---	
								ESE	50		---	---	
RA457	Industrial Robots	3	-	-	54	90	3	ISE	20	40	---	---	
								MSE	30		---	---	
								ESE	50		---	---	
	Program Elective – III	3	-	-	54	90	3	ISE	20	40	---	---	
								MSE	30		---	---	
								ESE	50		---	---	
	Program Elective - IV	3	-	-	54	90	3	ISE	20	40	---	---	
								MSE	30		---	---	
								ESE	50		---	---	
	Program Elective – IV Lab.	-	-	2	6	30	1	ISE	--	---	50	50	
								ESE	--	---	50	50	
RA459	Robot Kinematics and Dynamics Lab	-	-	2	6	30	1	ISE	--	---	50	50	
								ESE	--	---	50	50	
RA435	Hydraulics and Pneumatics Lab.	-	-	2	6	30	1	ISE	--	---	100	50	
RA461	Seminar	-	-	2	6	30	1	ISE	--	--	50	100	
TOTAL		15	-	12	330	630	21						
TOTAL CONTACT HOURS		27											

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

Total Contact Hours/week : 27

Total Credits : 21



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Program Elective – III:

Sr. No.	Course Code	Course
1	RA431	Noise and Vibration
2	RA333	Power Electronics
3	RA335	Applied AR VR
4	RA437	Agricultural Robotics and Automation

Program Elective – IV:

Sr. No.	Course Code	Course
1	RA439	Finite Element Analysis
2	RA441	Industrial Internet of Things
3	RA443	Computer Vision and Image Processing
4	RA445	Drone Technology

Program Elective – IV Lab.:

Sr. No.	Course Code	Course
1	RA447	Finite Element Analysis Lab
2	RA449	Industrial Internet of Things Lab
3	RA451	Computer Vision and Image Processing Lab
4	RA453	Drone Technology Lab



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

Class: Final Year B. Tech. (Robotics & Automation)

Semester: VIII

SEMESTER V													
Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max.	Min. for passing		Max.	Min. for passing
OE4382	Finance for Engineers (Online Course)	2	-	-	36	60	2	ISE	25	40	40	---	---
								ESE	75	40		---	---
OE4362	Engineering Management & Economics (Online Course)	2	-	-	36	60	2	ISE	25	40	40	---	---
								ESE	75	40		---	---
IP4024	Industry Internship & Project	-	-	-	360	360	12	ISE	---	----		50	50
								ESE	---	---		50	50
	TOTAL		-	-	432	480	16						

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

Total Contact Hours/week : –

Total Credits : 16

Note:

- Weekly Contact hours are not mentioned as the student is expected to be in the industry regularly for 20 weeks. However, students need to report to the Institute mentors as and when required.
- 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 the college campus.

Model II: Research Internship (RI)

Class: Final Year B. Tech. (Robotics & Automation)

Semester: VIII

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max.	Min. for passing		Max.	Min. for passing
OE4382	Finance for Engineers (Online Course)	2	-	-	36	60	2	ISE	25	40	40	---	---
								ESE	75	40		---	---
OE4362	Engineering Management & Economics (Online Course)	2	-	-	36	60	2	ISE	25	40	40	---	---
								ESE	75	40		---	---
RE4044	Research Internship	-	-	-	360	360	12	ISE	---	---		50	50
								ESE	---	---		50	50
	TOTAL		-	-	432	480	16						

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

Total Contact Hours/week : -

Total Credits : 16

Note:

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

- Students who opt for a research internship need to undergo a minimum of one month of research internship in outside research organizations or laboratories.

Model III: Entrepreneurial Internship (EI)

Class: Final Year B. Tech. (Robotics & Automation)

Semester: VIII

Class: Final Year B. Tech.

Semester: VIII

		Teaching Scheme							Evaluation Scheme				
Course Code	Course	L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max	Min. for passing		Max	Min. for passing
ED4104	Project Management (Online Course)	2	-	-	36	60	2	ISE	25	40	40	-	-
								ESE	75	40	-	-	
ED4044	Commercial Aspects of the Project (Online Course)	2	-	-	36	60	2	ISE	25	40	40	-	-
								ESE	75	40	-	-	
ED4064	Entrepreneurship Development Program (EDP)	-	-	-	30	30	1	ISE	---	--	--	100	50
ED4084	Entrepreneurial Internship	-	-	-	330	330	11	ISE	--	--	--	50	50
								ESE				50	
	Total	-	-	-	432	480	16						

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

TW: Term Work, SL: Self-Learning

Total Contact Hours/week : 04

Total Credits : 16

Note:

- 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.
- 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.
- A one-week Entrepreneurship Development Program (EDP) will be conducted after completion of the 7th semester and before start of 8th semester.
- Students who opt for an entrepreneurial internship need to undergo a one-month internship at an outside reputed organization or firm.



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B.Tech. in Robotics & Automation with Multidisciplinary Minor



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 2025-29					
MDM Basket Name	Sr. No.	Course Code	Course Name	Sem ester	Offered by Department
Construction Engineering	1	CEMD2011	Building Construction and Planning		Civil Engineering
	2	CEMD2021	Building Estimation and Valuation		
	3	CEMD3011	Infrastructure Engineering		
	4	CEMD3031	Smart Cities and Sustainable Development		
	5	CEMD3021	Environmental Engineering		
Software Programming	1	CSMD2011	Introduction to Data Structures		Computer Science & Engineering
	2	CSMD204	Fundamentals of Database Systems		
	3	CSMD305	Software Testing		
	4	CSMD3031	Object-oriented Programming in Python		
	5	CSMD3021	Artificial Intelligence		
Electrical Power System	1	EEMD2011	Electrical Power Generation		Electrical Engineering
	2	EEMD2021	Power System		
	3	EEMD3011	Electrical Machines		
	4	EEMD3051	Electrical Technology		
	5	EEMD3021	Smart Grid		
Electronics System Design	1	ECMD2011	Electronics Devices and Applications		Electronics & Telecommunication Engineering
	2	ECMD2021	Electronics Communication Systems		
	3	ECMD3011	Advanced Communication Systems		
	4	ECMD3031	Electronic Product Design		
	5	ECMD3021	Industrial Electronics		
Software Development	1	CIMD2011	Data Structures		Computer Science & Information Technology
	2	CIMD2021	Computer Algorithms		
	3	CIMD3011	Introduction to DBMS		
	4	CIMD3031	OOP using Java		
	5	CIMD3021	Software Engineering		



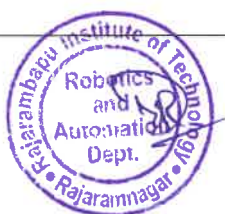
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Product Design and Development	1	MEMD2031	Design Thinking		Mechanical Engineering
	2	MEMD2041	Behavioral Engineering and Design		
	3	MEMD3051	Product Design Tools and Techniques		
	4	MEMD3071	Design and Prototyping		
	5	MEMD3041	Marketing and Business Fundamentals for New Products		
Automobile Engineering	1	MEMD205	I. C. Engine		Mechanical Engineering
	2	MEMD206	Automotive Drivetrain		
	3	MEMD309	Automotive Chassis Systems		
	4	MEMD311	Automotive Engineering Laboratory		
	5	MEMD306	Electric Vehicles		
Mechatronics Engineering	1	MCMD2011	Fundamentals of Mechatronics		Mechatronics Engineering
	2	MCMD2021	Industrial Fluid Power		
	3	MCMD3011	Sensor and Instrumentation		
	4	MCMD3031	Industrial Automation		
	5	MCMD3021	Industrial Robotics		
Artificial Intelligence	1	AIMD2011	Object-Oriented Programming		Computer Science & Engineering (AI-ML)
	2	AIMD2021	Data Structures and Algorithms		
	3	AIMD3011	Machine Learning		
	4	AIMD3031	Business Intelligence		
	5	AIMD3021	Principles of AI		
Robotics & Automation	1	RAMD2011	Fundamentals of Robotics & Automation		Robotics & Automation
	2	RAMD2021	Sensors and Actuators		
	3	RAMD3011	Kinematic & Dynamics for Robots		
	4	RAMD3051	Robot Programming		
	5	RAMD3021	Industrial Automation & Control		





B.Tech. in Robotics & Automation with Double Minor (Multidisciplinary and Specialization Minor)





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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	RADM3XXX
2	IV	DM – II	RADM4XXX
3	V	DM – III	RADM5XXX
4	VI	DM – IV	RADM6XXX
5	VII	DM – V	RADM7XXX
6	VIII	DM – VI	RADM8XXX

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 recommendation of BoS of the department.
7. Student will get the credits of respective DM course in following conditions,
 - a. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
 - b. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA(oral) exam.
8. While selecting online course, following points must be taken care of,
 - a. Selected course must be of basic or fundamental level.
 - b. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective) or in Multidisciplinary Minor (MDM)
 - c. Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for UDEMY, COURSERA courses.





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B.Tech. in Robotics & Automation with Honor and Multidisciplinary Minor



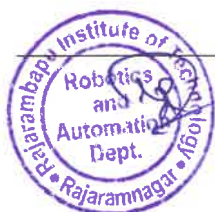
Honors with Multidisciplinary Minors

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.	Course	Code
1	Honor - I	RAHNXXX
2	Honor - II	RAHNXXX
3	Honor - III	RAHNXXX
4	Honor - IV	RAHNXXX
5	Honor - V	RAHNXXX
6	Honor - VI	RAHNXXX

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 recommendation of BOS.
7. Student will get the credits of respective Honor course in following conditions,
 - a. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
 - b. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA(oral) exam.
8. While selecting online course, following points must be taken care of,
 - a. Selected course must be of advanced level and not basic or fundamental level.
 - b. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective)
 - c. Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for COURSERA, UDEMY courses.

B. Tech. in Robotics & Automation - Honors with Research and Multidisciplinary Minor



Honors with Research and Multidisciplinary Minor

The student will work on Research Project or Dissertation for 18 Credits in the Fourth Year in respective discipline. The distribution of 18 Credits for Research project in Sem-VII and Sem-VIII is given below. To get B. Tech in Mechatronics Engineering Honors with Research and Multidisciplinary Minor degree Student need to earn total 188 Credits which consist 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	TW+SL	Total Hr.	credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max.	Min. for passing		Max.	Min. for passing
REH401	Intellectual Property Rights (IPR)	-	-	-	60	60	2	ISE	50	40	40	---	---
								ESE	50	40		---	---
REH403	Research project (Synopsis) phase - I	-	-	-	60	60	2	ISE				50	50
								ESE				50	50
REH405	Research Specific core course - I (Online NPTEL course)	-	-	-	90	90	3	ISE	50	40	40		
								ESE	50	40			
	TOTAL	-	-	-	210	210	7						

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

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



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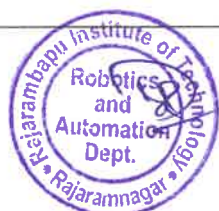
Department of Robotics & Automation

Class: Final Year B. Tech.
VIII

Semester:

Course Code	Course	Teaching Scheme						Scheme	Evaluation Scheme				
		L	T	P	TW+SL	Total Hr.	Credits		Theory (Marks%)			Practical (Marks %)	
									Max.	Min for passing		Max.	Min. for passing
REH402	Research project phase - II	-	-	-	330	330	11	ISE				50	50
								ESE				50	
	TOTAL	-	-	-	330	330	11						

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



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Class: S.Y. B.Tech.	Semester-III	L	T	P	Credits
Course Code: RA2171	Course Name: Electric Drives and Control	2	-	-	2

Course Description:

This course on Electrical Drives and Controls focuses on the principles, design, and control of electric motor drives used in robotics and automation systems. It covers DC and AC motors, power electronics, digital control techniques, and real-world applications, equipping students with the knowledge to design and implement efficient drive systems.

Course Outcomes:

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

- CO1. Analyse the fundamentals of electrical drives and their components.
- CO2. Apply the concepts of power electronics to control electric motors
- CO3. Design and control DC& AC electrical drives
- CO4. Implement digital control techniques for electrical drives
- CO5. Integrate electrical drives in robotic and automation systems

Prerequisite: Engineering Mathematics, Basic Electrical Engineering, Control Systems and Electrical Machines

Course Content		
Unit No.	Description	Hrs
1.	Introduction to Electrical Drives Definition and importance in automation and robotics, AC and DC electrical drives, Drive systems and components, Motors, controllers, and power electronic converters, Basic principles of DC motors, Construction, working, and characteristics, safety concerns in electrical drives.	04
2.	Power Electronic Converters for Motor Control Introduction to Diodes, thyristors, MOSFETs, IGBTs, Switching techniques and converters. DC Motor Control, Pulse width modulation (PWM) for DC drives, Frequency control for AC motors (V/f control), Motor Protection-type, faults and devices.	04
3.	DC Motor Drives and Control Types of DC Motors- Series, shunt, and compound motors, Speed-torque characteristics of DC motors, Speed Control of DC Motors- Field flux control, Armature voltage control, Regenerative and dynamic braking	04

	methods, Energy efficient drive Design, Applications of DC Motor Drives, BLDC motor.	
4.	AC Motor Drives and Control Induction to AC Motor Drives, Speed control methods: V/f control, Synchronous Motor Drives, Principle of operation and control of synchronous motors. Applications in robotics and automation	04
5.	Digital Control of Electrical Drives Introduction to Digital Control Systems, Basics of digital control and discrete-time systems, PID, Fuzzy logic. Control Techniques for Stepper Motors.	04
6.	Applications of Electrical Drives in Robotics and Automation Robotic Arm Drives and Control, Drive systems for articulated arms: Stepper motors, servos, and DC motors. Motion Control in Automated Systems, introduction to PLC for automation systems, case studies of Applications of Electrical Drives in Robotics and Automation. Safety standards and industrial protocols used for electric drive applications in robotics.	04

References –

Text Books:

1. G.K. Dubey, Fundamentals of Electric Drives, Alpha Science International Ltd.
2. Ned Mohan, Tore M. Undeland, William P. Robbins, Power Electronics: Converters, Applications, and Design, John Wiley & Sons.

Reference Books:

1. R.K. Gupta, N.P. Padhy, Electric Motor Drives: Modeling, Analysis, and Control, Wiley.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press.
3. W. Leonhard, Electric Drives, Springer.
4. Werner Leonhard, Control of Electrical Drives, Springer.

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Class: S.Y. B. Tech.	Semester-III	L	T	P	Credits
Course Code: RA203	Course Name: Engineering Mechanics	2	-	-	2

Course Description:

Engineering Mechanics focuses on the analysis of static bodies. The course helps the students to understand facts, concepts, principles and techniques of scientific investigation in the field of engineering. It develops thinking, analytical ability and imaginative skill of student. It develops thinking, analytical ability and imaginative skill of student. It is an introductory course which supports study of many other advanced courses like analysis and design of various structures and machine components.

Course Outcomes:

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

- CO1. Calculate resultant force of coplanar force system.
- CO2. Analyse engineering problems applying conditions of equilibrium
- CO3. Determine centroid & moment of inertia of the geometrical plane lamina.

Prerequisite: Engineering Mathematics, Engineering Physics

Course Content		
Unit No.	Description	Hrs
1.	Fundamentals of Mechanics and force systems: Force and classification of force systems. Resultant of parallel, concurrent and non-concurrent coplanar forces.	04
2.	Equilibrium of force system: Free body diagram, conditions of equilibrium, types of loads, types of beams, types of supports and reactions. Analysis of simple and compound beams using conditions of equilibrium	04
3.	Friction: Introduction to Laws of friction, Surface friction for bodies on horizontal and inclined planes.	04
4.	Analysis of trusses: Analysis of simple truss, Method of joints, Method of sections.	04
5.	Centroid: Centroid of plane and composite figures.	04
6.	Moment of Inertia: Moment of Inertia of plane and composite figures.	04

References –

Text Books:

1. Bhavikatti S. S., Rajashekarappa, “Engineering Mechanics”, New age International publication (India) Pvt. Ltd. New Delhi,
2. Ramamrutham S., “Engineering Mechanics”, Dhanpat Rai Publishing Company Ltd., New Delhi.

Reference Books:

1. S. Junnarkar, “Elements of Applied Mechanics”, Charotar Publishing House (India) Pvt. Ltd., Anand (Gujarat)
2. Ferdinand. Beer and E. Russell Johnson, “Vector Mechanics for Engineers (Statics and Dynamics)”, McGraw Hill Publication, New York.
3. Ferdinand L. Singer, “Engineering Mechanics (Statics and Dynamics)” Publications (India) Pvt. Ltd. Noida.
4. Timoshenko and Young, “Engineering Mechanics (Statics and Dynamics)”, McGraw Hill Publication, New York.

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Class: S. Y. B. Tech.	Semester: III	L	T	P	Credits
Course Code: RA205	Course: Sensors & Instrumentation	3	-	2	4

Course Description:

This course provides a comprehensive overview of measurement systems and sensor technologies. It begins with the fundamentals of measurement, including error analysis and the static and dynamic characteristics of transducers. Students will explore the principles, construction, and operation of various motion, proximity, and ranging sensors, as well as force, magnetic, and heading sensors. The course delves into optical, pressure, and temperature sensors, examining their practical applications and performance measures. Emphasis is placed on intelligent sensors, covering their general structure, self-calibration, self-testing, and self-communication capabilities, and their application in fields like robotics and automotive engineering. Additionally, the course covers signal conditioning techniques and data acquisition systems for various industrial applications. This course equips students with the knowledge and skills necessary to effectively utilize sensors and instrumentation in modern engineering systems.

Course Outcomes:

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

- CO1. Explain the basic principles of measurement systems, classify different types of measurement errors, and perform error analysis.
- CO2. Compare different types of motion, proximity and ranging sensors.
- CO3. Illustrate the working principles of force measurement devices.
- CO4. Comprehend and implement optical and pressure sensing technologies.
- CO5. Describe the general structure, components and key characteristics of smart sensors.
- CO6. Analyse and apply Data Acquisition Systems in various applications.

Prerequisite: Basic electronics, basics of sensing elements.

Course Content:

Unit No.	Description	Hrs.
1.	Introduction: Basics of Measurement– Classification of errors– Error analysis– Static and dynamic characteristics of transducers– Performance measures of sensors– Classification of sensors, Sensor calibration techniques– Sensor Output Signal Types.	06
2.	Motion, Proximity and Ranging Sensors: Motion Sensors– Potentiometers, Resolver, Encoders– Optical, Magnetic, Inductive, Capacitive, LVDT– RVDT– Synchro– Microsyn, Accelerometer– GPS, Bluetooth, Range Sensors– RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).	06

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3.	Force, Magnetic and Heading Sensors: Strain Gage, Load Cell, Magnetic Sensors–types, principle, requirement and advantages: Magneto resistive– Hall Effect– Current sensor, Heading Sensors– Compass, Gyroscope, Inclinometers.	06
4.	Optical, Pressure and Temperature Sensors: Photo conductive cell, photo voltaic, Photo resistive, LDR– Fiber optic sensors– Pressure Diaphragm, Bellows, Piezoelectric– Tactile sensors, Temperature– IC, Thermistor, RTD, Thermocouple. Acoustic Sensors– flow and level measurement, Radiation Sensors- Smart Sensors- Film sensor, MEMS & Nano Sensors, LASER sensors.	06
5.	Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.	06
6.	Signal Conditioning and DAQ Systems: Amplification– Filtering– Sample and Hold circuits– Data Acquisition: Single channel and multi-channel data acquisition– Data logging-applications- Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring	06

References –

Text Book:

1. Ernest O Doebelin, “Measurement Systems– Applications and Design”, Tata McGraw-Hill, 2009
2. C. Sujatha, Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
3. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013
4. Ruocco, S.R., Robot Sensors and Transducers, Open University Robotics Series, John Wiley & Sons
5. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
6. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.

Reference Books:

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
2. A.D. Helfrick and W.D. cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI – 2001
3. Hermann K.P. Neubert, “Instrument Transducers” 2nd Edition 2012, Oxford University Press.

Practical Content:

Course Content		
Expt. No.	Description	Hrs
1.	Measurement of displacement using Linear Variable Differential Transformer (LVDT)	02
2.	Measurement of speed using proximity inductive sensor, hall effect sensor and photoelectric sensor	02
3.	Measurement of force / load using Strain gauge / Load cell	02
4.	Measurement of temperature using RTD and thermocouples	02
5.	Measurement of vibration characteristics using piezoelectric sensor / accelerometer	02
6.	Calibration of pressure gauge using dead weight pressure gauge tester.	02
7.	Study of data acquisition systems and interfacing sensors with computer	02
8.	Measurement of resistance using Wheatstone Bridge	02
9.	Signal amplification using DC Amplifier / AC Amplifier	02
10.	Object Detection Using Inductive Proximity Sensor (PNP)	02
11.	Signal transmission using Fiber Optic Amplifier	02
12.	Light Intensity Measurement using Photovoltaic Cell	02
13.	Conveyor control using Capacitive Sensor, Inductive Sensor and Photoelectric Sensor	02

Note: Any 10 experiments from the list

Class: S.Y. B. Tech.	Semester- III	L	T	P	Credits
Course Code: RA207	Course Name: Analog and Digital Electronics	3	-	--	3

Course Description:

This course provides an insight into the fundamental principles of analog and digital electronics. It enables students to select components such as diodes, transistors, and amplifiers. Additionally, the course includes combinational and sequential logic circuits, design of analog and digital circuits and the conversion of digital signals to analog and vice versa.

Course Outcomes:

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

- CO1. Explain the working principles of electronic devices.
- CO2. Select components for building analog circuits.
- CO3. Design analog and digital circuits.
- CO4. Convert digital signals to analog and vice versa.

Prerequisite: Basic Electronics

Course Content

Unit No	Description	Hrs
1.	Diodes and its Applications P-N Junction Diode, V-I Characteristic, clipping circuits, half wave rectifier, full wave rectifier, rectifier with filter, design of rectifier with filter.	06
2.	Transistors Transistors- V-I characteristics, BJT configurations, FET V-I characteristics, MOSFET -V-I characteristic.	06
3.	OPAMP Circuit and Its Applications Basic OPAMP, characteristic of OPAMP, inverting amplifier, non-inverting amplifier, design of amplifier, differential amplifier, summing and scaling amplifier, comparator, integrator and differentiator. IC technologies relevant to robotics applications such as low-power op-amps and advanced comparators	06
4.	Fundamentals of Digital System Number systems: Decimal, Binary, Octal, Hexadecimal, Binary coded decimal (BCD), and conversion, Logic gates, Boolean Algebra, K-map, Minimization of logic functions using K-map.	06
5.	Combinational Logic Circuits Combinational logic circuits- analysis and design, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Multiplexer, Demultiplexer, Encoder, Decoder, ADC, and DAC conversion.	06

6.	Sequential Logic Circuits S-R flip-flop, D flip-flop, J-K flip-flop, T flip-flop. Applications of flip-flops: Shift registers, Counters: Ripple/asynchronous counters, Synchronous counters, Counters design using flip flops.	06
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References -

Text Books:

1. Boylestad, Robert & Louis, Nashelsky, "Electronics Devices and Circuit Theory", Pearson
2. Ramakant Gaikwad, "Op-Amps and Linear Integrated Circuits", Pearson
3. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.

Reference Books:

1. Donald Neamen, "Electronics Circuits: Analysis and Design", Tata McGraw Hill Publication.
2. Anand Kumar, "Digital Circuits", PHI 4th Edition,
3. Mitchel E Schultz, "Basic Electronics", Tata McGraw Hill Publication, 10th Edition.

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Class: S.Y. B. Tech.	Semester-III	L	T	P	Credits
Course Code: RA209	Course Name: Materials and Manufacturing Technology	3	-	--	3

Course Description:

This course is significant for students of Robotics and Automation Engineering. This course covers basic material selection insights and various manufacturing techniques for robot manufacturing. The course also useful in view of implementation of automation in manufacturing technology and flexible manufacturing system using advanced manufacturing techniques.

Course Outcomes:

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

- CO1. Explain the characteristics of materials.
- CO2. Select suitable material for robotics and automation application.
- CO3. Select manufacturing method for robotic and automation components.
- CO4. Describe advanced manufacturing methods.

Prerequisite: Engineering Physics, Engineering Chemistry

Course Content		
Unit No	Description	Hrs
1.	Metals and Metal Alloys Basic Material Structures, Material properties, classification of materials, metal alloys, iron-iron carbide diagram, cast iron, stainless steel, Aluminium, magnesium and tungsten alloys.	06
2.	Non-Metallic and Modern Materials Elastomers and Engineering plastics, FRP composite materials, ceramics, microalloyed high strength low alloy steel, High Strength Steel (HSS), Advanced High Strength Steel (AHSS), Ultra High Strength Steel (UHSS), Developments in Aluminium and Magnesium alloys, SMART materials-Shape memory alloys, piezo-electric materials, MEMS, Metallic glass.	06
3.	Casting and machining Fundamental of metal casting, Sand casting, Shell-Mould casting, Mold casting (plaster and ceramic), Investment casting, Vacuum casting, Permanent mould casting, Slush casting, Pressure casting, Die casting, Centrifugal casting, Continuous casting, Squeeze casting, Machining- Turning, milling, drilling, broaching.	06
4.	Metal Forming and Metal Shaping Forming -Metal working, Elastic and plastic deformation, Concept of strain hardening, Hot and cold Working,	06

	Rolling: Principle and operations, Roll pass sequence, Extrusion, Wire and tube drawing processes. Forging: Method of forging, Forging hammers and presses, Principle of forging tool design, Cold working processes. Shaping-Shearing, Drawing, Squeezing, Blanking, Piercing, deep drawing, Coining and embossing, Metal working defects, cold heading, Riveting, Thread rolling bending and forming operation	
5.	Metal Joining Processes Classification of joining processes, Welding terminology and types of joints Arc Welding Processes: Principles and equipment of Single carbon arc welding, FCAW, TIG, MIG, SAW Resistance Welding: Spot, Seam and Projection weld process, Heat balance in resistance welding Gas Welding and Cutting, Soldering, brazing and braze welding metallurgy and Heat Affected Zone, Weld inspection, Defects in various joints and their remedies.	06
6.	Advanced Technologies Additive Manufacturing, classification, advantages, limitations, applications, g, Fundamentals of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM), Basics of CNC programming language (G-code, M-code), Programming techniques and syntax for CNC machining operations, Robotic Inspection.	06

References -

Text Books:

1. P. N. Rao, "Manufacturing Technology Vol. I & II", Tata McGraw Hill Publishers
2. P. C. Sharma, "Production Engineering", Khanna Publishers

Reference Books:

1. R. K. Jain, "Production Technology", Khanna Publishers
2. K. C. Chawala, "Composite Materials", Springer,
3. Brent Strong, "Fundamentals of Composites Manufacturing: Materials, Methods", SME Book series

Class: S. Y. B. Tech.	Semester-III	L	T	P	Credits
Course Code: CEMD2011	Course Name: Building Construction and Planning	3	-	-	3

Course Description:

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

Course Outcomes:

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

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

Prerequisite: Basic knowledge of engineering graphics.

Course Content		
Unit No.	Details of Content	Hrs.
1.	Construction Materials: Properties and applications of various materials viz. cement, stone, aggregate, brick, steel, flooring materials, roofing materials, cladding materials, plumbing materials, mortar, plain cement concrete (PCC), reinforced cement concrete (RCC) and pre-stressed concrete (PSC).	06
2.	Components of Building I: Types of structures: Load Bearing Structure and Framed Structure, sectional details of load bearing and framed structure showing substructure components -PCC bed, footing walls, plinth. Concept of soil bearing capacity, types of foundation and their suitability, types of brick and stone masonry, bonds in brickwork.	06
3.	Components of Building II: Superstructure components of the buildings: column, beam, slab, wall, sill, lintel, chajja, ventilator, roofing, parapet, ramp, lift and escalator, doors, windows. Staircase: technical terms, classification, functional design.	06
4.	Planning of Buildings and Bye-laws: Types of buildings, site selection criteria, concept of planning, principles of planning. Bye-laws: definition, necessity, procedure for obtaining building permit, general building requirements: setback, marginal distance, height and FSI as per unified development control and promotion regulations (UDCPR) for Maharashtra state. Introduction and necessity of building drawings, concept of scale, types of building drawings-layout plan, site plan, measured, submission, working and perspective drawing. Introduction to RERA (Real Estate Act, 2016), Introduction to National Building Code (NBC).	07
5.	Building Services: Concept of plumbing and drainage plan, plumbing systems, types of traps, fittings, septic tank, soak pit, rainwater harvesting, and plumbing layout for buildings, preparation of plumbing and electrification layouts for building.	06

6.	Building Finishes: Plastering and pointing, types and application procedure Paints-characteristics of ideal paints, constituents, classification, suitability, applying procedure and applications, defects. Varnishes- characteristics of good varnish, ingredients, types, suitability, application procedure and applications. Distemper- ingredients, applying procedure and applications. White washing and colour washing.	05
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References –

References Books: -

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

Text Books: -

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

Government Rules & Regulations: -

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

Class: - S.Y. B. Tech.	Semester - III	L	T	P	Credits
Course Code: CSMD2011	Course Name: Introduction to Data Structures	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

- CO1.** Describe the characteristics of various data structures such as stacks, queues, trees, and graphs.
- CO2.** Explain the operations and applications of linear data structures.
- CO3.** Compare linear and non-linear data structures with respect to their structure, operations, and applications.
- CO4.** Determine and justify appropriate data structures for solving real-world problems effectively.

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

Course Content		
Unit No.	Description	Hrs.
	Introduction to Data Structures: Primitive and non-primitive data structures, Operations on data structures, Algorithms, Abstract Data Types (ADT).	06
	Stack: Definition & Concepts, Operations on Stack, Applications of Stack, Polish expressions, Reverse Polish Expression and conversions, Recursion.	06
	Queue: Queue and its sequential representation, Simple Queue, Circular Queue, Double Ended Queue, Priority Queue, Applications of Queue.	06
	Linked List: Definition and structure of singly linked list, doubly linked list and circular linked list. Operations: creation, traversal, insertion, deletion.	06
	Tree: Definitions and concepts, Terminology, Binary trees, Binary Tree Representations, Binary Tree Traversals, Binary Search Tree, Insertion and Deletion in BST, Applications of Tree.	06
	Graph: Definition and concepts, Graph Representation, Graph Terminology, Graph Traversals – Depth First Search and Breadth First Search. Applications of Graph.	06
References - Text Books: 1. "Data Structures using C, A Practical Approach for Beginners" by Amol M. Jagtap & Ajit S. Mali 2. Data structures -- Seymour Lipschutz (MGH) Schaum's Outlines. 3. Introduction to Data Structures in C – Ashok N. Kamthane (Pearson Education). Reference Books: 1. Data structures and Algorithms -- Alfred V. Aho, John E. Hopcroft, J. D. Ullman (Addison- Wesley Series) 2. Data Structure using C -- ISRD Group (TMH) ACE series.		

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Class:- S.Y.B. Tech.	Semester- III	L	T	P	Credits
Course Code: EEMD2011	Course Name: Electrical Power Generation	3	--	--	3

Course Description:

This course provides an understanding of the principles and performance of systems used for the generation of electrical energy. It covers the conversion of primary energy sources such as coal, hydro, natural gas, nuclear, solar, and wind into electrical power through conventional and renewable power plants.

With a multidisciplinary approach, it familiarizes students with modern generation technologies, efficiency considerations, environmental aspects, and the role of electrical energy in the evolving global energy scenario.

Course Learning Outcomes:

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

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

Prerequisite:

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

Course Content

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

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

References -

Text Books:

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

Reference Books:

1. Twidell, J. and Tony W., Renewable Energy Resources, Taylor & Francis.
2. Yasuo Koizumi, Tomio Okawa and Shoji Mori, Fundamentals of Thermal and Nuclear Power Generation, Elsevier, Publisher.

Class : Second Year B. Tech.	Semester : III	L	T	P	Credits
Course Code : ECMD2011	Course Name : Electronics Devices and Applications	3	-	--	3

Course Description:

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

Course Learning Outcomes:

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

- CO1. Describe the fundamental concepts of electronics and working principles of different devices.
- CO2. Analyze different analog and digital electronics circuits.
- CO3. Design digital electronics circuits with truth table and logic diagram.

Prerequisite: Fundamental concepts of Mathematics and Physics.

Course Content		
Unit No.	Description	Hrs
1.	Introduction to Electronic components Resistor, Inductor, Capacitor, Transformer, Diodes: P-N Junction Diode, Zener diode, LED, Photo diode. Applications of diodes: Rectifiers, Clippers and Clampers.	06
2.	Bipolar Junction Transistor & Field Effect Transistor Introduction to transistors, BJT characteristics, Common Emitter configuration of BJT. Application of BJT: Transistor as a switch, Transistor as an amplifier. Introduction & types of FET.	06

	Operational Amplifiers	06
3.	Block Diagram of Op-Amp, Characteristics of Op-Amp, Virtual ground concept, Inverting and Non-inverting amplifier. Linear Applications of Op-Amp: Adder, Subtractor. Non-linear Applications of Op-Amp: Schmitt Trigger, Comparator.	
	Fundamentals of Digital System	06
4.	Number systems: Decimal, Binary, Octal, Hexadecimal, Binary coded decimal (BCD), Number system conversions, Binary Arithmetic, 1's and 2's complements, Logic gates.	
	Combinational Logic Circuits	06
5.	Standard representation for logic functions, K-map, Minimization of logic functions using K-map, Half Adder, Full Adder, Half Subtractor, Full Subtractor, 1-Bit Comparator, Multiplexer, Demultiplexer, Encoder, Decoder.	
	Sequential Logic Circuits:	06
6.	S-R flip-flop, D flip-flop, J-K flip-flop, T flip-flop. Applications of flip-flops: Shift registers, Counters: Ripple/asynchronous counters, Synchronous counters, Counters design using flip flops, Ring counter & Twisted ring/Johnson counter.	

References -

Text Books:

- Boylestad, Robert & Louis, Nashelsky, "Electronics Devices and Circuit Theory", Pearson, 11th Edition, 2015
- Ramakant Gayakwad, Op-Amps and Linear Integrated Circuits, PHI, 4th Edition, 2007
- A. Anand Kumar, "Fundamentals of Digital Circuits", PHI, 4th Edition, 2019

Reference Books:

- Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3rd, Tata McGraw Hill, 2002
- R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 4th Edition, 2017

Class:- S.Y. B. Tech	Semester- III	L	T	P	Credits
Course Code : CIMD2011	Course Name : Data Structures	3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

- CO1.** Explain basic terminologies of data structures.
- CO2.** Write algorithms for operations performed on data structures.
- CO3.** Demonstrate the working of various data structures like stack, queue, linked list, tree, graph, etc.
- CO4.** Compare static and dynamic representations of data structures.
- CO5.** Choose appropriate data structure while developing solution to the problem.

Prerequisite: Basics of C Programming Language

Course Content

Unit No	Description	Hrs
1.	Introduction to Data Structures Introduction to data structures, basic terminologies in data structure, Need and Applications, classification of data structures, Operations on data structures, Abstract Data Types.	06
2.	Array Data Structures	04

	Introduction of Array, Representation of Array, Memory allocation of Array, types of array, operation in array, Applications of Array, Advantages and Disadvantages of Array.	
3.	Stack and Queue Stack: Definition, Representation, Operations and Applications of Stack. Queue: Definition, Representation, Operations and Applications of Linear Queue, Circular queue, Deque, Priority Queue.	07
4.	Linked Lists Definition, Terminologies, Representation, Operations, Singly linked list, Doubly linked list, Circular linked list, Stack using linked list, Queue using linked list.	07
5.	Trees Terminology in data Structure Tree definition, Terminologies and Applications, Binary trees and types. Binary tree traversals, Binary search trees, AVL tree, B tree.	06
6.	Graphs Terminology in data Structure Graph Definition, Terminologies and Applications, Types of graphs, Representation of graph using adjacency matrix and adjacency list, Graph traversal Techniques: Depth first and Breath first search.	06

References -

Text Books:

1. G. S. Baluja, "Data Structure Through C: A Practical Approach", Dhanpat Rai Publications.
2. S. Tanenbaum, Y. Langsam, M. J. Augenstein, "Data Structure using C", (PHI).

Reference Books:

1. Alfred V. Aho, John E. Hopcroft, J. D. Ullman, "Data structures and Algorithms", Addison, Welsely Series.
2. Ashok N. Kamthane, "Introduction to Data Structures in C", Pearson Education.
3. Yashwant P. Kanetkar, "Data Structures through C", BPB Publications.



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Class:- Second Year B. Tech.	Semester- III
Course Code :MEMD2031	Course Name : Design Thinking

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

- CO1. Identify the new product opportunities and sources of new product ideas.
- CO2. Elaborate the product life cycle and product design process.
- CO3. Integrate the customer and end-consumer needs into design process.
- CO4. Assimilate the various product characteristics to design a novel product.
- CO5. Participate effectively in group work sessions and teams to become acquainted with the importance of teamwork and collaboration that is critical to new product success.

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

Course Content

Unit No	Description	Hrs
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1	Discovery- Opportunity Identification for New products Product life cycle, need for new products, strategic planning and new product opportunity, sources of new product ideas, S curves and technology forecasting. Product idea generation, Product Design Process steps.	06
2	Creativity and Innovation Definition, relevance of Creativity and Innovation in new product design, Improving creativity and innovation, hindrances to creative thinking, importance and formation of teams. Improving creativity and innovation, hindrances to creative thinking, importance and formation of teams.	06
3	Identifying Customer Needs Understanding customer needs, Voice of the customer, gathering customer needs, organizing and prioritizing needs, Product mission statement, establishing product function.	06
4	Establishing Product Specification Product Teardown and Experimentation, Benchmarking, Quality Function Deployment (QFD)	06
5	Product Portfolios and Portfolio Architecture Product Architecture-types, establishing architecture, Modular design-basic clustering method, advanced functional methods	06
6	Product Concept Generation, Selection and Testing Concept generation process and methods, Concept selection mechanism and techniques, Concept Testing-Purpose, process and methods.	06

References:

Reference Books:

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



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Class: S. Y. B. Tech	Semester: III	L	T	P	Credits
Course Code: MEMD205	Course Name: I. C. Engines	3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

- CO1. Explain construction and working of SI and CI engines
- CO2. Perform a primary thermodynamic analysis of Otto and diesel cycle engines.
- CO3. Select proper fuel system for IC engine
- CO4. Evaluate engine emissions and pollution norms.
- CO5. Interpret modern engine technologies

Prerequisite:

Nil.

Course Content

Unit No	Description	Hrs
1	Basics of I. C. Engines	6.00

	Introduction, Classification of I. C. Engines, Basic engine components and nomenclature, applications, Difference between two stroke and four stroke engine, difference between SI and CI engines.	
2	Engine Cycles Theoretical cycles (Air standard cycles and Fuel Air cycles), Deviation of actual cycles from theoretical cycles, Various losses in actual cycles, Valve timing diagram for high and low speed engine, Port timing diagram.	6.00
3	Engine Systems Heat rejection and cooling, Air cooling, liquid cooling, Introduction to lubrication systems, Types of lubrication systems, Air intake system, filters & manifolds, Mufflers and resonators, Supercharging, Turbocharging.	6.00
4	Fuel Systems in I. C. Engines Carburetion, A/F ratio, Mixture requirements at different loads and speeds, Simple carburetor, Complete carburetor systems, Introduction to MPFI system, Requirements of injection systems, types of injection system, CRDI systems and its comparison with other systems, Injection pumps, injectors, nozzles, Governors, trouble shooting in fuel systems.	6.00
5	Engine emissions and control methods Emissions from SI and CI engines, need to control emissions, emission Standards, pollution norms like EURO, BHARAT etc. methods to control emissions like catalytic converter.	6.00
6	Recent trends in I C Engines Alternative Fuels Homogeneous Charge Compression, Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine, Four Valve and Overhead cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine.	6.00

References-



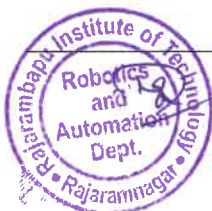
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Text Books:

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

Reference Books:

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



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Class: S.Y. B. Tech	Semester: III	L	T	P	Credits
Course Code: MCMD2011	Course Name: Fundamentals of Mechatronics	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

- CO1. Identify various elements of mechatronics systems.
- CO2. Select appropriate sensor/Actuator/controller/control algorithm for different applications.
- CO3. Develop PLC/ microcontroller-based applications.

Prerequisite: The students should have knowledge of basic electronics.

Course Content		
Unit No.	Description	Hrs.
1.	Introduction: Introduction to Mechatronics, Key elements of Mechatronics, Block diagram of mechatronics system, Control systems and Modes of control, Difference between traditional and concurrent design process.	02
2.	Sensors and transducers: Transducers- classification, Development in Transducer technology Sensors - Introduction, Need of Sensors, Classification, Working and Application of- Potentiometer Sensors, Strain Gauge Elements. Capacitive Elements, Eddy Current, Proximity Sensors, Inductive, Proximity Sensors, Light Sensors, Pressure Sensors, Pneumatic Sensors, Pyro	08

	electrical Sensors, Piezoelectric Sensors, Shaft Encoders. Selection of Sensors.	
3.	Drives and Actuators: Introduction and Classification of Actuators. Need and Scope. Hydraulic Actuation systems – Linear, Single and Double Acting system, Pneumatic Actuation systems- Gear Motors and Vane Motors. Electrical Actuation Systems – solenoid type Devices, Stepper Motors, and Servo Motor. Selection of Actuators.	06
4.	Controllers: PLC- Introduction, definitions, PLC block diagram, Difference between Relay panel and PLC, Selection of PLC, Programming formats, Ladder logic programming. Microcontroller and Microprocessor- Introduction, Comparison of Microcontroller and Microprocessor, Architecture – Pin configuration of 8051 Microcontroller, Assembly programming	08
5.	Signal Conditioning: Operational amplifier circuits, filtering circuits, Analog, and Digital signal conversion.	06
6.	Advanced applications in mechatronics: Mechatronics in automated manufacturing, Artificial intelligence in mechatronics, Fuzzy logic in mechatronics, Case studies of mechatronics systems.	06

References -

Textbooks:

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

Reference Books:

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



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Class:- S. Y. B. Tech.	Semester- III	L	T	P	Credits
Course Code: AIMD2011	Course Name: Object Oriented Programming	3	--	--	3

Course Description:

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

Course Learning Outcomes:

The course should enable the students to:

- CO1. Identify and integrate basic object-oriented programming concepts and apply them in problem-solving
- CO2. Construct and test inheritance concepts for reusing the program.
- CO3. Develop and test a program using loops, decision statements, and functions in Python.
- CO4. Evaluate the given Plot data using appropriate Python visualization libraries.

Prerequisite:

Basic Programming Skills

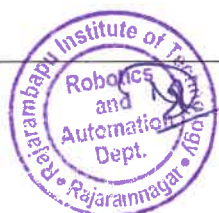
Course Content		
Unit No	Description	Hrs
1	Oops Concepts and Java Programming: OOP concepts: Procedural and object oriented programming paradigm, Classes and objects, data abstraction, encapsulation, constructors, inheritance, polymorphism and overloading, Java programming: History of java, comments data types, variables, constants, scope and life time of variables, operators,	06





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	control flow statements, arrays, console input and output, garbage collection, exploring string class.	
2	Multiple Inheritance, Interfaces and Packages: Inheritance: Inheritance hierarchies, super and subclasses, preventing inheritance, Polymorphism: dynamic binding, method overriding, Interface: Interfaces VS Abstract classes, implement interfaces, accessing implementations through interface references, Packages: Defining, creating and accessing a package, importing packages.	06
3	Introduction to Python fundamentals: Python introduction, Python syntax, Python comments, Python variables, Python data types, Python numbers, Python casting, Python strings, Python Booleans, Python operators.	06
4	Lists, Tuples, Sets, Dictionaries: Access, change, add and remove list elements, loop lists, list comprehension, list methods, access, update, unpack tuples, loop tuples, tuple methods, Access, add, remove set items, set methods, access, add, change, remove dictionary items, nested dictionaries, dictionary methods.	06
5	Python conditional statements: If-else, while, for, lambda, arrays, Python Iterators, Python scope Python classes and objects: Classes, objects, parameterized and non-parameterized init constructor, object methods, self-parameter, association, aggregation and inheritance using python.	06
6	Python for Machine Learning Numpy, Pandas, Matplotlib and Seaborn,	06



References –

Text Books:

1. Herbert Schildt and Dale Skrien, "Java Fundamentals – A comprehensive Introduction", McGraw Hill
2. Herbert Schildt, "Java the complete reference", McGraw Hill, Osborne
3. Charles Dierbach, "Introduction to Computer Science Using Python", Wiley India
4. ReemaThareja, "Python Programming using problem solving approach", Oxford University press

Reference Books:

1. P. RadhaKrishna, "Object Oriented programming through Java", CRC Press.
2. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", Shroff Publishers

Class: S.Y. B. Tech.	Semester - III	L	T	P	Credits
Course Code: RAMD2011	Course Name: Fundamentals of Robotics & Automation	3	-	--	3

Course Outcomes:

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

- CO1. Differentiate various robotic configurations and performance metrics.
- CO2. Compare various end effectors, sensors, and drive systems in robotic applications.
- CO3. Illustrate kinematic and dynamic principles applied to robotic systems.
- CO4. Outline robot programming solutions for diverse applications.
- CO5. Distinguish various types and aspects of automation.
- CO6. Relate the knowledge of Programmable Logic Controllers (PLCs) to industrial automation tasks.

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

Course Content		
Unit No.	Description	Hrs
1.	Introduction to Robots: Definition - Historical background - Various generations of robots – Robot Anatomy - Robot configuration: Polar, Cylindrical, Cartesian coordinate, Joint-arm configuration - Degree of freedom - Work volume and Dead zone - Dynamic performance: Speed of response and Stability - Precision of movement: Spatial Resolution, Accuracy, Repeatability and Compliance.	06
2.	Robot End Effectors, Sensors and Drive Systems: End Effectors: Characteristic features - Types: Mechanical grippers, Magnetic grippers, Vacuum cups, Adhesive gripper, Hooke's and Scoops - Tools as end effectors - Robot / End-effectors interface - Consideration in Gripper selection and Design	06

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

References-

Text Books:

1. Mittal R K & Nagrath, "Robotics and Control", 2nd Edition, McGraw Hill Publication TMH.
2. S. K. Saha, "Introduction to Robotics", 2nd Edition, TMH, 2014.
3. Groover, M.P. Weiss, M. Nagel, R.N. & Odrey, N.G., Ashish Dutta, "Industrial Robotics, Technology, Programming & Applications", Tata McGraw Hill Education Pvt. Ltd. New Delhi.

Reference Books:

1. John J Craig, "Introduction to Robotics", Pearson Edu. 2005.
2. Fu K.S, "Robotics", McGraw Hill, 2004.
3. Niku SB, "Introduction to Robotics – Analysis, Control, Applications", 3rd Edition, John Wiley & Sons Ltd., 2020.

NPTEL Course on Robotics:

1. https://onlinecourses.nptel.ac.in/noc19_me74/preview
2. https://onlinecourses.nptel.ac.in/noc20_de11/preview

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Class: S.Y. B. Tech.	Semester-III	L	T	P	Credits
Course Code: RA211	Course Name: Engineering Mechanics Lab.	-	-	2	1

Course Description:

Engineering Mechanics Laboratory deals with performing experiments, interpreting results, and correlate theoretical and experimental results. This lab focuses on verification of Laws of forces, principle of moment, Lami's theorem, compare coefficient of friction and will be assessed through rubrics designed. It develops thinking, analytical ability and imaginative skill of student. It is an introductory course which supports study of many other advanced courses like analysis and design of various structures and machine components.

Course Outcomes:

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

- CO1. Verify law of polygon of forces, law of triangle of forces and principle of moment.
- CO2. Verify Lami's theorem
- CO3. Compare coefficient of friction of various surfaces in contact.
- CO4. Correlate theoretical and practical results of support reactions and Centroid of plane lamina.
- CO5. Analyze a simple truss.

Prerequisite: Engineering Mathematics, Engineering Physics.

Course Content		
Expt. No.	Description	Hrs
	I-Experiments	
1	Law of polygon of forces	02
2	Principle of moment using Bell Crank Lever	02
3	Support reactions of simple beam	02
4	Support reactions of compound beam	02
5	Lami's Theorem	02
6	Equilibrium of connected bodies	02
7	Compare value of coefficient of Friction for various contact surfaces	02
8	Analysis of simple truss	02
9	Analysis of simple truss by graphical method	02
10	Centroid of plane & composite figures	02
	II- Assignments: One Assignment per unit of course Engineering Mechanics	



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Note- Perform any Ten Experiments.

References –

Text Books:

1. Bhavikatti S. S., Rajashekarappa, “Engineering Mechanics”, New age International publication (India) Pvt. Ltd. New Delhi,
2. Ramamrutham S., “Engineering Mechanics”, Dhanpat Rai Publishing Company Ltd., New Delhi.

Reference Books:

1. S. Junnarkar, “Elements of Applied Mechanics”, Charotar Publishing House (India) Pvt. Ltd., Anand (Gujarat)
2. Ferdinand. Beer and E. Russell Johnson, “Vector Mechanics for Engineers (Statics and Dynamics)”, McGraw Hill Publication, New York.
3. Ferdinand L. Singer, “Engineering Mechanics (Statics and Dynamics)” Publications (India) Pvt. Ltd. Noida.
4. Timoshenko and Young, “Engineering Mechanics (Statics and Dynamics)”, McGraw Hill Publication, New York.



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Class: S.Y. B. Tech.	Semester- III	L	T	P	Credits
Course Code: RA213	Course Name: Analog and Digital Electronics Lab	-	-	2	1

Course Description:

Analog and Digital Electronics Lab course focuses on working principles of Electronics Devices, operational amplifiers, Logic gates and its applications with various feature course also develops the ability to analyze and design various applications of electronics devices.

Course Outcomes:

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

- CO1. Verify characteristics of electronics devices.
- CO2. Analyze electronic circuits as per requirement.
- CO3. Design analog and digital circuits.
- CO4. Use logic gates to design circuits.

Prerequisite: Boolean Algebra, electronic active and passive components

Course Content		
Experiment No	Description	Hrs
1.	Verify Characteristics of P-N Junction Diode	02
2.	Design of half Wave	02
3.	Design of Full Wave Rectifier	02
4.	Analyze various Clippers	02
5.	Analyze various clamper circuit	02
6.	Verify V-I Characteristics of BJT	02
7.	Verify Truth Table of all logic gates	02
8.	Design and Built Multiplexer	02
9.	Design and Built Demultiplexer	02
10.	Design Inverting and Non-Inverting amplifier using OPAM.	02
11.	Design Flipflops using Gates	02
12.	Display Roll Numbers on seven Segment Display	02

Note- Perform any Ten Experiments.



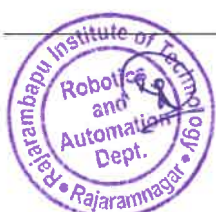
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Text Books:

1. Boylestad, Robert & Louis, Nashelsky, "Electronics Devices and Circuit Theory", Pearson
2. Ramakant Gaikwad, "Op-Amps and Linear Integrated Circuits", Pearson
3. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.

Reference Books:

1. Donald Neamen, "Electronics Circuits: Analysis and Design", Tata McGraw Hill Publication.
2. Anand Kumar, "Digital Circuits", PHI



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Class: - S.Y. B. Tech.	Semester - III	L	T	P	Credits
Course Code: RA215	Course Name: Object Oriented Programming Lab.	-	-	2	1

Course Description:

This course introduces the student to object-oriented programming through concepts of program specification and design, algorithm development, and coding. Students learn how to write programs in an object-oriented high level programming language like C++. The content focuses on fundamentals of algorithms, flowcharts, problem solving, programming concepts, classes and methods, control structures, arrays, and strings. Weekly laboratory experiments provide opportunity for hands-on experience.

Course Outcomes:

After completion of this course students will be able to -

- CO1. Identify elements and features of object-oriented programming.
- CO2. Implement various object-oriented concepts with the help of programs.
- CO3. Apply the object-oriented concepts in real time problem-solving.
- CO4. Use constructors and destructors in the programs.
- CO5. Implement inheritance concept in programming.

Prerequisite: Prerequisite: C Programming

Course Content		
Expt. No.	Description	Hrs
1	Review on C.	02
2	C++ Control Statements - decision making and loop control statements.	02
3	Functions in C++, Function overloading concepts.	02
4	Structure and Union in C++, Concept of data hiding.	02
5	Class and objects.	02
6	Constructor & Destructor.	02
7	Array of objects and Pointers.	02
8	Inline function and friend function.	02
9	Inheritance - Single Inheritance, multilevel Inheritance, multiple Inheritance.	02
10	File handling.	02
11	Applications of C++ to Engineering problems.	02

Note- Perform any Ten Experiments.



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References:

Text Book-

1. E Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill.
2. Robert Lafore, Object oriented programming in Turbo C++, Sams Publishing

Reference Books-

1. Herbert Schildt, The Complete Reference: C++, Tata McGraw-Hill
2. Bjarne Stroustrup, An Overview of The C++ Programming Language
3. D. Ravichandran, Programming with C++, Tata McGraw Hill
4. D. S. Malik, C++ Programming: From Problem Analysis to Program Design, Thomson publication.





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Class: S.Y. B.Tech.	Semester-III	L	T	P	Credits
Course Code: RA2191	Course Name: Robotics Technology Lab	-	-	2	1

Course Description:

This course provides hands-on experience in assembling, controlling, and analyzing robotic systems using DIY kits. It covers robotic grippers, performance and control of hexcopters, and programming of quadruped and humanoid robots for practical tasks. The course emphasizes system integration, real-world applications, and skills required for modern industrial robotics.

Course Outcomes:

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

- CO1. Assemble and control robots using a DIY kit.
- CO2. Analyse working principles of various robotic grippers.
- CO3. Analyze the performance parameters and operation of Hexcopter
- CO4. Operate and program quadruped robot to perform various industrial tasks.

Prerequisite: Basic fabrication/assembly practices, Fundamentals of electronics, Basic Programming Knowledge.

Course Content		
Unit No.	Description	Hrs
1	Perform assembly and demonstrate operation of engineering vehicle robot using DIY kit.	02
2	Perform assembly and demonstrate operation of Quadruped robot using DIY kit.	02
3	Perform assembly and demonstrate operation of Spider robot using DIY kit.	02
4	Program a Humanoid robot for Action Demonstration	02
5	Program a Humanoid robot for standard conversation.	02
6	Program a Humanoid robot Pose, Record and Play (PRP)	02
7	Integration of electromagnetic gripper with the robot for specific operation.	02
8	Integration of twin pneumatic and vacuum gripper with the robot for specific operation.	02
9	Performance of Hexcopter: Flight Stability Testing	02
10	Payload Handling & Lift Calculation of Hexcopter	02
11	Introduction and manual navigation of Quadruped Robot	02





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12	Perform autonomous way point of Quadraped Robot	02
13	Industrial Visit	02

Note- Perform any Ten Experiments.

References –

Reference Books:

1. John J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson
2. R.K. Mittal & I.J. Nagrath, "Robotics and Control", McGraw Hill Education (India) Private Limited.
3. Dan Zhang & Bin Wei, "Collaborative Robots and Advanced Industrial Automation", McGraw Hill Education



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Class: - Second Year B. Tech.	Semester- III	L	T	P	Credits
Course Code: RA221	Course Name: Manufacturing Processes and Practices	-	-	2	1

Course Description:

The Workshop Practice Laboratory course provides practical exposure to fundamental machining and manufacturing processes used in mechanical engineering workshops. The course enables students to perform basic lathe operations such as plain turning, facing, taper turning, threading, and knurling, along with preparation of process sheets. In addition, the course includes practical work involving milling and grinding operations to develop skills in precision machining, surface finishing, and safe handling of workshop equipment.

Course Learning Outcomes:

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

- CO1. Demonstrate effect of variables such as Voltage, current on welding process.
- CO2. Produce given joint by MIG welding process.
- CO3. Produce welding run on S.S. by TIG welding.
- CO4. Produce welding run on Aluminum by TIG welding.
- CO5. Produce given job with proper taper and V threading within dimensional tolerances ± 0.2 mm on diameter and ± 0.5 mm on length. (Job — A).

Prerequisite:

Basic knowledge of engineering workshop practices, engineering drawing, and manufacturing processes. Students should be familiar with basic hand tools, measurement instruments, and fundamental safety practices in a mechanical workshop.

Course Content

Experiment No	Description	Hrs
1.	Lathe Operations Job Involving Tool Grinding, Facing, Step Turning, Taper Turning, Knurling, 'V' Threading Operations, Analyzing Machining response during these operations e.g., Surface roughness and Tool wear.	06
2.	Advance Welding Shop Job on TIG Welding, Job on MIG Welding, Demonstration of Stainless Steel & Aluminum Welding, Job on Plasma Arc Cutting, Job on Submerged Arc Welding, Comparison of strength of various weld joints.	06



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References -

Textbooks:

1. P.N. Rao, Manufacturing Technology (Vol. I & II), McGraw Hill Education.
2. Serope Kalpakjian and Steven Schmid, Manufacturing Engineering and Technology, Pearson Education.
3. S.K. Hajra Choudhury, A.K. Hajra Choudhury, S.K. Nirjhar Roy, Workshop Technology (Vol. I & II), Media Promoters & Publishers Pvt. Ltd.

Reference Books:

1. Mikell P. Groover, Fundamentals of Modern Manufacturing, Wiley India Pvt. Ltd.
2. Hazara Choudhari, Mechanical Workshop Practice-II, Prentice Hall India.
3. K.K. Singh, Manufacturing Technology, S. Chand Publishing.
4. B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai & Co.
5. K. Venugopal, Workshop Technology Manual, New Age International Publishers.



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

Professional Skills Development and Foreign Languages Courses

1. 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. German Language - Level IV (SH2644)
7. Japanese Language - Level III (SH2714)
8. Japanese Language - Level IV (SH2624)

***An Important Notes:**

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

Class:- S.Y. B. Tech .	Semester-III/IV		L	T	P	Credits
Course Code : SH2634	Course Name : Professional Leadership Skills		-	-	2	1

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

Course Outcomes:

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

- CO1. Demonstrate self-management skills through co-curricular activities.
- CO2. Explain the traits of a leadership through real life examples.
- CO3. Exhibit the ability to work effectively in team.
- CO4. Apply decision making techniques in formal meetings.
- CO5. Prepare a presentation as per the audience and context requirements.

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

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

Minimum 12 sessions will be conducted from the following list.

Course Content		
Experiment No	Description	Hrs
1.	SMART Goal Setting, SWOT/C Analysis and Action Plan: Discussion on Dos and Don'ts, Advantages, and Generation of the Document by Students and its Assessment	02
2.	Assertiveness and Positive Thinking: Types of Behaviour, Benefits of Being Assertive and Positive Thinking, Developing Positive Attitude, Case Studies and Presentations	02
3.	Self Management: Need of Self Management, Developing Self Acceptance, Steps of Self Management, Individual Classroom Activity and its Assessment	02
4.	Leadership Styles and Change Management: Introduction to Different Types of Leaderships, Effective Organizational Change Management, Individual Classroom Activity and its Assessment	02

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

References -

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

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)

Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

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Class: - S.Y. B. Tech.	Semester- III/IV	L	T	P	Credits
Course Code : SH2614	Course Name : Interpersonal Skills	-	-	2	1

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

Course Outcomes:

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

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

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

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

Course Content		
Experiment No	Description	Hrs
1.	Importance of Universal Laws of Nature in Human Life.- Overview, scientific, universal, secular, usefulness in every walk and phase of life, overview of Universal Laws of Nature, determining factor in human life, important laws of nature and its influence on life of individual, family, society and world at large. wisdom, living life in tune with laws of nature	02
2.	‘You are the Architect of your Destiny’ - This unit will make you aware that none else but you alone are responsible and accountable for what you achieve in your life , freedom of decisions, choices to make up your future, guiding powers to make the choices in your life, achieving life full of health, wealth , success , peace and happiness for yourself and all	02



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





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References -

1. Spiritual Wisdom in Day-to-day life – Blogs by Mr. Pralhad Wamanrao Pai
2. Towards the goal of beautiful life – Book by Satguru Shri Wamanrao G. Pai
3. Power of your subconscious mind – Dr. Murphy
4. Seven people of highly effective people – Stephen Covey
5. How to win friends and influence people – Dale Carnegie
6. S. Hariharan, et al; *Soft Skills*, MJP Publishers, Chennai (2010)
7. Gopalaswamy Ramesh et al. *The ACE of Soft Skills: Attitude, Communication and Etiquette for Success*, New Delhi: Pearson Education, 2012. Print.
8. Masters, L. Ann et al. *Personal Development for Life and Work*, New Delhi: Cengage Learning, 2012. Print.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)

Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.



Class: - S.Y. B. Tech.	Semester-III/IV	L	T	P	Credits
Course Code : SH2694	Course Name : Innovation Tools and Methods for Entrepreneurs	-	-	2	1

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

Course Outcomes:

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

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

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

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

Course Content		
Experiment No	Description	Hrs
1.	Systematic Innovation: Define the problem in depth with all details, Trend prediction, Modeling the problem to identify tradeoffs and contradictions	02
2.	TRIZ: Theory of Inventive problem solving (TRIZ), HIT Matrix, Scamper, Algorithms of brain storming and innovation, Functional analysis	02
3.	Frugal and Disruptive Innovation: Biomimicry and frugal innovation for <u>prototyping</u> , Disruptive innovation.	02
4.	User Journey Map: Map showing user interaction at every stage of product/service. <u>Step-by step</u> process of UJM creation	02
5.	Competitor analysis: Analysis of competitor and users for similar products, effectiveness of existing solutions and identifications of gaps	02
6.	Product/Software Design Specifications: Detailed specifications for better product design, detailed UI for software for clarity on user interaction, specify USPs of the product in comparison to the competitors	02
7.	Business Canvas: A. Definition of a Business Model B. The 9 Building Blocks: 1. Customer 2. Value Propositions 3. Channels, distribution, 4. Customer relationships 5. Revenue 6. Key Resources 7. Key Activities 8. Key Partnerships 9. Cost Structure	02
8.	Design Thinking (Part I): Customer Insights, Ideation, Visual Thinking.	02
9.	Design Thinking (Part II): A. Prototyping. B. Storytelling. C. Scenarios	02
10.	Institutional arrangement for Entrepreneurship Development: Institutional arrangement for Entrepreneurship Development – DIC, ITCOT, SIDCO, NSIC, SISI, TIIC, SIDBI, Commercial Banks	02
11.	Project Report: a) Economic Aspects b) Technical Aspects c) Financial Aspects d) Production Aspects e) Managerial Aspects	02
12.	Investor Pitch Tool: a) Introduction b) Helpful Tips about preparation, pitchin and content sharing c) Does and Don'ts d) Introduction e) Problem f) Solution/Product/Service	02



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g) Traction	h) Market Opportunities/ Size	
i) Competition	j) Go To Market Strategies	
k) Financials	l) Team	

References -

1. J. Knapp. Design Sprint, Simon & Schuster Publisher.
2. D. Silverstein. The Innovator's Toolkit, Wiley Publishing House.
3. M. A. Orloff. ABC-TRIZ: Introduction to creative design thinking with modern TRIZ modeling, Springer Publication.
4. M. Lavery. Entrepreneurship, OpenStax Publication.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)

Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.



Class: - S.Y. B. Tech.	Semester-III/IV	L	T	P	Credits
Course Code : SH2594	Course Name : Personal Effectiveness and Body Language	-	-	2	1

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

Course Outcomes:

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

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

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

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

Minimum 12 sessions will be conducted from the following list.

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

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

References -

1. S. Hariharan, *Soft Skills*, MJP Publishers, Chennai.
2. Gopalaswamy Ramesh, *The ACE of Soft Skills: Attitude, Communication and Etiquette for Success*, New Delhi: Pearson Education.
3. Jeff Butterfield, *Soft Skills for Everyone*, cengage Learning India Private Limited.
4. UNLESH the power within... Soft Skills – Infosys Training Manual *Module 1 to 5* (Infosys Campus Connect Programme)
5. Masters, L. Ann, *Personal Development for Life and Work*, New Delhi: Cengage Learning.
6. Covey, Stephen R., *Seven Habits of Highly Effective People: Powerful Lessons in Personal Change*
7. Barun K. Mitra, *Personality Development & Soft Skills*, Oxford Publishers, Third impression.

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)

Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

Class: - S.Y. B. Tech.	Semester-III	L	T	P	Credits
Course Code : SH 2734	Course Name : : German Language - Level III	-	-	2	1

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

Course Outcomes:

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

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

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

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

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

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

References -

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

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

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)

Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

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Class: - S.Y. B. Tech.	Semester- III	L	T	P	Credits
Course Code : SH2714	Course Name : Japanese Language - Level III	-	-	2	1

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

Course Outcomes:

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

1. Make use of basic conversations in various situations.
2. Apply Japanese grammatical structures accurately in spoken and written communication.
3. Identify the sentence patterns.
4. Explain insights about the communication required for living in Japan.
5. Interpret Japanese work ethics required in their professional career.

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

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

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

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

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

References -

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

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)

Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

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Class: S.Y. B. Tech.	Semester - IV	L	T	P	Credits
Course Code: RA222	Course Name: Mathematics of Engineering for Robotics & Automation	3	--	--	3

Course Description:

This course intends to build the competency in the students to apply the concepts learned in respective modules to various engineering problems. It contains six units that accomplish the fundamentals of mathematics required for engineers.

Course Outcomes:

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

- CO1. Solve higher order linear differential equations and its applications.
- CO2. Solve Partial Differential Equation to various engineering problems.
- CO3. Apply Laplace and Invers Laplace transforms to standard functions and use it to solve Ordinary Differential Equation.
- CO4. Evaluate Fourier transform and apply them to solve heat conduction problem in Engineering.
- CO5. Apply Z-Transform, Inverse Z-Transform and Solve Difference Equations.

Prerequisite: Differential Equations, Partial Fraction, Integration and Derivatives standard results

Course Content		
Unit No.	Description	Hrs
1.	Linear Differential Equations: Definition, complete solution of Linear Differential Equation with constant coefficients. (All Types to find Particular Integral & General type) Solution of Linear Differential Equation with Variable coefficients. (Cauchy Linear differential equation, Legendre's Linear differential equation)	06
2.	Applications of Linear Differential Equations: Mass spring Mechanical system, Free oscillations system, Damped Free oscillations, Forced Oscillations, Forced Damped Oscillations	06
3.	Partial Differential Equations: Introduction and definition, Solution to linear homogeneous partial differential equation of higher order, Application to the wave equation, one-dimensional heat equation.	06
4.	Laplace Transforms and its Applications: Definition of Laplace transform, Laplace transform of elementary functions, properties of Laplace transform, Definition of inverse Laplace transform, Properties of inverse Laplace transform, convolution theorem, Application to solve Linear differential equation with one dependent variable	06



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5.	Fourier Transform and its Applications: Introduction, Fourier Integral Theorem, Fourier transform, Fourier sine transform, Fourier cosine transform, Properties(Statement only), Convolution theorem, Perceval's Identity, Solution of Heat Conduction problems by Fourier Transform	06
6.	Z-Transform and Difference Equations: Z-transforms - Elementary properties, Inverse Z-transform (using partial fraction and residues), Initial and final value theorems, Convolution theorem, Formation of difference equation, Solution of difference equations using Z – Transform.	06

References -

Text Books

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication.
2. H. K. Das, Higher Engineering Mathematics, S. Chand Publication

Reference Books

1. Erwin Creyszing, Advanced Engineering Mathematics, John Wiley.
2. P.N. Wartikar & J.N. Wartikar, A Textbook of Applied Mathematics, PVG Prakashan.
3. N.P.Bali, A Textbook of Engineering Mathematics, Laxmi Publication.



Class: S.Y. B. Tech.	Semester-IV	L	T	P	Credits
Course Code: RA204	Course Name: Strength of Materials	3	-	-	3

Course Description:

Strength of Materials is offered as the core course at the fourth semester of Robotics and Automation Engineering undergraduate program. This is basic and very important subject for structural design of Robots. It is divided in three parts, i.e. strength, stiffness and torsion. Strength criteria consist of elementary theories of simple stresses and strains and combined bending and shear stresses. A stiffness criterion is related to deflection and buckling of beams and columns. Torsion of circular shaft is included in third part. This course intends to build the competency in the students to apply the strength and stiffness approach to suggest optimum structural design of Robot components.

Course Outcomes:

After completion of this course students will be able to

- CO1. Apply elementary knowledge of stresses and strains
- CO2. Select appropriate beam section for robotic arms
- CO3. Apply stiffness criteria for beam analysis
- CO4. Analyze the twisting of robot links.
- CO5. Compare behavior of columns based on end conditions.

Prerequisite: Engineering Mathematics, Engineering Mechanics

Course Content:		
Unit No	Description	Hrs
1.	Stresses and Strains: Normal and shear stresses and strains, stresses in varying, tapered cross section, stresses in composite materials, Elastic constants,	06
2.	Shear Force and Bending Moment: Concept of SFD & BMD, relation between load, shear force and bending moment, variation of shear force and bending moment under concentrated load, UDL, UVL and moment. SFD, BMD for cantilever, simply supported beam and overhang beams.	06
3.	Stresses in Beams: Bending stresses in beams, Theory of pure bending, section modulus, applications of bending equation, strength of section, Shear stresses in beam, shear flow, shear stress in symmetric and built-up section.	06
4.	Deflection of beam: Slope, deflection and radius of curvature, Double integration method and Moment area method for deflection of cantilever and simply supported beams.	06

5.	Columns and Torsion: Euler's theory of long columns. Types of columns, Effective length of column, Rankine's theory of columns. Theory of pure torsion. Torque transmission through solid and hollow shaft, Power transmitted, shaft strength and torsional rigidity.	06
6.	Compound Stresses: Stresses on inclined planes, Principal stresses and strains, Analytical method for compound stresses. Graphical method for principal stresses-Mohr's circle method.	06

References:

Text Book-

1. H. J. Shah and S. B. Junnarkar, "Mechanics of Structures Vol.-I", Charotar, Gujrat
2. James M. Gere and Stephen P., "Timoshenko, Mechanics of Materials", CBS Publisher

Reference Books-

1. Den Hartong, "Strength of Materials", McGraw Hill, New York
2. Vaidyanathan, R., Perumal, P., Lingewari, S. "Mechanics of Solids and Structures", Scitech Publications Pvt. Ltd., Chennai
3. Dr. B. C. Punmia, "Strength of Materials", Laxmi Publication
4. R. S. Vaishwanar, "Mechanics of Solids", Jain brothers, New Delhi
5. Ramamurthum, "Strength of Materials", Dhanpat Rai and Sons, New Delhi

Class: S.Y. B.Tech.	Semester-IV	L	T	P	Credits
Course Code: RA206	Course Name: Control Systems	3	-	2	4

Course Description:

This course introduces the theory and applications of control systems in robotics and automation. Students will learn fundamental concepts of control theory and apply them to analyze, design, and implement control systems for robotic and automated systems.

Course Outcomes:

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

- CO1. Discuss various control systems.
- CO2. Model the control system mathematically.
- CO3. Analyse control systems using various mathematical tools.
- CO4. Represent the system using state space model.
- CO5. Discuss role of control systems in industrial automation and process control applications.

Prerequisite: Engineering Mathematics

Course Content

Unit No.	Description	Hrs
1.	Introduction to Control Systems Definition and classification of control systems, Open-loop and closed-loop, Linear and Non-Linear, Time Variant and Time invariant Systems with Examples, Feedback control and its significance, Block diagram representation of control systems.	06
2.	Mathematical Modelling of Dynamic Systems Introduction to Laplace transform and its application in control system analysis, Representation of dynamic systems using differential equations, Transfer function, Modelling of mechanical, electrical, and electromechanical systems. Analogy between mechanical & electrical system.	06
3.	Time Response Analysis Types of inputs – impulse, step & ramp. Time-domain specifications: rise time, peak time, settling time, and overshoot, Analysis of first order and second-order systems, Steady-state error and error constants, Stability analysis.	06
4.	Frequency Response Analysis Routh's Stability Criteria, Significance of Root Locus, Construction of Root Loci, General Procedure, Effect of Poles and Zeros on the System Stability. Introduction to Bode plot, gain margin, phase margin.	06

5.	State Space Analysis System Representation, Direct, Parallel, Series and General Programming, Conversion of state space model to Transfer Function. Concept of Controllability and observability.	06
6.	Applications of Control Systems in Robotics and Automation Feedback control in robotic manipulators, Motion control systems for robotic platforms, Industrial automation and process control systems, Emerging trends and challenges in control systems for robotics and automation (Case studies).	06

References –

Text Books:

1. M.Gopal, Control System - Principles and Design, Tata McGraw Hill.
2. R. A. Barapate, Feedback Control Systems, Tech. Max.

Reference Books:

3. N. Nise, Control System Engineering, Wiley.
4. A. Anand Kumar, Control Systems, Prentice Hall.
5. K. Ogata, Modern Control Systems, Prentice Hall.
6. R Anandnatarajan, P. Ramesh Babu, Control System Engineering, SciTech.
7. John J. D Azzo & H.Houpis, Linear Control System Analysis and Design, Tata McGraw-Hill.

Course Content (Lab)		
Experiment No	Description	Hrs
1.	Study of DC position control system and find its transfer function.	02
2.	Compute transfer function of AC Servomotor & draw speed-torque characteristics.	02
3.	Performance of AC Servo Motor with Synchro Transmitter and Control Transformer.	02
4.	Study the Synchro Transmitter-Receiver to find the error.	02
5.	Stepper Motor demonstration	02
6.	Demonstration on Process Simulator Pannel.	02
7.	Analyze the system stability using Root-locus plot and verify the plot in MATLAB environment.	02
8.	Analyze the system stability using Bode-plot and verify the plot in MATLAB environment.	02
9.	Stabilization of AC Voltage Servo.	02
10.	Develop state space model of the LTI system using MATLAB and convert SS2TF and TF2SS.	02



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11.	Test controllability and observability of a given LTI system.	02
12.	Closed loop speed control DC motor using PID controller using MATLAB.	02
13.	Temperature process Control	02
14.	Study of feedback control in robotic manipulators.	02
Note- Perform any Ten Experiments.		



Class: S.Y. B. Tech.	Semester-IV	L	T	P	Credits
Course Code: RA208	Course Name: Robot Kinematics	3	-	-	3

Course Description:

This course provides an opportunity for the second-year students to learn kinematic analysis of robots. The fundamental concepts of mechanisms and methods of mechanism design and selection are introduced. The course covers the concepts of kinematic analysis of robots such as forward kinematics and inverse kinematics. The robot effectors and their design procedure, workspace analysis and trajectory planning are also covered in the course. The course outcomes will ultimately help to perform kinematic analysis of the robots for different robots used in various applications.

Course Outcomes:

After completion of this course students will be able to

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

Prerequisite: Kinematics of Machines, Dynamics of Machines

Course Content:

Unit No	Description	Hrs
1.	Introduction to Kinematics Kinematic links, kinematics pair, types of constrained motion, kinematic chain, mechanisms, inversion of mechanism, position and orientation of rigid body, Linear and angular velocity of links, Degrees of Freedom, Robot Joints, Calculating DOF of planer mechanism and special mechanism, Workspace analysis, work envelope of robots.	06
2.	Representation of Object in 3D Space 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
3.	Forward Kinematics Denavit-Hartenberg notations, link- joint parameter, D-H rules for coordinate assignment, Arm Equation, Forward kinematics of manipulators, Screw transformation	06
4.	Inverse Kinematics	06

	Decoupling technique, Inverse transformation Technique, Inverse kinematic analysis of robot with standard configurations, methods for solution of non-linear simultaneous equations, singularity.	
5.	Jacobian Analysis of Serial Manipulators 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.	06
6.	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

References:

Text Book-

1. D. K. Pratihar, 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.

Class: - S.Y Year B. Tech.	Semester- III	L	T	P	Credits
Course Code: RA224	Course Name: Robot Standards and Ethics	2	---	---	2

Course Description:

This course covers international and national standardization frameworks for robotic systems along with the ethical dimensions of robot deployment. It includes an overview of standardization bodies, industrial and collaborative robot standards (ISO 10218, ISO/TS 15066), service robot standards (ISO 13482), performance testing standards (ISO 9283), roboethics, and compliance and certification procedures for safe and certified robot operation.

Course Learning Outcomes:

This course enables students to

- CO1. Identify and interpret major international and national standards applicable to robotic systems.
- CO2. Apply industrial and collaborative robot standards (ISO 10218, ISO/TS 15066) to robot system design and integration.
- CO3. Evaluate service robot standards and performance criteria for non-industrial applications.
- CO4. Explain the ethical issues and responsibilities involved in robot design, deployment, and human-robot interaction.
- CO5. Describe compliance and certification procedures for robotic systems in accordance with applicable standards.

Prerequisite:

Basic knowledge of robotic systems, Understanding of mechanical and electrical interfaces, Awareness of professional ethics.

Course Content		
Unit No	Description	Hrs
1	Introduction to Standardization Concept and need for standardization in robotics. Types and levels of standards—international, regional, and national. Major standardization bodies: ISO, IEC, ANSI, DIN, and BIS. Standard-setting processes and classification of standards. Benefits and challenges of standardization in the robotics industry. Overview of ISO/TC 299 Robotics technical committee and its working groups.	04
2	Industrial Robot Standards ISO 10218-1: Safety requirements for industrial robots — robot design and construction. ISO 10218-2: Safety requirements for industrial robot systems and integration. ANSI/RIA R15.06 industrial robot safety	04

	standard. Mechanical interface standards for manipulators (ISO 9409). Electrical interface standards for end-effectors and connectors. Coordinate systems and motion nomenclature as per ISO 9283.	
3	Collaborative and Service Robot Standards ISO/TS 15066: Robots and robotic devices — collaborative robots. Power and force limiting, speed and separation monitoring in collaborative operations. ISO 13482: Safety requirements for personal care robots. Categories: mobile servant, physical assistant, and person carrier robots. Performance criteria for service robots. Human-robot interaction considerations in standards for non-industrial environments.	04
4	Robot Performance Standards and Testing ISO 9283: Manipulating industrial robots — performance criteria and related test methods. Performance characteristics: pose accuracy, repeatability, path accuracy, and velocity. Robot testing procedures and test environment requirements. Test equipment and instrumentation. Test reports and documentation requirements. Conformity assessment and certification procedures. Safety considerations during testing and commissioning.	04
5	Roboethics Roboethics and levels of robomortality. Fundamental ethical theories applied to robotics. Top-down and bottom-up approaches in roboethics. Ethics in human-robot symbiosis and coexistence. Robot rights and legal responsibilities. Socialized roboethics and ethical issues of social robots. Privacy, autonomy, and accountability in AI-driven robots. Case studies in robot ethics and emerging dilemmas.	04
6	Compliance, Certification and Emerging Standards CE marking and product compliance procedures for robotic systems. Standards compliance workflow: gap analysis, documentation, testing, and certification. Emerging standards for autonomous and AI-driven robots. IEEE standards for robotics and automation. Standards for medical robots (IEC 60601), agricultural robots, and construction robots. Future directions in robot standardization and the role of industry consortia.	04

References -

Text Books:

1. ISO/TC 299, Robotics Standards Collection, International Organization for Standardization (ISO), 2022.
2. Spyros G. Tzafestas, Roboethics: A Navigating Overview, 1st Edition, Springer, 2016.

Reference Books:

3. Paolo Barattini, Federico Vicentini, Human-Robot Interaction: Safety, Standardization, and Benchmarking, CRC Press, 2019.

Class: S. Y. B. Tech.	Semester-IV		L	T	P	Credits
Course Code: CEMD2021	Course Name: Building Estimation and Valuation		3	--	--	3

Course Description:

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

Course Outcomes:

- After successful completion of the course, student will be able to,
- CO1. Explain the types and basic requirements of the estimate.
 - CO2. Explain measurement sheet, abstract sheet, and detailed specifications of different construction items.
 - CO3. Prepare detailed estimate of load bearing structure and framed structure.
 - CO4. Prepare rate analysis and bar bending schedule of different construction items.
 - CO5. Explain the tenders and contracts.
 - CO6. Describe basic terms of valuation.

Prerequisite:

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

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



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3.	Detailed estimate of building, road and culvert: Detailed estimate of load bearing structures and RCC structures.	06
4.	Rate Analysis and Schedule of Reinforcement: Importance of rate analysis, Factors affecting the cost of materials, labour, Task work, Transports, Overhead charges, market rates of various materials, labours. Rate analysis preparation of PCC, RCC, brick and stone masonry, plastering, pointing, flooring. Preparation of bar bending schedule for isolated footings, pile footings, beams, columns, slabs, staircase, lintel, chajja.	06
5.	Introduction of Tender and Contracts: Tender- Notice, Documents, Procedure and Types, Contract- Types, Conditions, Earnest money, Security deposit, Validity period, Defect liability period, Liquidated and liquidated damage, Arbitration, Escalation of cost, Daily reports maintained on site.	06
6.	Valuation: Definition, Necessity, Cost, Price, Value, Types of values, Depreciation and obsolescence, Sinking fund, Methods of calculating depreciation, Annuity, Year purchase, Land valuation, Methods of land and building valuation, Methods of valuation, Freehold and leasehold property, types of lease, Mortgage, Mortgage deed and Precautions, Problems based on valuation.	06

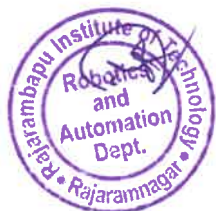
References –

References Books: -

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

I. S. Code:-

1. Updated I. S. 1200
2. Updated S. S. R.



Class: - S. Y. B.Tech	Semester- IV	L	T	P	Credits
Course Code: CSMD204	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,

- CO1.** Describe the fundamental elements of relational database management systems.
- CO2.** Design ER-models to represent simple database application scenarios.
- CO3.** Write SQL query to perform various operations on the database.
- CO4.** Analyze principle of integrity constraints, Hashing and Indexing on databases.
- CO5.** Illustrate the transaction management, concurrency control and crash recovery.

Prerequisite:

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



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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:- S. Y. B. Tech.	Semester- IV	L	T	P	Credits
Course Code : EEMD2021	Course Name : Power System	3	--	--	3

Course Description:

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

Course Learning Outcomes:

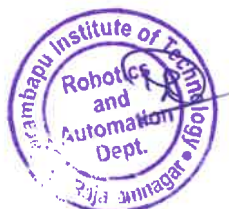
After successful completion of the course, students will be able to,

- CO1. Write the basic working principles of different generating sources.
- CO2. Analyze different types of loads
- CO3. Explain importance of power factor and tariffs in power system.
- CO4. Identify various components in power transmission and distribution system.
- CO5. Select substation equipments as per requirement.

Prerequisite:

Basic Electrical Engineering, Basic Mathematics and Physics.

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





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References -

Text Books:

1. V.K Mehta, Principles of Power Systems, S. Chand
2. Ashfaq Husain, Electrical Power System, CBS Publication

Reference Books:

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



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Class:- S.Y. B. Tech.	Semester- IV	L	T	P	Credits
Course Code : ECMD2021	Course Name: Electronics Communication Systems	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

- CO1. Describe different communication systems.
- CO2. Explain applications of analog and digital modulation techniques.
- CO3. Analyze different modulation and demodulation techniques.
- CO4. Explain the use of satellite communication.

Prerequisite:

Fundamental concepts of engineering and Mathematics

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



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5.	Satellite Communication: Basic concepts of Satellite Communications, Satellite subsystems, Satellite Link design, Orbital Mechanics,	06
6.	Satellite Application: DBS, VSAT, GPS, Case Studies – Mars Mission, Chandrayan.	06

References -

Text Books:

1. K.Sam Shanmugan, Digital & Analog Communication Systems, Wiley India
2. RP Singh, S D Sapre, Communication System-Analog & Digital, Tata Mc-Graw Hill
3. Kennedy, Davis, Electronics Communication Systems, Tata McGraw Hill

Reference Books:

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



Class:- S.Y. B. Tech	Semester-IV	L	T	P	Credits
Course Code : CIMD2021	Course Name : Computer Algorithms	3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

- CO1. Analysing asymptotically the performance of algorithms.
- CO2. Compare and analyse searching and sorting algorithms.
- CO3. Apply different algorithm design techniques to solve problems like job sequencing, knapsack, TSP, finding shortest path etc.
- CO4. Apply backtracking method to solve problems like N-queens, graph coloring, sum of subsets etc.
- CO5. Describe computational complexity theory to classify computational problems according to their inherent difficulty.

Prerequisite:

Basic knowledge of Mathematics

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



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

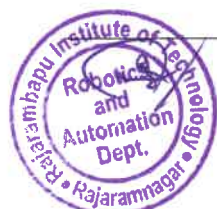
References -

Text Books:

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

Reference Books:

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



Class:- S.Y. B. Tech.	Semester-IV		L	T	P	Credits
Course Code : MEMD2041	Course Name: Behavioural Engineering and Design		3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

- CO1. Explain key concepts and theories related to influencing user behavior in product design.
- CO2. Utilize psychological principles to develop product designs that effectively address user needs and preferences.
- CO3. Create products that demonstrate high levels of user engagement, measured through metrics such as adoption rates, user interaction patterns, user satisfaction and usability.
- CO4. Incorporate aesthetic appeal into product designs, assessed through objective criteria such as visual appeal ratings.
- CO5. Incorporate ergonomic considerations into product designs assessed through objective criteria such as user comfort.

Prerequisite:

Course on Design Thinking

Course Content		
Unit No.	Description	Hrs
1	Behavioral Engineering and Design for Product Innovation: Overview of behavioral engineering and its relevance in product design, Key concepts and theoretical frameworks, Understanding the role of psychology in product development, Ethical considerations in designing products for behavior change	06
2	Human Behavior and Product Design: Psychological principles influencing user behavior, Factors affecting consumer decision-making, User experience (UX) design principles for physical and digital products, Designing for emotional engagement and user satisfaction	06

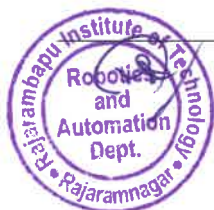


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3	Applying Behavioral Insights in New Product Development: Integrating behavioral research into the product design process, Behavioral design techniques for enhancing product adoption and usage, Case studies of successful products leveraging behavioral engineering principles, Hands-on exercises in applying behavioral insights to product ideation and prototyping	06
4	Persuasive Design for Consumer Products: Principles of persuasive design in consumer product development, Creating compelling product experiences through persuasive techniques, Designing for habit formation and behavior change, Ethical considerations in persuasive product design.	06
5	Aesthetics: Principles of aesthetic design and its impact on user perception, Integrating aesthetics with functional design requirements	06
6	Ergonomics in Product Design: Understanding anthropometrics and ergonomics in product design, Case studies of products exemplifying successful integration of aesthetics and ergonomics	06

References:-

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



Class: S. Y. B. Tech	Semester: IV	L	T	P	Credits
Course Code: MEMD206	Course Name: Automotive Drive Train	3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

- CO1. Explain the layout, components, and working principles of automotive drivetrain systems.
- CO2. Analyze the construction, operation, and performance characteristics of different clutch systems.
- CO3. Analyze various automotive transmission systems including manual, automatic, CVT, AMT, and DCT with respect to their construction, operation, and performance characteristics.
- CO4. Examine the function and performance of propeller shafts, universal joints, and constant velocity joints in power transmission.
- CO5. Evaluate the construction and working of differential and final drive systems for vehicle performance.
- CO6. Assess hybrid and electric vehicle drivetrain technologies with respect to efficiency, energy management, and future mobility trends.

Prerequisite: NIL

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

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

References –

Text Books:

1. Kripal Singh, “Automobile Engineering”, Vol. I Standard publisher’s distributors.
2. Dr. N. K. Giri, “Automobile Engineering”, Khanna Publishers.
3. S Srinivasan, “Automotive Mechanics” Tata McGraw Hill Publication.
4. K K Ramalingam, “Automobile Engineering” SCITECH publication.
5. R. K. Rajput, “Automobile Engineering” Laxmi Publications.
6. G. B. S. Narang, “Automobile Engineering,” Khanna Publishers.

Reference Books:

1. Heinz Heisler, “Advanced Vehicle Technology”, Elsevier
2. Chhikara, “Automobile Engineering”, Vol. II, Published by Satya Prakashan.
3. Motor Vehicle; Newton, K., Steeds, W., Garrett, T. K., published by society of automobile engineering.
4. Automobile Engineering; William H. Crouse, William Harry Crouse Tata McGraw-Hill Education.
5. Motor Vehicle science volume I; P. W. Ketts.
6. Automotive Engines Theory & Servicing by J D Harderman/C D Mitchell Pierson Education

Class: S. Y. B. Tech.	Semester: IV	L	T	P	Credits
Course Code: MCMD2021	Course Name: Industrial Fluid Power	3	-	--	3

Course Description:

Fluid power has the highest power density of all conventional power-transmission technologies. Learn the benefits and limitations of fluid power, how to analyse fluid power components and circuits, and how to design and simulate fluid power circuits using Automation Studio for applications.

In this course, you will be introduced to the fundamental principles and analytical modelling of fluid power components, circuits, and systems. You will learn the benefits and limitations of fluid power compared with other power transmission technologies; the operation, use, and symbols of common hydraulic & pneumatic components; how to formulate and analyse models of hydraulic & pneumatic components and circuits; and how to design and predict the performance of fluid power circuits.

Course Learning Outcomes:

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

- CO1. Describe the structure and function of common hydraulic and pneumatic components such as cylinders, valves, pumps, and motors etc.
- CO2. Model and analyze common hydraulic and pneumatic components such as cylinders, valves, pumps, and motors.
- CO3. Create & simulate basic hydraulic and pneumatic circuit diagrams for different applications.
- CO4. Design, develop & analyze simple hydraulic and pneumatic systems for given task.

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

Course Content		
Unit No.	Description	Hrs.
1.	Fluid Power Systems and Fundamentals 1. Introduction to fluid power, Advantages of fluid power. 2. Application of fluid power system. 3. Types of fluid power systems, Properties of hydraulic fluids, General types of fluids. 4. Fluid power symbols. (ISO/JIC) 5. Use of Automation studio to draw circuits.	06
2.	Hydraulic System and Components (Pumps And Actuators) 1. Pumping theory, Pump classification. 2. Gear pump, Vane Pump, construction and working of pumps, pump performance, piston pump 3. Variable displacement pumps. 4. Linear hydraulic actuators, Types of hydraulic cylinders, Single acting, Double acting cylinders. 5. Special cylinders like tandem, Rod less, Telescopic - Construction and application.	06

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

References -

Textbooks:

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

Reference Books:

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

Class:- S.Y. B. Tech.	Semester- IV	L	T	P	Credits
Course Code : AIMD2021	Course Name : Data Structures & Algorithms	3	--	--	3

Course Description:

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

Course Learning Outcomes:

The course should enable the students to:

- CO1. Compare between linear and nonlinear data structures
- CO2. Describe the characteristics of various data structure such as stacks, queues, trees, graphs and Hash tables.
- CO3. Analyze various searching and sorting algorithms and apply it to solve particular problem.
- CO4. Determine a suitable data structure and algorithm to solve a real-world problem

Prerequisite:

Basic knowledge of C programming, Knowledge of basic mathematical concepts

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



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4.	Searching ,Sorting and Hashing Techniques : Linear search, Binary search, Bubble sort, insertion sort, Merge sort, Quick sort, Selection sort, Radix sort, Heap sort, Complexity of algorithms Hashing: Definition, Hash functions, Overflow, Collision, Open Hashing, closed hashing, Rehashing Techniques.	07
5.	Trees: Basic Technology, Binary Tree, Traversal methods, Binary search tree, AVL Tree, B tree, B+ tree, Heaps - operations and their applications.	06
6.	Graphs: Basic concepts of graph theory, Storage representation, Operations on graphs, Traversing a graph, shortest path algorithm.	05

References -

Text Books:

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

Reference Books:

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



Class: S. Y. B. Tech.	Semester: IV	L	T	P	Credits
Course Code: RAMD2021	Course: Sensors & Actuators	3	-	-	3

Course Description:

The goal of this course is to give senior and graduate students in engineering a hands-on introduction to the fundamental technology and practical applications of sensors. Various sensors, including capacitive, inductive, ultrasonic, accelerometers, image sensors and others will be covered in the course. Instrumentation techniques incorporating computer control, sampling, and data collection and analysis are reviewed in the context of real-world scenarios. There will be weekly laboratory assignments where students will have hands on experience with various sensors.

The course is based around a custom board equipped with various sensors, such as a high speed camera, touch sensor, humidity sensor, temperature sensor, pressure sensor, accelerometer and position sensor. Additional peripheral sensors using the PMOD interface standard can also be attached to the sensor board. The board interfaces with these sensors via an FPGA device and it can also communicate with a PC via USB 3.0 interface. Students will use Verilog language to program the FPGA and communicate with various sensors and PC.

Course Outcomes:

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

- CO1. Explore the functions, characteristics, and operating principles of different sensors, transducers, and actuators.
- CO2. Examine the process and techniques involved in calibrating sensors and transducers for optimal performance.
- CO3. Evaluate and justify the choice of material and manufacturing methods used in the design of specific sensors.
- CO4. Select the most appropriate sensors, transducers, and actuators based on the requirements of a given application.

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

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

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

References –Text Book:

1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
3. S. Gupta, J.P. Gupta, PC interfacing for Data Acquisition & Process Control, 2nd ED, Instrument Society of America, 1994.
4. Gary Johnson, Lab VIEW Graphical Programming II Edition, McGraw Hill 1997.
5. Patranabis. D, Sensors and Transducers, Wheeler publisher, 1994.



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6. Sergej Fatikow and Ulrich Rembold, Microsystem Technology and Microbotics, First edition, Springer –Verlag NEwYork, Inc, 1997.
7. Jacob Fraden, Hand Book of Modern Sensors: Physics, Designs and Application, Fourth edition, Springer, 2010.

Reference Books:

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
2. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI – 2001
3. Hermann K.P. Neubert, “Instrument Transducers” 2nd Edition 2012, Oxford University Press.





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Class: S.Y. B. Tech.	Semester – IV	L	T	P	Credits
Course Code: RA210	Course Name: Machine Drawing Lab.	-	-	2	1

Course Description:

The Machine Drawing Lab. equips B.Tech. Robotics and Automation students with essential drafting and modelling skills for machine design through hands-on exercises, students learn to create accurate engineering drawings of machine components. It consists of drawing, part modelling, assembly and production drawing, surface modelling and simulation of systems using modern engineering tool.

Course Outcomes:

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

1. Develop base features for modeling of machine elements.
2. Develop 3D model for machine components.
3. Assemble components using functional constraints.
4. Prepare production drawings in drafting workbench.
5. Simulate the working of systems.

Prerequisite: Engineering Graphics

Course Content		
Expt. No.	Description	Hrs
1.	To create 2D closed profiles of different shapes using sketching tools.	02
2.	To create solid models using modelling features – I	04
3.	To create solid models using modelling features – II	04
4.	Part modelling of assembly components (Part modelling of any robotic component with 5-10 parts for example Robotic Arms, Robotic Gripper etc.)	04
5.	To Create assembly using different components	02
6.	Production drawing of assembly and details- concept of limits, fits, tolerances	02
7.	Production Drawing- Drawing of assembly with limits, fits and tolerances, surface finish and machining symbols	04
8.	To create surface models	02
9.	Surface modeling operations	04
10.	Design of sheet metal components	04

Note- Perform any Ten Experiments.





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References –

Text Books:

1. K. L. Narayana, P. Kannaiah, Machine Drawing, Scitech Publication.
2. R. K. Dhawan, A Textbook of Machine Drawing, S. Chand Publication.

Reference Books:

3. P. S. Gill, A Textbook of Machine Drawing, S. K. Kataria and Sons.
4. N. D. Bhatt, Machine Drawing, Charotar Publication House.
5. Tutorials: www.solidworks.com





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Class:- S.Y. B. Tech.	Semester - IV	L	T	P	Credits
Course Code: SH2174	Course Name: Environmental Science	1	--	2	2

Course Description:

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

Course Outcomes:

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

- CO1. Apply interdisciplinary knowledge from various fields of science and engineering to address environmental issues.
- CO2. Evaluate environmental impacts of human activities on the environment.
- CO3. Use scientific approach to identify and solve environment related problems.
- CO4. Design suitable solutions to address environmental challenges.
- CO5. Participate in group work to become acquainted with the importance of teamwork collaboration.
- CO6. Develop presentation and report writing skills.

Course Content

Unit No	Description	Hrs
1.	Natural Resources and Ecosystem Renewable and Non-renewable resources, Forest resources, water resources, Mineral resources, food resources, Energy resources, alternative energy resources Land resources, Structure and Functions of ecosystem, biotic and abiotic components, food chains, food web, Biodiversity, types of biodiversity, conservation of biodiversity.	04
2.	Environmental Pollution and Health Environmental Pollution, types of pollution, Air pollution, Water Pollution, Noise Pollution, Soil Pollution, Marine Pollution, Radioactive Pollution, Thermal Pollution (Causes, sources and effects, abatement methods), Pollution Case studies-Bhopal Gas Tragedy, Chernobyl Accident: A nuclear Disaster, Ganga Water Pollution. Solid Waste management (Causes, sources,	04



	effects & control measures), Hazardous waste management, Plastic waste management, E-waste management. Disaster management and risk analysis.	
3.	Climate change and Sustainable development From unsustainable to sustainable development, Urban problems related to energy, Water conservation: Rainwater harvesting, Watershed management, Climate change, Global Warming, Ozone layer depletion, Acid Rain, Consumerism & waste Products, Concepts of Eco-labeled products, Eco-mark, Awareness of Environmental Legislation.	04

Guidelines for Project:

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

References –

Text Books:

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

Reference Books:

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



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Class: S.Y. B.Tech.	Semester-IV	L	T	P	Credits
Course Code: RA226	Course Name: Industrial Robotics Technology	-	-	2	1

Course Description:

This course focuses on the operation, programming, and application of modern robotic systems in industrial and autonomous environments. It covers SCARA robot programming, implementation of SLAM and path planning for autonomous mobile robots, and fundamentals of robot kinematics and control. The course also introduces safe operation and programming of collaborative robots using teach pendants and graphical interfaces, with emphasis on real-world industrial applications.

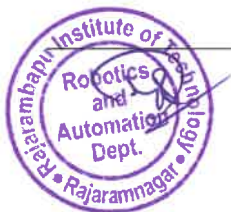
Course Outcomes:

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

- CO1. Operate and program SCARA effectively.
- CO2. Implement SLAM and path planning techniques on an Autonomous Mobile Robot for navigation in a dynamic environment.
- CO3. Demonstrate basic kinematics and control in robot applications.
- CO4. Demonstrate the ability to safely operate and program collaborative robots for basic industrial tasks using teach pendants or graphical programming environments

Prerequisite: Basic electrical and electronics, Fundamentals of Robotics and Automation, Basic programming skills (C++ / Python / MATLAB).

Course Content		
Unit No.	Description	Hrs
1	Write a robot program to draw/trace 2D or 3D paths for the given shape.	02
2	Program robot to perform integration of pick and place with palletizing and warehouse storage station.	02
3	Perform wiring operation and program SCARA robot for part identification and sorting station.	02
4	Perform wiring operation and program SCARA robot for manufacturing processing and inspection station.	02
5	Program robot and PLC to perform integration of part identification and sorting and VMC machine tending station.	02
6	LIDAR Mapping: Calibrate LIDAR for real-time obstacle detection and mapping	02



7	Hector SLAM: Build and test maps for navigation using Hector SLAM	02
8	Point to point path planning and navigation using algorithms in ROS	02
9	Auto Path Planning: Implement and compare algorithms in ROS for multi goals navigation	02
10	Obstacle Avoidance: Test LIDAR-based detection and response to stationary and dynamic obstacles.	02
11	AI based sorting of Objects in 3D Vision using a cobot	02
12	AI based Automatic Programming of the Robot to identify and Pick Objects in 3D Space	02

References –

Text Books:

1. Daniel Roth, Robot Programming, McGraw-Hill Publication.
2. Nicholas Odrey , Mitchell Weiss , Mikell Groover et al. , Industrial Robotics, Second Edition, McGraw-Hill Publication.

Reference Books:

1. Kevin M. Lynch & Frank C. Park, Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press.
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Fourth Edition, Pearson Publication

Class: Second Year B. Tech.	Semester- IV	L	T	P	Credits
Course Code: RA228	Course Name: Python Programming Lab	-	-	2	1

Course Description:

This laboratory course introduces Python programming with a focus on robotics and automation applications. Students will learn fundamental programming concepts and apply them to robotic systems, sensor data processing, automation logic, and basic control algorithms. The course emphasizes hands-on implementation using Python libraries relevant to robotics, such as NumPy, OpenCV, and basic interfacing concepts. By the end of the course, students will be able to develop simple robotic control programs and automation scripts.

Course Learning Outcomes:

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

- CO1. Apply fundamental Python programming concepts to solve engineering problems.
- CO2. Develop Python programs for data acquisition and basic robotic control.
- CO3. Implement automation logic and control algorithms using Python.
- CO4. Design simple applications using Python libraries and simulation tools.

Prerequisite: Fundamentals of Mathematics, Basic Programming Knowledge

Course Content

Experiment No	Description	Hrs
1	Introduction to Python Programming and Development Environment	2
2	Implementation of Operators and Control Structures in Python	2
3	Development of User-Defined Functions and Modular Programming	2
4	Implementation of Object-Oriented Programming Concepts in Python	2
5	File Handling and Data Logging in Python	2
6	NumPy and Pandas for Robotics Applications	2
7	Data Visualization using Matplotlib	2
8	Serial Communication between Python and Microcontroller	2



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9	Image Processing Basics using OpenCV	2
10	Implementation of Basic Control Algorithms (ON/OFF and PID Control)	2
11	Automation Script Development using Python	2
12	Development of a Simple Robotics or Automation Application	2

Note- Perform any Ten Experiments.

References -

Textbooks:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 3rd Edition, Green Tea Press, 2024.
2. Swaroop C H, A Byte of Python, Python 3 Updated Edition, Self-Published / Open Source Community, 2023.
3. Clayton Cafiero, An Introduction to Programming and Computer Science with Python, 2nd Edition, University of Vermont, 2025.
4. Al Sweigart, Automate the Boring Stuff with Python, 3rd Edition, No Starch Press, 2025.

Reference Books:

1. Al Sweigart, *Python Programming Exercises, Gently Explained*, No Starch Press, 2022.
2. Zed A. Shaw, *Learn Python 3 the Hard Way*, 5th Edition, Addison-Wesley Professional, 2023.
3. Python for Data Analysis – Wes McKinney, O'Reilly Media.



Class: S.Y. B.Tech.	Semester - IV	L	T	P	Credits
Course Code: RA220	Course Name: Massive Open Online Course (MOOC)	-	-	-	01

Course Description:

Online courses offered through platforms like NPTEL, SWAYAM, and NASSCOM provide opportunities to deepen students' understanding of advanced robotics and automation concepts and emerging technologies in Robotics and Automation. These courses focus on critical domains such as robot programming, robotic process automation, artificial intelligence and machine learning etc. They blend theoretical foundations with practical applications, enabling students to strengthen problem-solving skills, engage with modern tools, and prepare for industry-oriented challenges, enabling life-long learning. The objective of this course is to emphasize the development of skills and attitudes that enable continuous learning & adaption to new situations.

Course Learning Outcomes:

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

- CO1. Explain advanced principles, methods, and technologies in various areas of robotics and automation
- CO2. Analyze the problems in the domain of robotics and automation using mathematical and engineering fundamentals.
- CO3. Design solutions for robotics and automation systems using modern engineering tools and platforms.
- CO4. Write a robot program to design an automation system for industrial and real life applications.
- CO5. Demonstrate the ability to engage in independent and self-directed learning

Note:

1. Student will get the credits of respective course in following conditions,
 In case of course selected from NPTEL/SWAYAM/NASSCOM platforms, students have to complete the timely assignments, pass the exam and secure the certificate.
2. While selecting online course, following points must be taken care of,
 - a. Selected course must be approved by Departmental Programme Committee (DPC).
 - b. Duration of each online course must be of at least FOUR weeks for NPTEL/SWAYAM & minimum 12 to 20 hours for NASSCOM.



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References-

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





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Class: - S.Y. B. Tech.	Semester- IV	L	T	P	Credits
Course Code : SH 2644	Course Name : German Language - Level IV	-	-	2	1

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

Course Outcomes:

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

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

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

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

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



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

References -

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

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

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)

Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

Class: - S.Y. B. Tech.	Semester- IV	L	T	P	Credits
Course Code : SH2624	Course Name : Japanese Language - Level IV	-	-	2	1

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

Course Outcomes:

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

- 1) To be able to make basic conversations in various situations.
- 2) To recognize the sentence patterns.
- 3) To improve Japanese Language proficiency.
- 4) To give students insights about the communication required for living in Japan.
- 5) To expose students to the Japanese work ethics required in their professional careers.

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

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

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

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

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

References -

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

Evaluation Scheme: ISE – 100 Marks (Minimum Passing: 50%)

Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

