



K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Curriculum Structure and Evaluation Scheme
To be implemented for 2022-26 Batch
Department of Electrical Engineering

Rev: EE Course Structure/RIT/03/2022-26

B.Tech. in Electrical Engineering with Multidisciplinary Minor





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 Department of Electrical Engineering

Rev: EE Course Structure/RIT/03/2022-26

Class: S. Y. B. Tech

Semester: III

Semester: III											
Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)		Practical (%Marks)		
							Max	Min. for passing	Max.	Min. for passing	
EE2014	DC Machines and Transformer	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
EE2034	Electrical Circuit Analysis	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
EE211	Mathematics for Electrical Engineers	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
EE213	Power Transmission and Distribution Systems	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
	Multidisciplinary Minor-I	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
SH2174	Environmental Science	1	-	2	2	ISE	50	40	40	--	----
						ESE	50			40	--
EE2514	DC Machines and Transformer Lab	-	-	2	1	ISE	----	----	----	50	50
						ESE	----			50	50
EE2574	Computer Programming Lab	-	-	2	1	ISE	----	----	----	50	50
						ESE	--			--	50
EE261	Electrical Maintenance and Troubleshooting	-	-	2	1	ISE	----	----	----	100	50
EE2594	Technical Aptitude-I	-	-	2	1	ESE	--	----	----	100	50
	Professional Skills Development and Foreign Languages	-	-	2	1	ISE	-	-	-	100	50
	TOTAL	16	-	12	22						
	TOTAL CONTACT HOURS	28									

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

Total Contact Hours/week : 28

Total Credits : 22

Technical Aptitude Courses : DC Machines and Transformer, Electrical Circuit Analysis, Power Transmission and Distribution Systems, Mathematics for Electrical Engineers





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Rev: EE Course Structure/RIT/03/2022-26

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

Note:

1. A student 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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Rev: EE Course Structure/RIT/03/2022-26

Class: S. Y. B. Tech

Semester: IV

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)			Practical (%Marks)	
							Max	Min. for passing		Max	Min. for passing
EE2064	Analog and Digital Electronics	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
EE2024	AC Machines	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
EE214	Electrical Measurement and Instrumentation	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
EE2084	Signals and Systems	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
	Multidisciplinary Minor-II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			40	---
	Modern Indian Language	2	-	-	2	ISE	100	50		--	--
EE2524	AC Machines Lab	-	-	2	1	ISE	---	----	--	50	50
						ESE	--	--	--	50	50
EE2544	Analog and Digital Electronics Lab	-	-	2	1	ISE	---	----	--	50	50
						ESE	---	----	--	50	50
EE262	Electrical Measurement and Instrumentation Lab	-	-	2	1	ISE	---	----	--	100	50
EE264	Electrical Installation	-	-	2	1	ISE	---	----		100	50
EE2564	Technical Aptitude-II	-	-	2	1	ESE	---	----		100	50
	Professional Skills Development and Foreign Languages	-	-	2	1	ISE	-	-	--	100	50
	TOTAL	17	-	12	23						
	TOTAL CONTACT HOURS	29									

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

Total Contact Hours/week : 29

Total Credits : 23

Technical Aptitude Courses : Analog and Digital Electronics, AC Machines, Electrical Measurement and Instrumentation, Signals and Systems

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.





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

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





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Rev: EE Course Structure/RIT/03/2022-26

Class: T. Y. B. Tech

Semester: V

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)		Practical (%Marks)		
							Max	Min. for Passing	Max	Min. for passing	
EE3034	Power System Analysis	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
EE3054	Control System	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Program Elective -I	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Open Elective-I	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Multidisciplinary Minor-III	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
SH3034	Scholastic Aptitude I	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Multidisciplinary Minor-IV	1	-	2	2	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
EE3514	Control Systems Lab	-	-	2	1	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
EE3534	Microcontroller Lab	-	-	2	1	ISE	---	---	---	50	50
						ESE	---	---	---	50	50
EE359	Advanced Software Lab	-	-	2	1	ISE	---	---	---	100	50
EE3554	Technical Aptitude-III	-	-	2	1	ESE	--	---	---	100	50
EE3574	Summer Internship	-	-	-	2	ISE	---	---	---	100	50
TOTAL		17	-	10	24						
TOTAL CONTACT HOURS		27									

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

Total Contact Hours/week : 27

Total Credits : 24

Technical Aptitude Courses : Power System Analysis, Control System, Microprocessor and Microcontroller



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Program Elective-I

Rev: EE Course Structure/RIT/03/2022-26

Sr. No	Course Code	Domain	Course
1	EE3094	Power and Energy Systems	Energy Storages Technologies
2	EE3114		Restructured Power System
3	EE3134	Drives and Control	Digital Signal Processing
4	EE3154		Electrical Utilization and Traction

Open Elective-I			
Sr. No	Course Code	Course Name	Offered By Department
1	OE345	Soft Computing	Computer Science & Information Technology
2	OE361	Object Oriented Modeling and Design	Computer Science & Information Technology
3	OE343	Data Science	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
4	OE347	New Product Design & Development	Mechanical Engineering
5	OE349	Non-Conventional Energy Sources	Mechanical Engineering
6	OE351	Hydrogen & Fuel Cell Technology	Mechanical Engineering
7	OE3044	Renewable Energy Sources	Automobile Engineering
8	OE353	Factory Automation	Mechatronics Engineering
9	OE355	Cyber Physical Systems	Mechatronics Engineering
10	OE3104	Network Administration	Computer Science & Engineering
11	OE3064	Environmental Impact Assessment	Civil Engineering
12	OE350	Operations Research	Civil Engineering
13	OE341	Energy Auditing and Management	Electrical Engineering
14	OE357	Internet of Things	Electronics & Telecommunication Engineering
15	OE359	Drone Technology	Electronics & Telecommunication Engineering



Class: T. Y. B. Tech

Semester: VI

		Semester: VI									
Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)		Practical (%Marks)		
							Max	Min. for passing	Max	Min. for passing	
EE314	Power System Protection	2	-	-	2	ISE 20 UT1 15 UT2 15 ESE 50	40	40	---	---	
EE3044	Power Electronics	3	-	-	3	ISE 20 UT1 15 UT2 15 ESE 50	40	40	---	---	
EE316	Research Methodology	2	-	-	2	ISE 20 UT1 15 UT2 15 ESE 50	40	40	---	---	
	Program Elective-II	3	-	-	3	ISE 20 UT1 15 UT2 15 ESE 50	40	40	---	---	
	Open Elective-II	3	-	-	3	ISE 20 UT1 15 UT2 15 ESE 50	40	40	---	---	
	Multidisciplinary Minor-V	3	-	-	3	ISE 20 UT1 15 UT2 15 ESE 50	40	40	---	---	
SH3064	Scholastic Aptitude II	2	-	-	2	ISE 20 UT1 15 UT2 15 ESE 50	40	40	---	---	
EE3544	Power Electronics Lab	-	-	2	1	ISE -- ESE --	--	--	50	50	
EE360	Automation and Control Lab	-	-	2	1	ISE -- ESE --	--	--	50	50	
EE362	Power System Protection Lab	-	-	2	1	ISE	---	---	100	50	
EE3564	Technical Aptitude IV	-	-	2	1	ISE	---	---	100	50	
EE3584	Capstone Project Phase I	-	-	2	1	ESE	--	--	100	50	
	TOTAL	18	-	10	23	ISE	--	---	100	50	
	TOTAL CONTACT HOURS	28									

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

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

Total Contact Hours/week : 28

Total Credits : 23

Technical Aptitude Courses: Power System Protection, Power Electronics, Electromagnetic Fields





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Program Elective – II

Sr. No.	Course Code	Discipline	Course
1	EE3064	Power and Energy Systems	Electrical Energy Conservation and Auditing
2	EE318		Battery Management Systems
3	EE3104	Drives and Control	Advanced Control Systems
4	EE3124		Application of Microcontrollers in Electrical Engineering

Open Elective-II			
Sr. No.	Course Code	Course Name	Offered By Department
1	OE3401	Cyber security	Computer Science & Information Technology
2	OE360	Distributed Systems	Computer Science & Information Technology
3	OE342	Data Mining	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
4	OE3024	Reliability Engineering	Automobile Engineering
5	OE344	Supply Chain Analytics	Mechatronics Engineering
6	OE346	Mobile Robotics	Mechatronics Engineering
7	OE348	Information Technology Foundation Program	Computer Science & Engineering
8	OE3381	Disaster Management	Civil Engineering
9	OE3084	Materials Management	Civil Engineering
10	OE358	Plumbing (Water and Sanitation)	Civil Engineering
11	OE3182	Industrial Drives	Electrical Engineering
12	OE352	Image Processing	Electronics & Telecommunication Engineering
13	OE354	Fuzzy logic and Neural Network	Electronics & Telecommunication Engineering
14	OE356	Project Management	Mechanical Engineering
15	OE3284	Supply Chain Management	Mechanical Engineering
16	OE3324	Entrepreneurship Development	Mechanical Engineering





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Department of Electrical Engineering

Class: Final Year B. Tech

Rev: EE Course Structure/RIT/03/2022-26

Semester: VII

Class: Final Year B. Tech

Rev: EE Course Structure/RIT/03/2022-26

Semester: VII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)		Practical (%Marks)		
							Max.	Min. for passing	Max.	Min. for passing	
EE429	Power System Operation and Control	2	-	-	2	ISE	20	40	40	---	---
						MSE	30			---	---
EE413	Electrical Vehicle	3	-	-	3	ESE	50	40	40	---	---
						ISE	20			---	---
EE4034	Electrical Drives	3	-	-	3	MSE	30	40	40	---	---
						ESE	50			---	---
						ISE	20	40	40	---	---
						MSE	30			---	---
	Program Elective-III	3	-	-	3	ESE	50	40	40	---	---
						ISE	20			---	---
						MSE	30	40	40	---	---
						ESE	50			---	---
	Program Elective-IV	3	-	-	3	ISE	20	40	40	---	---
						MSE	30			---	---
						ESE	50	40	40	---	---
						ISE	20			---	---
	Program Elective-IV Lab	-	-	2	1	MSE	30	40	40	---	---
						ESE	50			---	---
EE473	Solar and Wind Energy Systems Lab	-	-	2	1	ISE	---	---	---	100	50
EE475	Electrical Vehicle and Drives Lab	-	-	2	1	ISE	---	---	---	100	50
EE4594	Capstone Project Phase-II	-	-	6	3	ESE	---	---	---	50	50
						ISE	---	---	---	50	50
						ESE	---	---	---	50	50
	TOTAL	14	-	12	20					50	50
	TOTAL CONTACT HOURS	26									

ISE: In Semester Evaluation, MSE: Mid Semester Examination, ESE = End Semester Exam
Total Contact Hours/week : 26
Total Credits : 20





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Program Elective-III

Sr. No.	Course Code	Discipline	Course
1	EE4054	Power and Energy Systems	Power System Dynamics and Control
2	EE4074		HVDC Transmission Systems
3	EE4094	Drives and Control	Nonlinear Control Systems
4	EE429		Power System Operation and Control

Program Elective-IV Theory

Sr. No.	Course Code	Discipline	Course
1	EE4134	Power and Energy Systems	High Voltage Engineering
2	EE4154		Power Quality and Harmonics
3	EE4114	Drives and Control	FACTS Controllers
4	EE4174		Smart Grids

Program Elective-IV Lab

Sr. No.	Course Code	Discipline	Course
1	EE465	Power and Energy Systems	High Voltage Engineering Lab
2	EE467		Power Quality and Harmonics Lab
3	EE469	Drives and Control	FACTS Controllers Lab
4	EE471		Smart Grids Lab





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Department of Electrical Engineering

Rev: EE Course Structure/RIT/03/2022-26

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

Class: Final Year B. Tech

Semester: VIII

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

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

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

Note:

- 1] Weekly Contact hours are not mentioned as student is expected to be in industry regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.
- 2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

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





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Rev: EE Course Structure/RIT/03/2022-26

Model II: Research Internship (RI)

Class: Final Year B. Tech

Semester: VIII

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

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

Total Contact Hours/week :-
Total Credits : 16

Note:

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

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





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Model III: Entrepreneurial Internship (EI)

Class: Final Year B. Tech

Semester: VIII

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

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

Total Contact Hours/week :-

Total Credits : 16

Note:

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

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

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

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

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





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Department of Electrical Engineering

Rev: EE Course Structure/RIT/03/2022-26

Multidisciplinary Minor

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

Multidisciplinary Minor Baskets					
MDM Basket Name	Sr. No.	Course Code	Course Name	Semester	Offered by Department
Automobile Engineering	1	ATMD201	Automobile Systems	III	Automotive Technology
	2	ATMD202	I. C. Engines	IV	
	3	ATMD301	Automotive Safety & Ergonomics	V	
	4	ATMD303	Automobile Engineering Lab.	V	
	5	ATMD302	Electric Vehicles	VI	
Construction Engineering	1	CEMD201	Building Construction and Planning	III	Civil Engineering
	2	CEMD202	Building Estimation and Valuation	IV	
	3	CEMD301	Infrastructure Engineering	V	
	4	CEMD303	Smart Cities and Sustainable Development	V	
	5	CEMD302	Environmental Engineering	VI	
Software Programming	1	CSMD201	Introduction to Data Structures	III	Computer Science & Engineering
	2	CSMD202	Problem solving using JAVA	IV	
	3	CSMD301	Fundamentals of Database Systems	V	
	4	CSMD303	Object-oriented Programming in Python	V	
	5	CSMD302	Artificial Intelligence	VI	
Electrical Power System	1	EEMD201	Electrical Power Generation	III	Electrical Engineering
	2	EEMD202	Power System	IV	
	3	EEMD301	Electrical Machines	V	
	4	EEMD303	Electrical Technology	V	
	5	EEMD302	Smart Grid	VI	
Electronics System Design	1	ECMD201	Electronics Devices and Applications	III	Electronics & Telecommunic
	2	ECMD202	Electronics Communication Systems	IV	





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Rev: EE Course Structure/RIT/03/2022-26

Multidisciplinary Minor Baskets					
MDM Basket Name	Sr. No.	Course Code	Course Name	Semester	Offered by Department
	3	ECMD301	Advanced Communication Systems	V	ation Engineering
	4	ECMD303	Electronic Product Design	V	
	5	ECMD302	Industrial Electronics	VI	
Software Development	1	CIMD201	Data Structures	III	Computer Science & Information Technology
	2	CIMD202	Computer Algorithms	IV	
	3	CIMD301	Introduction to DBMS	V	
	4	CIMD303	OOP using Java	V	
	5	CIMD302	Software Engineering	VI	
Elements of Mechanical Engineering	1	MEMD201	Materials and Applications	III	Mechanical Engineering
	2	MEMD202	Design and Drawing of Machine Components	IV	
	3	MEMD301	Manufacturing and Assembly Process	V	
	4	MEMD303	Refrigeration and Air Conditioning	V	
	5	MEMD302	Power Plant Engineering	VI	
Mechatronics Engineering	1	MCMD201	Fundamentals of Mechatronics	III	Mechatronics Engineering
	2	MCMD202	Industrial Fluid Power	IV	
	3	MCMD301	Sensor and Instrumentation	V	
	4	MCMD303	Industrial Automation	V	
	5	MCMD302	Industrial Robotics	VI	
Artificial Intelligence	1	AIMD201	Object Oriented Programming	III	Computer Science & Engineering (AI-ML)
	2	AIMD202	Data Structures and Algorithms	IV	
	3	AIMD301	Machine Learning	V	
	4	AIMD303	Business Intelligence	V	
	5	AIMD302	Principles of AI	VI	





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Rev: EE Course Structure/RIT/03/2022-26

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





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To be implemented for 2022-26 Batch

Department of Electrical Engineering

Rev: EE Course Structure/RIT/03/2022-26

B.Tech. in Electrical Engineering with Double Minor degree

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

Sr. No.	Course	Code
1	DM-I	EEDM5XXX
2	DM-II	EEDM5XXX
3	DM-III	EEDM6XXX
4	DM-IV	EEDM6XXX
5	DM-V	EEDM7XXX
6	DM-VI	EEDM8XXX

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





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Department of Electrical Engineering

Rev: EE Course Structure/RIT/03/2022-26

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

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

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

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





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





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Rev: EE Course Structure/RIT/03/2022-26

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

Class: Final Year B. Tech

Semester: VII

Class: Final Year B.Tech		Semester: VII									
Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for passing		Max.	Min. for passing
REH401	Intellectual Property Rights	-	-	-	2	ISE	50	40	40	---	---
						ESE	50	40		---	---
REH403	Research project (Synopsis) phase - I	-	-	-	2	ISE	--	--	--	50	50
						ESE	--	--		50	50
REH405	Research Specific core course - I (Online NPTEL course)	-	-	-	3	ISE	50	40	40	--	--
						ESE	50	40		--	--
	TOTAL	-	-	-	7						

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

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

Class: Final Year B. Tech

Semester: VIII

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

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





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B.Tech. in Electrical Engineering with Multidisciplinary Minor



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Rev: EE Course Structure/RIT/04/2023-27

Class: S. Y. B. Tech

Semester: III

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)		Practical (%Marks)		
							Max	Min. for passing	Max.	Min. for passing	
EE2014	DC Machines and Transformer	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
EE2034	Electrical Circuit Analysis	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
EE211	Mathematics for Electrical Engineers	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
EE213	Power Transmission and Distribution Systems	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
	Multidisciplinary Minor-I	3	-	-	3	ISE	20	40	40	----	----
						UT1	15			----	----
						UT2	15			----	----
						ESE	50			40	----
SH2174	Environmental Science	1	-	2	2	ISE	50	40	40	--	---
						ESE	50			40	--
EE2514	DC Machines and Transformer Lab	-	-	2	1	ISE	----	----		50	50
						ESE	----	----		50	50
EE2574	Computer Programming Lab	-	-	2	1	ISE	----	----		50	50
						ESE	--	--		50	50
EE261	Electrical Maintenance and Troubleshooting	-	-	2	1	ISE	----	----		100	50
EE2594	Technical Aptitude-I	-	-	2	1	ESE	--	---		100	50
	Professional Skills Development and Foreign Languages	-	-	2	1	ISE	-	-	-	100	50
	TOTAL	16	-	12	22						
	TOTAL CONTACT HOURS	28									

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

Total Contact Hours/week : 28

Total Credits : 22

Technical Aptitude Courses : DC Machines and Transformer, Electrical Circuit Analysis, Power Transmission and Distribution Systems, Mathematics for Electrical Engineers



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

Note:

1. A student 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)



Class: S. Y. B. Tech

Semester: IV

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)		Practical (%Marks)		
							Max	Min. for passing	Max	Min. for passing	
EE2064	Analog and Digital Electronics	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
EE2024	AC Machines	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
EE214	Electrical Measurement and Instrumentation	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
EE2084	Signals and Systems	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Multidisciplinary Minor-II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Modern Indian Language	2	-	-	2	ISE	100	50		--	--
EE2524	AC Machines Lab	-	-	2	1	ISE	---	----	--	50	50
						ESE	--	--	--	50	50
EE2544	Analog and Digital Electronics Lab	-	-	2	1	ISE	---	----	--	50	50
						ESE	---	----	--	50	50
EE262	Electrical Measurement and Instrumentation Lab	-	-	2	1	ISE	---	----	--	100	50
EE264	Electrical Installation	-	-	2	1	ISE	---	----		100	50
EE2564	Technical Aptitude-II	-	-	2	1	ESE	---	----	--	100	50
	Professional Skills Development and Foreign Languages	-	-	2	1	ISE	-	-	--	100	50
	TOTAL	17	-	12	23						
	TOTAL CONTACT HOURS	29									

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

Total Contact Hours/week : 29

Total Credits : 23

Technical Aptitude Courses : Analog and Digital Electronics, AC Machines, Electrical Measurement and Instrumentation, Signals and Systems

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.

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

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



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Class: T. Y. B. Tech

Semester: V

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)			Practical (%Marks)	
							Max	Min. for Passing		Max	Min. for passing
EE3034	Power System Analysis	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
EE313	Feedback Control System	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
EE315	Microcontroller & Its Applications	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Program Elective -I	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Open Elective-I	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Multidisciplinary Minor-III	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Multidisciplinary Minor-IV	1	-	2	2	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
SH3035	Scholastic Aptitude-I	2*			Audit	ISE	100	50 (P/NP)	--	--	--
EE361	Feedback Control System Lab	-	-	2	1	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
EE363	Microcontroller Lab	-	-	2	1	ISE	---	---	--	50	50
						ESE	---	---	--	50	50
EE359	Advanced Software Lab	-	-	2	1	ISE	---	---	--	100	50
EE365	Industrial Training	-	-	-	1	ISE	---	---	---	100	50
EE367	MOOCS-II**	-	-	-	1	-	-	-	-	-	-
	TOTAL	18+2* = 20*	-	08	24						
	TOTAL CONTACT HOURS	28*									

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, P = Pass, NP = Not Pass

Total Contact Hours/week : 28*

Total Credits : 24

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

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



Program Elective-I

Sr. No	Course Code	Domain	Course
1	EE3094	Power and Energy Systems	Energy Storages Technologies
2	EE3114		Restructured Power System
3	EE3134	Drives and Control	Digital Signal Processing
4	EE3154		Electrical Utilization and Traction

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



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Open Elective I			
Sr. No.	Course Code	Open Elective Subject Name	Offered by the department
13	OE357	Internet of things	Electronics & Telecommunication Engineering
14	OE359	Drone technology	Electronics & Telecommunication Engineering
15	OE361	Object Oriented Modeling and Design	Computer Science and Information Technology
16	OE363	Robotics Engineering & Applications	Robotics & Automation



Class: T. Y. B. Tech

Semester: VI

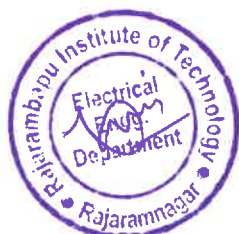
Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)		Practical (%Marks)		
							Max	Min. for passing	Max	Min. for passing	
EE314	Power System Protection	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
EE3044	Power Electronics	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
EE316	Research Methodology	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
EE320	Control System Design	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Program Elective-II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Open Elective-II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
	Multidisciplinary Minor-V	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50			---	---
SH3065	Scholastic Aptitude-II	2*			Audit	ISE	100	50 (P/NP)	--	--	--
EE3544	Power Electronics Lab	-	-	2	1	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
EE360	Automation and Control Lab	-	-	2	1	ISE	---	--	--	100	50
EE364	Power System Protection Lab	-	-	2	1	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
EE3584	Capstone Project Phase I	-	-	2	1	ISE	--	---	---	100	50
	TOTAL	19+2* = 21*	-	08	23						
	TOTAL CONTACT HOURS	29*									

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, P = Pass, NP = Not Pass

Total Contact Hours/week : 29*

Total Credits : 23

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



Program Elective – II

Sr. No.	Course Code	Discipline	Course
1	EE3064	Power and Energy Systems	Electrical Energy Conservation and Auditing
2	EE318		Battery Management Systems
3	EE3104	Drives and Control	Advanced Control Systems
4	EE3124		Application of Microcontrollers in Electrical Engineering

Open Elective II			
Sr. No.	Course Code	Open Elective Subject Name	Offered by the department
1	OE3024	Reliability Engineering	Robotics & Automation
2	OE3084	Materials Management	Civil Engineering
3	OE3182	Industrial Drives	Electrical Engineering
4	OE3284	Supply Chain Management	Mechanical Engineering
5	OE3324	Entrepreneurship Development	Mechanical Engineering
6	OE3401	Cyber Security	Computer Science and Information Technology
7	OE342	Data Mining	CSE(AI&ML)
8	OE344	Supply Chain Analytics	Mechatronics Engineering Dept.
9	OE346	Mobile Robotics	Mechatronics Engineering Dept.
10	OE348	Information Technology Foundation Program	Computer Science and Engineering
11	OE350	Operations Research	Civil Engineering
12	OE352	Image Processing	Electronics & Telecommunication Engineering

Open Elective II			
Sr. No.	Course Code	Open Elective Subject Name	Offered by the department
13	OE354	Fuzzy logic and Neural Network	Electronics & Telecommunication Engineering
14	OE356	Project Management	Mechanical Engineering
15	OE358	Plumbing (Water and Sanitation)	Civil Engineering
16	OE362	Flexible Manufacturing System	Robotics & Automation
17	OE364	AI for Manufacturing	Computer Science and Information Technology
18	OE366	AI for Cybersecurity	Computer Science and Engineering
19	OE368	AI for Agriculture	CSE(AI&ML)
20	OE370	AI for Sustainability	Electronics & Telecommunication Engineering
21	OE3242	Marketing for Engineers	MBA



Class: Final Year B. Tech

Semester: VII

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (%Marks)		Practical (%Marks)	
							Max.	Min. for passing	Max.	Min. for passing
EE429	Power System Operation and Control	2	-	-	2	ISE	20	40	---	---
						MSE	30		---	---
						ESE	50		---	---
EE413	Electrical Vehicle	3	-	-	3	ISE	20	40	---	---
						MSE	30		---	---
						ESE	50		---	---
EE4034	Electrical Drives	3	-	-	3	ISE	20	40	---	---
						MSE	30		---	---
						ESE	50		---	---
	Program Elective-III	3	-	-	3	ISE	20	40	---	---
						MSE	30		---	---
						ESE	50		---	---
	Program Elective-IV	3	-	-	3	ISE	20	40	---	---
						MSE	30		---	---
						ESE	50		---	---
	Program Elective-IV Lab	-	-	2	1	ISE	--	---	100	50
EE473	Solar and Wind Energy Systems Lab	-	-	2	1	ISE	--	---	100	50
EE475	Electrical Vehicle and Drives Lab	-	-	2	1	ISE	--	---	50	50
						ESE	--	---	50	50
EE4594	Capstone Project Phase-II	-	-	6	3	ISE	--	---	50	50
						ESE	--	---	50	50
	TOTAL	14	-	12	20					
	TOTAL CONTACT HOURS	26								

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

Total Contact Hours/week : 26

Total Credits : 20



Program Elective-III

Sr. No.	Course Code	Discipline	Course
1	EE4054	Power and Energy Systems	Power System Dynamics and Control
2	EE4074		HVDC Transmission Systems
3	EE4094	Drives and Control	Nonlinear Control Systems
4	EE411		Solar and Wind Energy Systems

Program Elective-IV Theory

Sr. No.	Course Code	Discipline	Course
1	EE4134	Power and Energy Systems	High Voltage Engineering
2	EE4154		Power Quality and Harmonics
3	EE4114	Drives and Control	FACTS Controllers
4	EE4174		Smart Grids

Program Elective-IV Lab

Sr. No.	Course Code	Discipline	Course
1	EE465	Power and Energy Systems	High Voltage Engineering Lab
2	EE467		Power Quality and Harmonics Lab
3	EE469	Drives and Control	FACTS Controllers Lab
4	EE471		Smart Grids Lab



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

Class: Final Year B. Tech

Semester: VIII

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

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

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

Note:

- 1] Weekly Contact hours are not mentioned as student is expected to be in industry regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.
- 2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

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



Model II: Research Internship (RI)

Class: Final Year B. Tech

Semester: VIII

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

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

Total Contact Hours/week : -
Total Credits : 16

Note:

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

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



Model III: Entrepreneurial Internship (EI)

Class: Final Year B. Tech

Semester: VIII

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

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

Total Contact Hours/week : -

Total Credits : 16

Note:

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

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

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

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

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



Multidisciplinary Minor

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

Multidisciplinary Minor Baskets					
MDM Basket Name	Sr. No.	Course Code	Course Name	Semester	Offered by Department
Construction Engineering	1	CEMD201	Building Construction and Planning	III	Civil Engineering
	2	CEMD202	Building Estimation and Valuation	IV	
	3	CEMD301	Infrastructure Engineering	V	
	4	CEMD303	Smart Cities and Sustainable Development	V	
	5	CEMD302	Environmental Engineering	VI	
Software Programming	1	CSMD201	Introduction to Data Structures	III	Computer Science & Engineering
	2	CSMD202	Problem solving using JAVA	IV	
	3	CSMD301	Fundamentals of Database Systems	V	
	4	CSMD303	Object-oriented Programming in Python	V	
	5	CSMD302	Artificial Intelligence	VI	
Electrical Power System	1	EEMD201	Electrical Power Generation	III	Electrical Engineering
	2	EEMD202	Power System	IV	
	3	EEMD301	Electrical Machines	V	
	4	EEMD303	Electrical Technology	V	
	5	EEMD302	Smart Grid	VI	
Electronics System Design	1	ECMD201	Electronics Devices and Applications	III	Electronics & Telecommunication Engineering
	2	ECMD202	Electronics Communication Systems	IV	
	3	ECMD301	Advanced Communication Systems	V	
	4	ECMD303	Electronic Product Design	V	
	5	ECMD302	Industrial Electronics	VI	
Software Development	1	CIMD201	Data Structures	III	Computer Science & Engineering
	2	CIMD202	Computer Algorithms	IV	

Multidisciplinary Minor Baskets					
MDM Basket Name	Sr. No.	Course Code	Course Name	Semester	Offered by Department
	3	CIMD301	Introduction to DBMS	V	Information Technology
	4	CIMD303	OOP using Java	V	
	5	CIMD302	Software Engineering	VI	
Product Design and Development	1	MEMD203	Design Thinking	III	Mechanical Engineering
	2	MEMD204	Behavioral Engineering and Design	IV	
	3	MEMD305	Product Design Tools and Techniques	V	
	4	MEMD307	Design and Prototyping	V	
	5	MEMD304	Marketing and Business Fundamentals for New Products	VI	
Mechatronics Engineering	1	MCMD201	Fundamentals of Mechatronics	III	Mechatronics Engineering
	2	MCMD202	Industrial Fluid Power	IV	
	3	MCMD301	Sensor and Instrumentation	V	
	4	MCMD303	Industrial Automation	V	
	5	MCMD302	Industrial Robotics	VI	
Artificial Intelligence	1	AIMD201	Object Oriented Programming	III	Computer Science & Engineering (AI-ML)
	2	AIMD202	Data Structures and Algorithms	IV	
	3	AIMD301	Machine Learning	V	
	4	AIMD303	Business Intelligence	V	
	5	AIMD302	Principles of AI	VI	
Robotics & Automation	1	RAMD201	Fundamentals of Robotics & Automation	III	Robotics & Automation
	2	RAMD202	Sensors and Actuators	IV	
	3	RAMD301	Kinematics & Dynamics for Robots	V	
	4	RAMD303	Robot Programming	V	
	5	RAMD302	Industrial Automation & Control	VI	



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



B.Tech. in Electrical Engineering with Double Minor degree

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

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

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



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



B.Tech. in Electrical Engineering with Honor and Multidisciplinary

Minor degree

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

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

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

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



Honors with Research and Multidisciplinary Minor

The student will work on Research Project or Dissertation for 18 Credits in the Fourth Year in respective discipline. The distribution of 18 Credits for Research project in Sem-VII and Sem-VIII is given below. To get B.Tech. in Electrical Engineering-Honors with Research and Multidisciplinary Minor degree Student need to earn total 188 Credits which consist 170 credits of regular Multidisciplinary Minor courses and 18 credits of Research courses.

Class: Final Year B. Tech

Semester: VII

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

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

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

Class: Final Year B. Tech

Semester: VIII

Class: Final Year B.Tech							Semester: VIII				
Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for passing		Max.	Min. for passing
REH402	Research project phase - II	-	-	-	11	ISE	--	--	--	50	50
						ESE	--	--		50	
	TOTAL	-	-	-	11						

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



Class:- T.Y. B. Tech.	Semester-V
Course Code : EE3034	Course Name : Power System Analysis

L	T	P	Credits
3	--	--	3

Course Description:

The electric power system is facing increasing stress due to interconnected system and smart grid. This course deals with basic of power system components and their representation in per unit value. Symmetrical component methods to solve symmetrical and unsymmetrical faults in power system, power system stability issues and equal area method for stability study and HVDC transmission system along with different FACTS devices used in power system for stability and performance improvement.

Course Learning Outcomes:

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

1. Apply per unit system for power system components.
2. Analyze symmetrical faults in power systems.
3. Apply symmetrical component method for unsymmetrical faults in power system
4. Examine power system transient stability.
5. Outline FACTs and HVDC devices for electrical power systems.

Prerequisite: Power System Economics, Electrical Machines, Mathematics- Differential Equation and Matrix Calculation, Basic Electrical Engineering

Course Content		
Unit No	Description	Hrs.
1	Power System Components: Introduction, single phase solution of balanced three phase networks, single line diagram and the impedance or reactance diagram, per-unit (PU) system for power system components, complex power, representation of loads.	06
2	Symmetrical Components: Symmetrical component transformation, phase shift in star-delta transformers, sequence impedance of transmission lines, sequence impedance and sequence network of power system- sequence impedance and network of synchronous machine, sequence impedance of transmission lines, sequence impedance and networks of transformers	06



3	Symmetrical Fault Analysis: Short circuit transients on transmission line, short circuit currents and reactance of a Synchronous Machine, Internal voltages of loaded Synchronous machine under transient Conditions.	06
4	Unsymmetrical Fault Analysis: Analysis of Single Line to Ground (LG) fault, Line-To-Line (LL) fault, Double-Line-To- Ground (LLG) fault, One conductor open fault, and two Conductors open fault.	06
5	Power System Stability: Introduction, dynamics of a synchronous machine, power angle equation, power angle curve, simple systems, steady state stability, transient stability, equal area criteria, numerical solution of swing equation, factors affecting transient stability	06
6	HVDC and FACTS Transmission Systems: DC Versus AC, HVDC technology, Configuration of HVDC Converter Stations, different HVDC projects, FACTS Technology , Basic Types of FACTS Controllers	06

References -

Text Books:

- Grainger John J and W D Stevenson, Power System Analysis, Tata McGraw Hill
- I. J. Nagrath, D. P. Kothari, Modern Power System Analysis, Tata McGraw Hill
- Hingorani, Narain G, Understanding FACTS : concepts and technology of flexible AC transmission systems, Cataloging-in-Publication

Reference Books:

- J. D. Glover and M. Sharma, Power System Analysis and Design, Brooks/ Cole Publishing.
- C. L. Wadhwa, Power System Analysis, New Age International
- T. K. Nagsarkar and M. S. Sukhija, Power System Analysis, Oxford university Press

Class:- T.Y. B. Tech.	Semester-V	L	T	P	Credits
Course Code : EE313	Course Name: Feedback Control System	3	--	--	3

Course Description:

The course Control Systems, is the study of the analysis and regulation of the output behaviors of dynamical systems subject to input signals. Many engineering disciplines viz. electrical, mechanical, chemical, manufacturing, aerospace and biomedical uses tools and concepts of control engineering. This course focus on the fundamental theories and design techniques for linear time-invariant systems' feedback controllers. The course provides techniques to represent the physical systems into mathematical model and then analyze using time-domain & frequency domain. It also introduces the modern control theory technique.

Course Learning Outcomes:

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

1. Represent the physical system into a mathematical model.
2. Calculate the time-domain specifications for a given second order system.
3. Analyse the different systems using Time domain and Frequency domain tools and techniques.
4. Compare different controllers and compensators used in control systems.
5. Apply the knowledge of State Space techniques for analysing and understanding the MIMO systems.

Prerequisite: Engineering mathematics – Differential equation, Laplace transform, Z-transform; Signals and Systems; Electrical Circuit Analysis

Course Content		
Unit No	Description	Hrs
1	Introduction to Control System: Introduction to control system. Importance of Control Systems. Block diagram and components of control system. Industrial Control examples. Introduction and Significance of Sensors and Actuators, Open loop control and closed loop control systems.	06
2	Control System Representation: Transfer function and Pole-Zero concepts. Mathematical representation of simple mechanical, electrical, thermal, hydraulic system. Block diagram representation and reduction. Representation with Signal flow graph and Mason's Gain formula.	06

3	Time Domain Analysis: Time response of first order, second order systems. Analysis of steady state error, Type of system and steady state error, Time response specifications. Effect of parameter variation on open loop and closed loop system response, sensitivity. Effect of feedback on system response, stability and disturbance.	06
4	Stability: Concept of stability, Effect of pole zero location on stability, Routh- Hurwitz criterion. Root Locus method for analysis of gain margin, phase margin and stability.	06
5	Control System Analysis in Frequency Domain: Concept of frequency domain behaviour, frequency domain performance specifications. Correlation between time domain and frequency domain specification. Bode Plot for analysing system in frequency domain. Polar Plot and Nyquist Analysis.	06
6	State Space Approach: Representation of system in state space, Converting transfer function model into state space model. Canonical representation, Eigen values, Solution of state equations, State Transition Matrix and its properties, Concept of State feedback control, controllability, Observability.	06

References -

Text Books:

- K. Ogata, Modern Control Engineering Prentice Hall of India
- Norman S. Nise Control system engineering, John Wiley and sons

Reference Books:

- I.J. Nagarath and M.Gopal, Control Systems Engineering, New Age Int. (P) Ltd.
- B.C.Kuo, Automatic Control Systems Tata Mcgrawhill Education
- M. Gopal, Control Systems: Principles and Design, McGraw Hill Education



Class:- T. Y. B. Tech.	Semester- V
Course Code : EE315	Course Name : Microcontrollers & Its Applications

L	T	P	Credits
3	-	-	3

Course Description:

This course introduces the fundamentals of microcontrollers with a focus on the 8051 family. It covers the architecture, memory organization, and programming in both assembly and C languages. Students will learn about I/O port programming, timers, interrupts, and serial communication techniques. Along with that there is an 8051 interfacing with peripheral devices such as LEDs, LCDs, keypads, ADC/DAC, motors, and relays. The course also provides an overview of advanced microcontrollers such as PIC and ARM, along with their applications in electrical systems. Students will gain the skills required to design and implement embedded systems in real-world electrical engineering applications.

Course Learning Outcomes:

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

1. Describe the architecture, memory organization, and functional blocks of the 8051 microcontroller.
2. Develop assembly and C language programs using the 8051 instruction set, addressing modes.
3. Implement timers, interrupts and serial communication protocols of 8051 microcontroller.
4. Design microcontroller-based systems for electrical applications using various input output peripherals.

Prerequisite: Digital Electronics, C programming, and fundamentals of microprocessors.

Course Content		
Unit No	Description	Hrs
1	Introduction to Microcontrollers: Brief History, Classification of MCS-51 family, Comparison of microprocessor and microcontroller, Applications of microcontrollers, 8051 microcontroller architecture, pin configuration, I/O ports and internal memory organization	06
2	8051 Programming: Instruction set, Addressing modes, Assembly and C language programming, Stack, Subroutines, Program structure, counters and delays.	06

3	I/O Port Programming and Timers: I/O port structure and programming, Bit manipulation techniques, Timers and counters: Modes, programming, and applications, Generating square wave, time delay	06
4	Interrupts and Serial Communication: Interrupt structure and priorities, Programming external and timer interrupts, Serial communication: Basics of UART, Serial data transmission and reception using 8051	06
5	Interfacing with Peripherals: Interfacing LEDs, switches, 7-segment displays, Interfacing LCD (16x2), Keypad, ADC and DAC interfacing, Stepper motor and DC motor control, Relay and opto-isolator interfacing	06
6	Advanced Microcontrollers and Applications: Introduction to ARM, PIC microcontroller, Applications in electrical systems: Power electronics, motor control, protection systems, Case studies: Smart meter, solar charge controller, automatic power factor correction	06

References -

Text Books:

- Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", Pearson Education
- Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey, "PIC Microcontroller and Embedded Systems", Pearson Education

Reference Books:

- Ajay V. Deshmukh, "Microcontrollers: Theory and Applications", Tata McGraw-Hill

Class:- T.Y. B. Tech.	Semester- V
Course Code: EE3094	Course Name: Energy Storage Technologies

L	T	P	Credits
2	--	--	2

Course Description:

This course covers energy storage techniques involving electrochemical, mechanical, and emerging options. Also, the course describes the advances in storage technology and its application in power systems.

Course Learning Outcomes:

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

1. Explain the energy storage as a structural unit of a power system.
2. Compare various energy storage technologies for power systems.
3. Apply hydrogen energy storage for power system applications.
4. Analyze the economics and reliability of energy storage systems.

Prerequisite: Basic electrical engineering, power systems.

Course Content		
Unit No	Description	Hrs
1	Introduction of Energy Storage: Energy storage as a structural unit of a power system, definition of energy, power, requirement for energy storage, electricity storage services, and benefits, technical definition: capacity, depth of discharge and state of charge, "Round-Trip" efficiency under normal, ideal, and real condition, Mathematical model of storage, storage applications, and econometric model of storage.	04
2	Energy Storage Technologies: Flywheel energy storage (FES), pumped-hydroelectric storage (PHS), compressed-air energy storage (CAES), and supercapacitor energy storage system (SCESS). Comparison and application state-of-art including principle, function, and deployments.	04

3	Thermal energy storage: Thermal energy storage (TES) methods - Sensible TES, Passive and active systems. Importance of thermal stratification, Strategies to enhance thermal stratification - Latent TES Selection of phase change materials depending on the application. Types of storage systems by change of phase, Cold TES, and Seasonal TES Characteristics of heat storage materials.	04
4	Battery energy storage: Introduction, different types of battery energy storage, conventional batteries and flow batteries, basic concepts: lead-acid batteries, nickel-cadmium batteries, sodium-sulfur batteries, lithium-based batteries, flow battery energy storage system, and modeling of battery.	04
5	Hydrogen-based energy storage system: Introduction, structure of a storage system based on hydrogen, electrolysis of water, storage of hydrogen, conversion, efficiency considerations. Application: large stationary power plants, small stationary power units, fuel cells for transport, and hydrogen energy storage transportation applications.	04
6	Economic and reliability of electric energy storage system: Electric energy storage economics, cost analysis, investment, and operation cost analysis of electric energy storage, reliability in power energy system, grid-reliability calculation, storage-system reliability, Techno-economic analysis of energy storage systems using reversible fuel cells and rechargeable batteries.	04

References -

Text Books:

- A. Ter-Gazarian, Energy Storage for Power System, Peter Peregrinus Ltd. London.
- Alfred Rufer, Energy Storage System and Component, CRC Press.
- Francisco Diaz-Gonzalez, Andreas Sumper, Energy Storage in Power System, Wiley.

Reference Books:

- Luisa F. Cabeza, Advances in Thermal Energy Storage Systems: Methods and Applications, Woodhead Publishing.
- Christopher D. Rahn and Chao-Yang Wang, Battery system engineering, Wiley.
- Frank S Barnes, John G Levine, L, Large Energy Storage System handbbok, CRC Press.

Class:- T.Y. B. Tech.	Semester- V	L	T	P	Credits
Course Code : EE3114	Course Name : Restructured Power System	2	--	--	2

Course Description:

This course focuses on fundamentals and includes the study of deregulation, open access, pricing issues, competitive environment, and reliability of the system. It describes role of independent system operator (ISO) in different market structure, generation scheduling, bidding strategies, market clearing, congestion management, bidding strategies and ancillary service management in deregulated power system. The course intends to build the competency in the students to develop awareness of new tariff structure and current scenario of electricity markets.

Course Learning Outcomes:

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

1. Identify new dimensions associated with the power system and its economics.
2. Compare the various operating mechanisms of conventional and restructured power system.
3. Interpret various aspects of power markets and market architecture.
4. Propose ancillary services and bidding strategies in power sectors

Prerequisite: Power system basics, Electricity act 2003, Regulation in power sector.

Course Content		
Unit No	Description	Hrs
1	Reforms in Indian power sector: Introduction to various institutions in Indian Power sector: Ministry of Power, state and central governments, Load dispatch centers, Regulatory commissions, Power Exchanges and their roles; The availability based tariff (ABT), The Electricity Act 2003, Power Market, Power Trading	04
2	Restructuring of Power Industry: Reasons for restructuring of power industry; restructuring process, Entities involved, deregulation vs restructuring, Role of the Independent System Operator; Market participation issues; Unit Commitment in Deregulated Environment; Reasons and objectives of deregulation of various power systems across the world.	04



3	Fundamentals of Economics: Consumer behavior, Supplier behavior, Total utility and marginal utility Law of diminishing marginal utility, Elasticity of demand and supply curve, Market equilibrium, Global welfare, and Deadweight loss.	04
4	Transmission Congestion Management and Pricing: Transfer capability, Available transfer capability, Total transfer capability. Effects of congestion, Importance of congestion management, Classification of congestion management methods, Transmission pricing methods, Nodal pricing, Locational Marginal Prices (LMPs)	04
5	Ancillary Service Management: Type and Classification of ancillary services, Ancillary Services Management in various countries; Sources of reactive power, Black start capability service, Provisions of ancillary services, Markets for ancillary services	04
6	Market power and generators bidding: Attributes of a perfectly competitive market, Imperfect competition, Electricity markets under imperfect competition Monopoly, Oligopoly, Sources of market power, Effect of market power, Identifying market power, role of demand side bidding, Introduction to optimal bidding by a generator company. Bidding strategies.	04

References -

Text Books:

- Kankar Bhattacharya, Math H.J. Boller, JaapE. Daalder, Operation of Restructured Power System, Klumer Academic Publisher.
- Daniel Kirschen and Goran Strbac, Fundamentals of Power System economics, John Wiley & Sons Ltd.
- Mohammad Shahidehpour, and Muwaffaq alomoush, Restructured Electrical Power Systems, Marcel Dekker Inc.

Reference Books:

- Loi Lei Lai; Power System Restructuring and Deregulation, John Wiley & Sons Ltd., England.
- NPTEL Course-Restructured Power Systems, A. R. Abhyankar, S. A. Khaparde, Available: <http://nptel.iitm.ac.in/courses/108101005/>:



Class:- T.Y. B. Tech.	Semester-V	L	T	P	Credits
Course Code : EE3134	Course Name: Digital Signal Processing	2	--	--	2

Course Description:

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Course starts from the basic concepts of discrete-time signals and proceed to learn how to analyze data via the Fourier transform, how to manipulate data via digital filters and how to convert analog signals into digital. It also includes, review of discrete-time linear, time-invariant systems, Fourier transforms, Z-transforms, digital filter designs and fast Fourier transform (FFT) algorithm.

Course Learning Outcomes:

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

1. Formulate signals mathematically in continuous, discrete-time, and frequency domains.
2. Analyze discrete-time systems using Z-transform.
3. Construct signals using Discrete-Fourier Transform (DFT) and FFT algorithms.
4. Design digital filters for various applications
5. Apply digital signal processing for the analysis of real-life signals.

Prerequisite: Engineering mathematics, signals & systems, control systems

Course Content

Unit No	Description	Hrs
1	Discrete time signals and systems DSP system concept, properties of DSP system, types of systems, Interconnection of DSP systems, Recursive and Non-recursive system, some elementary signals.	04
2	Z-Transforms for discrete signals Z-transforms overview, Region of Convergence, Properties of Z-transform for causal signals, Interpretation of stability in z-domain, Inverse Z-transforms. Applications of Z-transforms.	04

3	Discrete Fourier Transform Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform (FFT) Algorithm, Fast convolution signal segmentation (overlap save algorithm overlap-add algorithm), Parseval's Identity, Implementation of Discrete-Time Systems.	04
4	Design of IIR Digital Filters Impulse Invariant Technique, Bilinear transformation, Filters - Butterworth, Chebyshev, Low-pass, Band-pass, Band-stop, and High-pass.	04
5	Design of FIR Digital filters Window method, Park-McClellan's method. Low-pass, Band-pass, Band stop and High-pass filters. Effect of finite register length in FIR filter design.	04
6	Digital signal processors Applications of Digital Signal Processing, Selection of a processor; Architecture of TMS 320CXX; Addressing modes; Applications.	04

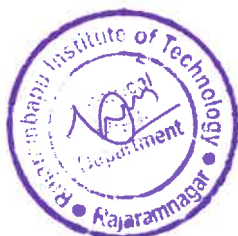
References -

Text Books:

- J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall.
- P. Ramesh Babu, Digital Signal Processing, Scitech Publisher

Reference Books:

- A.V. Oppenheim, R. W. Schaffer, Discrete Time Signal Processing, Prentice Hall
- L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall.
- S. K. Mitra, Digital Signal Processing: A computer-based approach, McGraw Hill
- J. R. Johnson, Introduction to Digital Signal Processing, Prentice Hall.



Class:- T.Y. B. Tech.	Semester-V
Course Code: EE3154	Course Name: Electrical Utilization and Traction

L	T	P	Credits
2	--	--	2

Course Description:

This course is designed to provide students with a comprehensive understanding of electrical utilization and traction systems, particularly in the context of electric heating for industrial application, electrical circuits for refrigeration and air conditioning, electrical traction systems and drives. The course will cover both theoretical principles and applications related to the efficient utilization of electrical energy for various purposes, with a focus on traction systems for transportation.

Course Learning Outcomes:

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

1. Analyze electric heating for industrial application.
2. Demonstrate electric welding for industrial application.
3. Inspect electric circuits for refrigeration and air conditioning.
4. Evaluate the use of various process control techniques.
5. Summarize electrical traction systems and drives.

Prerequisite: Basic Electrical, Power System, Electric Machines, Electric Drives

Course Content		
Unit No	Description	Hrs
1	Electric Heating: Advantages of electrical heating, Heating methods, Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, Induction heating; principle of core type and coreless induction furnace, Electric arc heating, direct and indirect arc heating, construction.	04
2	Electric Welding: Advantages of electric welding, Welding methods, Principles of resistance welding, types – spot, projection seam and butt, welding and welding equipment used, Principle of arc production, electric arc welding, characteristics of arc, carbon arc, metal arc, hydrogen arc welding, welding of aluminum and copper.	04

3	Electrical Circuits for Refrigeration and Air Conditioning: Electrical circuits used in Refrigeration, Air Conditioning and Water Coolers, Principle of air conditioning, vapor pressure, refrigeration cycle, eco-friendly refrigerants, Description of Electrical circuit used in refrigerator, air conditioner and water cooler	04
4	Electrolytic Processes: Need of electro-deposition, Laws of electrolysis, process of electro deposition - clearing, operation, deposition of metals, polishing, buffing, equipment and accessories for electroplating, factors affecting electro deposition Principle of galvanizing and its applications, Principle of anodizing and its applications.	04
5	Electric Traction Systems: Types of electric traction, systems of track electrification Traction mechanics- types of services, speed time curve and its simplification, average and schedule speeds Tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence	04
6	Electric Traction Drives: Salient features of traction drives, AC traction drives, series – parallel control of dc traction drives (bridge transition) and energy saving power electronic control of dc and ac traction drives diesel electric traction, Metro traction systems.	04

References -

Text Books:

- H. Partab, Dhanpat, Art and Science of Utilization of Electrical Energy, Rai & Sons.
- Dr. S. L. Uppal, Electrical Power, Khanna Publishers.
- E.O.Taylor , Utilisation of Electric Energy, Orient Blackswan

Reference Books:

- J. S. Sivanagaraju, Generation and Utilization of Electrical Energy, Pearson.
- J. B. Gupta, Utilization of Electrical Energy, Kataria Publications
- H. Partab, Modern Electric Traction, Dhanpat Rai & Co



Class:- T.Y. B. Tech.	Semester- V	L	T	P	Credits
Course Code: OE3044	Course Name : Renewable Energy Sources	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

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

Course Content		
Unit No	Description	Hrs
1	Introduction to Renewable Energy: Overview of global and national energy scenarios, Need for renewable energy and sustainability, Comparison of renewable and non-renewable energy sources, government policies and incentives for renewable energy adoption.	06



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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

1. Apply EIA methods to prepare a report.
2. Analyse the all projects by using Environmental Impact assessment tool.
3. Provide solution for decision making in Industrial Development Problem.
4. Prepare EIA report for submission to concerned authority.

Prerequisite: Possess basic knowledge of Environmental Science

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

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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

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

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

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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Environmental Science

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

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

References -

Codes of Practice:

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

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	–	–	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Electric Machines, Thermal Systems and Finance Management

Course Content		
Unit No	Description	Hrs
1	Energy Scenario : Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy and Environment, Air Pollution, Climate Change, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features.	06
2	Energy Management and Audit : Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments, suitable case study for energy audit.	06

3	Energy Action Planning Key elements, Force field analysis, Energy policy purpose, perspective, Contents, Formulation, Ratification, Organizing –location of energy management, Top management support, Managerial function, Roles and responsibilities of energy manager, Accountability. Motivating-motivation of employees: Information system-designing barriers, Strategies; Marketing and communicating-training and planning.	06
4	Financial Management Investment-need, Appraisal and criteria, Financial analysis techniques-Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs	06
5	Project Management Definition and scope of project, Technical design, Financing, Contracting, Implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification	06
6	Energy Monitoring And Targeting Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM). Suitable case study.	06

References -

Text Books:

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

Reference Books:

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

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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Basic Mathematics, Descriptive statistical techniques

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



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

References -

Text Books:

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

Reference Books:

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

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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Basics of Computer Networks.

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

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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

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

Course Learning Outcomes:

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

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

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

Course Content		
Unit No	Description	Hrs
1	Discovery- Opportunity identification for new products Product life cycle, need for new products, strategic planning and new product opportunity, sources of new product ideas, S curves and technology forecasting. Product idea generation, Product Design Process steps, creativity and innovation.	06



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

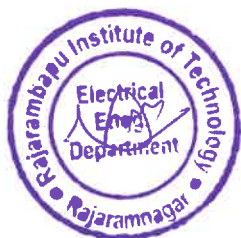
References -

Text Books:

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

Reference Books:

- Ulrich, Eppinger, Anita Goel, Product Design and Development, McGraw Hill Publishing.
- Otto & wood, Product Design, Pearson Education, reprint.
- Charles Flurschein, Industrial Design in Engineering, the Design Council, London.



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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Nil.

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

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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

1. Choose proper energy storage systems hydrogen and applications
2. Explain the different types of fuel cell technologies, fuels and membrane used in it
3. Design and Compare performance of fuel cell.

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

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

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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

1. Recognise various automation technologies in manufacturing and process industries.
2. Select various automation tools and methods in the manufacturing industry.
3. Implement various control and automation methods in process industries.
4. Analyse automation systems for manufacturing and process industries.

Prerequisite: Manufacturing systems, sensors and actuators,

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

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

References -

Reference Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: -NA-

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

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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

1. Explain the concepts of network connected embedded devices.
2. Identify and summarize different components required for IOT applications.
3. Analyse the system through Data Analytics tools.
4. Design suitable network architecture and use appropriate protocols for a given IOT application.

Prerequisite: Basic knowledge of microprocessor and microcontroller, communication

Course Content		
Unit No	Description	Hrs
1	Introduction & Basic of IoT Definition, Characteristics, Physical and Logical Designs, IOT enabling technologies, IoT levels and deployment templates. Major Components of IoT System	06
2	M2M and IOT management Introduction, M2M comparison with IOT, M2M architecture, software and development tools IOT management, communication technologies, communication protocols, Web connectivity tools.	06
3	IoT platform design methodology Design methodology, IoT Device, IoT Platform Design Specification, Building blocks, Hardware and board approach, Useful Softwares and packages	06

4	IOT data storage and Cloud Data generation, local data storage and Purpose of Cloud, clouds used in IoT application, Cloud Storage Models, Communication APIs	06
5	Iot Security Vulnerabilities, security requirements, Threat analysis, IoT Security Tomography, Layered Attacker Model, Identity Management, Establishment, Access Control Secure Message Communication, Security Models	06
6	Domain specific IOT Home automation, Cities, Environment, Agriculture, Health and lifestyle.	06

References-

Text Books:

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

Reference Books:

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

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

L	T	P	Credits
3	-	-	3

Course Description:

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

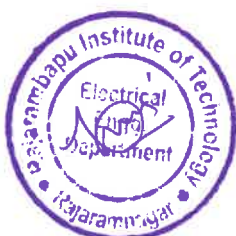
Course Learning Outcomes:

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

1. Elaborate drone technology.
2. Explain fundamentals and design principles of UAV.
3. Discuss the wide range of applications of drone.
4. Classify various propulsion and controlling techniques for drone.

Prerequisite: Basic knowledge of electronics and control.

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



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

References-

Text Books:

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

Reference Books:

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



Class:- T.Y. B. Tech.	Semester-V
Course Code : OE361	Course Name : Object Oriented Modeling & Design (Open Elective-I)

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Basics of Software Engineering and Object Oriented programming.

Course Content		
Unit No	Description	Hrs
1	Introduction to Object Modeling Object Oriented development & themes, Modeling as a Design Technique, Objects, classes, links and associations, generalization and inheritance, Aggregation, abstract classes, generalization as extension and restriction, multiple inheritance, metadata, candidate keys and inheritance.	06

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

References -

Text Books:

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

Reference Books:

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

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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

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

Course Content		
Unit No	Description	Hrs
1	Robotics in Agriculture Introduction, historical development, Autonomous tractors, drones, and harvesting robots, impact and sustainability of agricultural robots, artificial intelligence and machine learning in agricultural robotics	06
2	Industrial Robotics and Manufacturing Applications Use of robots in manufacturing and assembly lines, Robotics in material handling, welding, painting, and packaging, Integration of robots with CNC machines and flexible manufacturing systems (FMS), Industry 4.0 and smart factories: Role of IoT, AI, and digital twins.	06
3	Robotics in Healthcare and Medical Applications Robotics in surgery, rehabilitation, and prosthetics, Assistive robots for elderly and disabled individuals, Role of AI in robotic healthcare applications, Case studies on robotic-assisted surgery (e.g., Da Vinci Surgical System).	06

4	Robotics in Défense, and Space Exploration Military robots: Unmanned ground vehicles (UGVs), aerial drones (UAVs), and bomb disposal robots, Robotics in space exploration: Rovers, robotic arms, and satellite servicing, Challenges and advancements in space robotics.	06
5	Service, Autonomous, and Humanoid Robotics Service robots: Household, hospitality, and customer service applications, Autonomous robots: Self-driving cars, warehouse automation, and logistics, Humanoid robots and their interaction with humans, Ethical concerns and the impact of robotics on employment, Case Study of Humanoid Robots (Rashmi, Sofiya, Yashnee etc)	06
6	Future Trends, Challenges, and Ethical Considerations Soft robotics and bio-inspired robots, AI and machine learning in robotics, cybersecurity risks and ethical considerations in robotics applications, roborgrammer and robo romi, Future challenges and opportunities in robotics engineering. Case study on Ethical Considerations.	06

References -

Text Books:

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

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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Physics

Course Content		
Unit No.	Description	Hrs
01	Highway Planning Introduction: Classification of roads; Brief history of road development in India, Present status of roads in India, NHA1, NHDP, PMGSY, MSRDC; Geometric Design of Highways: Terrain classification, Design speed. Highway cross-section elements, Sight distance, Overtaking sight distance, Intersection sight distance.	06

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



K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
T. Y. B. Tech. Syllabus
To be implemented for 2023-27 NEP Batch
Department of Electrical Engineering

References:

Text Books:

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

Reference Books:

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



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

Course Description:

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

Course Learning Outcomes:

At the end of the course the student should be able to:

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

Prerequisites:

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



Course Content		
Unit No	Description	Hrs
1	Introduction and Database concepts and Data Model: Purpose of Database Systems, Data abstraction, Data Models, Overall System Design, Entities and Entity sets, Mapping Constraints, E-R Diagram, Reducing ER Diagrams to Tables, Generalization, specialization and Aggregation, Relational Algebra, Tuple Calculus.	06
2	Structured and Procedural Query Language: Introduction to SQL and PL/SQL, Set operations, Joins, Aggregate operations, Nested queries etc., PL/SQL Cursor, stored procedure and Trigger.	06
3	Relational Database Design: Domain Constraints, Referential Integrity, Functional Dependencies, Canonical cover, Pitfalls in Relational Database Design, Decomposition and Normalization using Functional Dependencies.	06
4	Transaction Management and Concurrency Control: Basic concepts, States, Concurrent execution, Serializability, Recoverability, isolation; Concurrency control: Timestamps and locking protocols, Validation based protocols, deadlock handling; Recovery: Log-based recovery, Shadow-paging.	08
5	Database Security and Crash Recovery: Introduction to Database Security, Confidentiality, Integrity, Availability Needs of Database Security SQL injection attack, error recovery and logging undo, redo, undo-redo logging, and recovery methods.	06
6	Introduction to NoSQL Database: Fundamentals of NoSQL (NoSQL Features, Data Models, and Distribution Models), Introduction to MongoDB, MongoDB CRUD operations. (Creating, Reading & Updating Data)	04



K.E. Society's
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(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
T. Y. B. Tech. Syllabus

To be implemented for 2023-27 NEP Batch
Department of Electrical Engineering

Text Books

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

References

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



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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Basic Electrical Engineering, Engineering mathematics and Engineering physics

Course Content

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

3	Induction Motors 1-Phase Induction motor: Resistance start/Split phase induction motor, Capacitor start induction run motor, Capacitor start capacitor run induction motor 3-Phase Induction motor: Construction and working of 3-Phase Induction motor, Types of 3-Phase Induction motors, Synchronous speed, rotor speed, Slip, Torque equation of 3-Phase Induction motor, Torque-Slip characteristic of 3-Phase Induction motor, Need and types of starters, Speed Control of 3-Phase Induction motors Applications of induction motors	06
4	Synchronous machines Alternator: Construction and working principle, EMF equation, Types of rotors, Terminal voltage, Armature reaction at various p.f., Voltage regulation Synchronous Motor: Construction and working principle, Different torques in synchronous motor, Effect of excitation, Applications of synchronous machines.	06
5	Fractional Horse Power Motors Permanent Magnet DC Motor (PMDC), Brushless DC Motor (BLDC), Steeper Motors, AC and DC Servo Motor, SRM, Universal motor. Applications of various special purpose motors	06
6	Electric Drives Introduction to controlled rectifiers, Electric Drives, Advantages of Electrical drives, Parts of electrical drives, Choice of electrical drives, Status of ac and dc drives, fundamental torque equations, Multi-quadrant operation, Classification of drives	06

References -

Text Books:

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

Reference Books:

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



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

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

Course Learning Outcomes:

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

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

Prerequisite: Knowledge of basic analog and digital communication.

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



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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Data Structures

Course Content		
Unit No	Description	Hrs
1	Introduction to Database Concepts: Purpose of Database Systems, Data abstraction, Data Models, Entities and Entity sets, Mapping Constraints, E-R Diagram, Reducing E-R Diagrams to Tables, Generalization and Aggregation.	06
2	Relational Model: Structure of Relational Databases, the Relational Algebra, the TupleRelational Calculus, Structured Query Language (SQL), Joins.	06
3	Integrity Constraints and Database Design: Domain Constraints, Referential Integrity, Complex datatypes, Functional Dependencies, Pitfalls in Relational Database Design, Decomposition, Normalization	06

4	Data Storage and Indexes: File Organization, Data Dictionary Storage, Indexing: B+ tree indexing and B tree indexing, Hashing: Static and Dynamic.	06
5	Query Processing and Basic of Transactions: Overview, Query Interpretation, Concepts of transaction processing, ACID properties, Transaction states, Serializability, Testing for serializability.	06
6	Concurrency Control and Recovery System: Lock-based protocols, Timestamp - based Protocols, Multiple Granularities, Deadlock handling, Crash Recovery: Failure Classification, Log-Based Recovery, Checkpoints, Shadow Paging	06

References -

Text Books:

- Abraham Silberschatz , Hank Korth and S. Sudarshan , “Database System Concepts”, McGraw Hill Education.
- Ram Krishnan, Johanes Gehrke, “Database Management Systems”, McGraw Hill Education.

Reference Books:

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



Class: - T.Y. B. Tech.	Semester-V	L	T	P	Credits
Course Code: MEMD305	Course Name: Product Design Tools and Techniques	3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

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



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

References:-

Text books:-

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

Reference Books:

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



Class: - T.Y. B. Tech.	Semester-V	L	T	P	Credits
Course Code: MCMD301	Course Name: Sensor and Instrumentation	3	-	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite:

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

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

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

References -

Text Books:

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

Reference Books:

- Measurement Systems by E.O. Doebelin, McGraw Hill, 06th Ed.
- Process Measurement & Analysis by B.G. Liptak, CRC press, 04th Ed.
- Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani,
- Tata McGraw-Hill Publishing Company Ltd., New Delhi, 02nd Ed.
- Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers, 02nd Ed.

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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

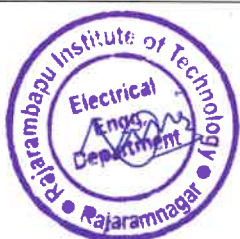
After successful completion of the course, students will be able to:

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

Prerequisites:

- Basic knowledge of Probability theory and python programming

Course Content		
Unit No	Description	Hrs
1	Introduction: Learning in the context of ML, three phases of performing ML, Algorithms and Models in ML, Logical, Geometric and Probabilistic models, Underfitting, Overfitting and Right models, Practical ML examples, Types of ML problems, Classification of ML algorithms.	06



2	Decision Trees: Purpose and uses, Constructing a decision tree, Gini Index, Gain ratio, ID3, C4.5, CART, Benefits of decision tree, Random Forest.	
3	Regression-Based Learning: Regression Analysis, Covariance, Correlation Coefficient, Regression Methods, Simple liner regression, Regression Model, Multiple Regression, Polynomial regression, Generalized linear models, Logistic regression	08
4	Instance Based Learning and kernel-methods based learning: KNN algorithm, Determining K, distance measures in KNN, Case based Reasoning, Support vector Machines (SVM).	06
5	Clustering Based Learning: Types of clustering, K-means clustering algorithm, Advantages and disadvantages of K-means clustering, Distance measures.	06
6	Bayesian learning: Classical, Empirical, Subjective methods, Types of events, Types of probabilities, Normal Distribution, Bayes' Theorem, Naïve Bayes' classifier.	06

References -

Text Books:

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

Reference Books:

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



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

Course Description:

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

Course Outcomes:

After completion of this course student will be able to -

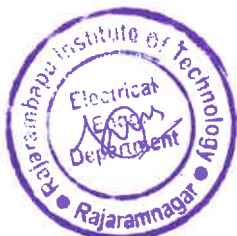
1. Select the type of mechanism for the robotic applications
2. Perform kinematic analysis and synthesis of mechanisms.
3. Perform forward and inverse kinematics of robots
4. Perform workspace analysis for different types of robots
5. Design robot manipulators based on dynamic analysis
6. Perform forward and inverse dynamics of robots

Prerequisite: Kinematics of Machines, Dynamics of Machines

Course Content		
Unit No	Description	Hrs
1	Fundamental Concepts: Kinematic Links, kinematics pair, types of constrained motion, Kinematic chain, Degrees of freedom, mechanisms, inversion of mechanism, position and orientation of rigid body, Linear and angular velocity of links, Velocity propagation, synthesis of mechanisms	06



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



References:

Text Book-

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

Reference Books-

- Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009.
- Richard D. Klafter, Thomas. A, Chri Elewski, Michael Negin, Robotics Engineering: An Integrated Approach, PHI Learning., 2009.
- Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
- Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993.
- Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, MIT Press., 2003.
- John J. Craig, Introduction to Robotics Mechanics and Control, Third Edition, Pearson, 2008.
- Hartenberg and Denavit, "Kinematics and Synthesis of Linkages", McGraw Hill Book Co.
- J. E. Shigley and J.J.Uicker Jr., Theory of Machines and Mechanism, McGraw Hill
- Kelly R, Santibanez V and Loria A, —Conrol of Robot Manipulators in Joint Space, Springer, 2005.
- John J. Craig, Introduction to Robotics, 3rd Edition, Addison Wesley, ISE 2008



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

L	T	P	Credits
2	-	-	2

Course Description:

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

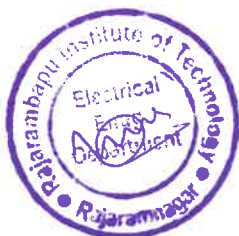
Course Learning Outcomes:

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

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

Prerequisite: Basics of civil engineering

Course Content		
Unit No.	Description	Hrs.
1	Introduction: Smart cities concept, origin, ideology. Typologies and different meanings, Wired city, Virtual city, Intelligent city, Information city, Digital city. Characteristics of smart cities: smart economy, smart people, smart governance, smart mobility, smart environment, smart living Strategies and policies.	04



2	Critical analysis of Smart City Concept: Approaches towards smart cities in various countries. Smart city planning in advanced economies, economic, financial viability, social implications. Financial and economic viability of smart city. Critical analysis of smart city development projects in India	04
3	Smart City Mission in India: Smart city mission: Objectives, features, coverage and duration. Preconditions and criteria for the selection of smart city, actions and tools for smart cities. Strategies, redevelopment, Greenfield, Brownfield, pan-city, Governance and management special purpose vehicles.	04
4	Resilience and Sustainable Development: Sustainable Development Introduction, Origin, Definition, three pillars of Sustainable Development, Critiques on Sustainable Development. The concept of resilience: need and significance in the contemporary time, city preparedness, adaptations, risk reduction and mitigation. Climate change and resilience.	04
5	Measurement of Resilience and Sustainability: The Theory and Measurement of Sustainability: Ideologies and Ethos of Sustainability, Indicators, Indicator Framework for Assessing Sustainability, Measurement Systems for Sustainable Urban Development: Concept Level (Broad) Measurement Systems.	04
6	Sustainability in India: Sustainability in India: Need, Issues and Challenges, Urbanization in India, Sustainable Development in India, Sustainability Measurement and Rating Systems and Initiatives in India.	04

References:

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
1	--	2	2

Course Description:

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

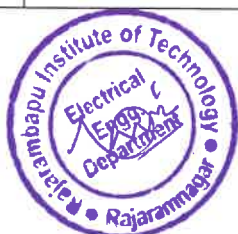
Course Learning Outcomes:

At the end of the course the student should be able to:

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

Prerequisites: Basic understanding of programming concepts.

Course Content		
Unit No	Description	Hrs
1	Introduction to Python fundamentals: Python introduction, Python syntax, Python comments, Python variables, Python data types, Python numbers, Python casting, Python strings, Python Booleans, Python operators, Loops and Conditional Statement If-else, while, for, lambda, arrays, Python Iterators, Python scope	02
2	Lists, Tuples, Sets, Dictionaries: Access, change, add and remove list elements, loop lists, list comprehension, list methods, access, update, unpack tuples, loop tuples, tuple methods, Access, add, remove set items, set methods, access, add, change, remove dictionary items, nested dictionaries, dictionary methods.	02
3	Classes and Objects: Classes, objects, parameterized and non-parameterized init constructor, object methods, self-parameter, association, Access modifiers: Private, public, protected	02



4	OOP Concepts: Inheritance, Encapsulation, Polymorphism: overloading and overriding, abstraction: interface and abstract class	02
5	File handling and Exception: File handling syntax, read files, write/create files, delete files, handling runtime exception and custom exception.	02
6	Modules and Libraries Introduction, modules, using dir() function, Numpy, Pandas, Matplotlib, Seaborn, markers, line, labels, grid, subplots, scatter, bars, histograms, pie-charts	02

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
1	-	2	2

Course Description:

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

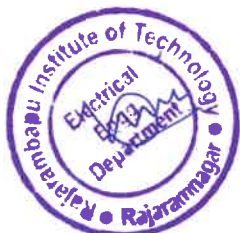
Course Learning Outcomes:

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

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

Prerequisite: Basic Electrical Engineering, Basic Electronics Engineering

Course Content		
Unit No	Description	Hrs
1	Power Electronic Devices: Power diode, BJT, Thyristor, MOSFET, IGBT: Structure, Symbol, Working Principle, Comparison.	02
2	Power Electronic Circuits: Rectifier: single phase full wave diode rectifier, Chopper: basic step-down and step-up Chopper, Inverter: single phase full bridge inverter.	02
3	Electrical and Electronic Measurements: Electrical instruments, characteristics of measuring instruments, standards of measurement, voltmeter, ammeter and wattmeter, digital multi-meter, power analyzer. Comparison of analog and digital meters.	02
4	Transducers: Introduction, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Measurement of weight, speed, temperature, pressure and flow.	02



5	Solar and Wind Energy Systems: Solar cell fundamentals, V-I characteristics of a PV panel, principles of wind energy conversion, components of wind energy conversion system, classification of wind turbines- horizontal axis and vertical axis. Wind power integration into grid-power system , grid connected PV systems	02
6	Electric Vehicle: What Is an Electric Vehicle? Engineering philosophy of EV development, Pure Electric Vehicle, Hybrid Electric Vehicle, Gridable Hybrid Electric Vehicle, Fuel-Cell Electric Vehicle, Overview of EV Technologies.	02

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

References -

Text Books:

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

Reference Books:

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





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T. Y. B. Tech. Syllabus
To be implemented for 2023-27 NEP Batch
Department of Electrical Engineering

Class: - T. Y. B. Tech.	Semester-V
Course Code : ECMD303	Course Name : Electronic Product Design

L	T	P	Credits
2	-	-	2

Course Description:

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

Course Learning Outcomes:

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

1. Elaborate product design processes.
2. Explain various aspects of PCB design.
3. Differentiate product-testing methods.
4. Create various documents for the product.

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

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



5	Electronic Product Testing : Introduction, Environmental Testing, Temperature Testing, Thermal Modeling of Components, Humidity Testing, Electrical Overstress Testing, Altitude Testing, Special Testing, Environmental Test Chambers and Rooms, Various Tests on Enclosures, EMI and EMC Related Testing, Importance of Standards, List of Some Standards.	04
6	Product Documentation: Introduction, Types of Documentation, How to Prepare an Effective Document, PCB Documentation, Bill of Material: A Documentation of Part List, Manual Types.	04

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
1	--	2	2

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Basic knowledge of C Programming

Course Content		
Unit No	Description	Hrs
1	Introduction to Java Programming: Java buzzwords, Features of Java, JDK, JRE and JVM, Variables and data types, I/O statements in Java, Conditional and looping statements, Arrays.	02
2	Introduction to Object-Oriented Programming : Features of object-oriented programming, Class and objects, Constructors, Method and constructor overloading, Nested classes.	02



3	Features of Object-Oriented Programming: Polymorphism: Method overloading (Compile time Polymorphism), Method overriding (Run time Polymorphism), Inheritance, super, this, static and final keywords, Abstraction, Interface, Garbage collection.	02
4	Collection and String: Collection, Collection Framework, List: ArrayList, LinkedList, Vector and Stack, Queue: Deque and Priority Queue, Set: TreeSet and HashSet, Map: Hash Table and Hash Map, Java String.	02
5	Exception Handling: Exceptions & Errors, Types of Exception, Control Flow in Exceptions, JVM reaction to Exceptions, Exception keyword. In-built and User Defined Exceptions, Checked and Un-Checked Exceptions.	02
6	Packages: Organizing Classes and Interfaces in Packages, Package as Access Protection Defining Package, CLASSPATH Setting for Packages, Naming Convention for Packages.	02

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



References -

Text Books:

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

Reference Books:

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



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

Course Description:

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

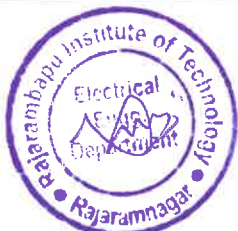
Course Learning Outcomes:

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

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

Prerequisites: Basic knowledge of engineering drawing and design principles

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



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

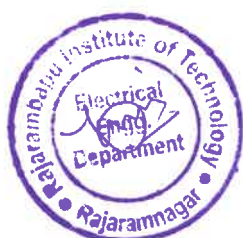
References:-

Text books

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

Reference Books:

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



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

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Knowledge of fundamentals of Mechatronics

Course Content		
Unit No	Description	Hrs
1	Programmable Logic Controllers : Introduction - Parts of PLC - Principles of operation - PLC sizes - PLC hardware components - I/O section - Analog I/O modules - digital I/O modules CPU processor memory module - PLC programming Simple instructions - Output control devices - Latching relays PLC ladder diagram,	04
2	Instructions : Timer instructions ON Delay, OFF Delay and Retentive Timers-UP Counter, DOWN Counter and UP down Counters, program control instructions.	04
3	Application of PLC : Parking process, Temperature control, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control	04
4	Networking of PLC and SCADA: Networking of PLCs-Data communication-Fieldbus, PROFI bus, and Mod bus-OSI. Supervisory Control and Data Acquisition-Architecture-Remote terminal unit-Master terminal unit.	04
5	Distributed Control System : Evolution - Architectures - Comparison - Local control unit - Process interfacing issues. Operator interfaces - Low level and high level operator interfaces - Engineering interfaces - Low level and high-level engineering interface	04

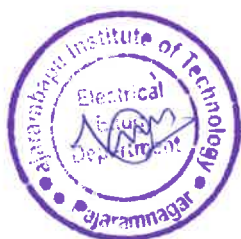


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6	Applications of DCS : Pulp and paper environment -Power plant Wireless control system in challenging environments like welding shops, Introduction to Soft PLC	04
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References -

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



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

L	T	P	Credits
2	-	-	2

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Database Management Systems, Basic Probability and Statistics

Course Content		
Unit No	Description	Hrs
1	Introduction: What is business intelligence (BI)? Need for BI. Drawing insights from data: DIKW pyramid, levels of decision making (strategic, tactical and operational BI). Examples of business analyses—funnel analysis, distribution channel analysis and performance analysis.	05
2	Data Preprocessing: Notion of data quality. Typical preprocessing operations: combining values into one, handling incomplete/ incorrect / missing values, recoding values, sub setting, sorting, transforming scale, determining percentiles, removing noise, removing inconsistencies, transformations, standardizing, normalizing - min-max normalization, score standardization.	04

3	Inferential Statistics: Role of probability in analytics, probability distributions and their characteristics. Need for sampling, generating samples, sampling and non-sampling error. Sampling Distribution of Mean, Central Limit Theorem, Standard Error. Estimation: Point and Interval Estimates, Confidence Intervals, level of confidence, sample size.	04
4	Data Warehousing: What is a data warehouse, need for a data warehouse, architecture, data marts, OLTP vs OLAP, Multidimensional Modeling: Star and snow flake schema, Data cubes, OLAP operations, Data Cube Computation and Data Generalization, Data Lake	04
5	Enterprise Reporting: Metrics, Measurement, Measures, KPIs, Dashboards, Reports, Scorecards	03
6	Hypothesis Testing: Basic concepts, Errors in hypothesis testing, Power of test, Level of significance, p-value, general procedure for hypothesis testing. Parametric and non-parametric tests – z test, t test, chi-square test. Two tailed and one-tailed tests. Chi-square test for independence and goodness of fit. ANOVA	04

References -

Text Books:

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

Reference Books:

- Business Intelligence for Dummies
- Applied Business Statistics: Making Better Business Decisions(English) , Wiley India
- Forecasting: Principles and Practices, Rob J Hyndman, George Athanasopoulos, Otext



Class: T. Y. B. Tech.	Semester: V	L	T	P	Credits
Course Code: RAMD303	Course: Robot Programming	1	--	2	2

Course Description:

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

Course Outcomes:

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

1. Explain Robot programming ecosystem.
2. Create reusable code for robot powered applications.
3. Design a custom robot using programming.
4. Simulate and control the robot using ROS.

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

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

4	Block-based coding: Working of block-based coding, features of block-based coding, designing interface, block-based coding with robots. Block based programming languages. Robot Programming using teach Pendant for various applications	03
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List of experiments (Any 10)

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

References Books:

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



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

L	T	P	Credits
2*	--	--	Audit

Course Description:

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

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

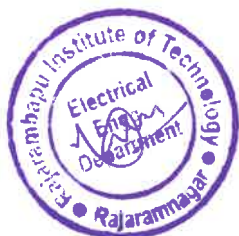
Course Learning Outcomes:

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

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

Prerequisite: Fundamentals of various Mathematical and Arithmetic operations, Calculations.

Course Content		
Unit No	Description	Hrs.
1	Number System, HCF, LCM: Basics, Base System, Exponents, LCM and HCF, Factors, Cyclicity, Different Methods to find LCM-HCF, HCF-LCM relation , Applications of HCF –LCM	03
2	Percentage: Understand Conversion, Single change, Successive change, Product Stability, Applications of percentage.	02



3	Average, Allegations: Weighted average, Concept of average speed & allegation, Applications of Average & mixture allegation.	02
4	Ratio & Proportion: Comparison of Ratio & fraction, Properties of Ratio & Proportion, Mean Proportion. Joint ratio	02
5	Profit & Loss: Same selling price different Cost Price, Same cost price different selling price Concept of false scale.	02
6	Simple interest -Compound interest: Basics, Difference between SI CI, Conversion Periods, Depreciation	02
7	TRW, Pipes & Cisterns: Time, Rate and Work-Unitary Method, LCM Method, Calculation of remuneration. Pipes & Cisterns -Concept of negative work, LCM Method.	02
8	Blood Relations: Blood Relations -Symbols, generation of tree diagram, types of questions-pointing towards person, tree based, coded blood relation	02
9	Numerical Analogy: Basics, Relation between two numbers, numerical	02
10	Pattern, Step Completion: Image completion, Mirror images, Water images, input-Output	02
11	Series Completion: Types of series, Number series pattern, Letter series, Alphanumeric series,	02
12	Direction Sense: Basics, shadow based concept, Concept of local time zone (IST,GMT, Longitude, Latitude), Problems on local time difference, Coded direction sense	02
13	Coding Decoding: Letter-Letter, Letter- Number, Number-Number, Letter-Symbol, Mixed Coding,	03

14	Syllogism: Basics , Types of Statements, Different diagram for different statements, Types of Questions-Based on Conclusion, Based on Statements	02
	Total Hours	30

References -

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



Class:- T.Y. B. Tech.	Semester-V
Course Code : EE361	Course Name: Feedback Control System Lab

L	T	P	Credits
--	--	2	1

Course Description:

This course deals with the implementation of fundamentals of classical and analysis which includes both the theoretical and practical aspects. This course provides hands on experience of using standard signals to test behavior of physical control systems and use of virtual environments to analyze system performance indices of feedback control systems via classical techniques such as root-locus and frequency-domain methods, also deals with design of LTI systems using various time domain and frequency domain techniques using real time hardware experiments and virtual environment like MATAB.

Course Learning Outcomes:

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

1. Test for responses of the mathematical model of different electromechanical systems for various standard inputs.
2. Evaluate time domain and frequency domain specifications of LTI systems
3. Examine the stability of LTI system using time-domain and frequency-domain techniques.
4. Design simple controller for LTI systems
5. Analyze state space models of LTI systems

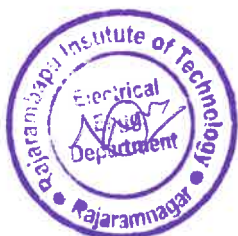
Prerequisite: Calculus and Transforms, Engineering Mathematics –III, Signals and Systems, Electrical Circuit analysis, Programming & Simulink with MATLAB

Expt. 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	Study the Synchro Transmitter-Receiver to find the error.	02
4	Calculate the Time domain specifications of first order and second order LTI system	02
5	Design a 1 st and 2 nd order system using RC/RLC circuit and with op-amp.	02



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6	To Study the effect of feedback on 1 st and 2 nd Order Circuit using op-amp.	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	Develop state space model of the LTI system using MATLAB and convert SS2TF and TF2SS.	02
10	Test controllability and observability of a given LTI system	02
11	Closed loop speed control DC motor using PID controller using MATLAB	02
12	Study of inverted pendulum control system.	02





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Class:- T.Y. B. Tech.	Semester- V
Course Code : EE363	Course Name : Microcontroller Lab

L	T	P	Credits
--	--	2	1

Course Description:

The Microcontroller Laboratory course is designed to provide hands-on experience and practical skills in working with microcontrollers, which are essential components in embedded systems. This course serves as a complement to theoretical knowledge gained in related microcontroller or embedded systems courses. Students will have the opportunity to apply their understanding of microcontroller architecture, programming, and interfacing through a series of laboratory exercises

Course Learning Outcomes:

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

1. Illustrate internal and external structure of microcontroller
2. Make a use of instruction set to write assembly language programming
3. Develop embedded C language program of modern microcontrollers
4. Design microcontroller interfacing circuit for various I/O device

Prerequisite: Analog electronics, Digital electronics, C programming

Exp. No	Description	Hrs
1	Introduction to 8051 microcontroller	02
2	Make a use of instruction set to perform addition, subtraction, multiplication, and division of 8/16 bit data.	02
3	Execute program to sum of a series of 8 bit data and multiplication by sequential add method.	02
4	Develop program to find largest and smallest number from a series.	02
5	Write program for Sorting (Ascending/Descending) of data.	02
6	Perform code conversion – Hex to Decimal/ASCII to Decimal and vice versa.	02
7	Develop program for waveform generation using timer	02
8	Develop program for time delay generation and relay interface	02





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9	Develop circuit for display (LED/Seven segments/LCD) and keyboard interfacing	02
10	Perform ADC interface for real life application	02
11	Develop DAC interfacing with wave form generation.	02
12	Develop stepper motor and DC motor interface.	02



Class:- T.Y. B. Tech.	Semester-V	L	T	P	Credits
Course Code : EE359	Course Name Advanced Software Lab	--	--	2	1

Course Description:

This laboratory course deals with advanced simulation software to cater the need of the students in the recent trends in the field of Electrical Engineering. The lab is important as it connects theory with real-world application, preparing students to contribute effectively to software projects. This lab course is designed for students aiming to succeed in software and testing companies. This hands-on lab course covers advanced programming, simulation design, and testing tools of cutting age software.

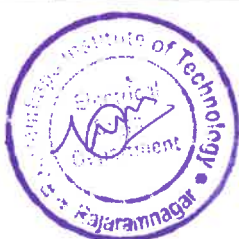
Course Learning Outcomes:

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

1. Analyze AC/DC converters circuits using software.
2. Make use of advance software programming and Simulink platform to solve different problems.
3. Analyze the power system analysis problem using advance simulation toolbox.
4. Develop power system network in advance software to solve power flow analysis problems.
5. Design power system network in advance optimization software to solve power systems problem.

Prerequisite: Analog and Digital Electronics, MATLAB Programming and Simulation, Power system, Power Electronics.

Expt. No	Description	Hrs
1	Study the effect of frequency on current in series RLC circuit with PSIM	02
2	Study the effect of time constant on circuit in series RL circuit with PSIM	02
3	Study of single-phase half wave uncontrolled rectifier with R load using PSIM	02
4	Study of the effect of a freewheeling diode for single phase half wave uncontrolled rectifier with RL load using MATLAB	02
5	Study of speed control of separately excited DC motor from armature side using MATLAB	02





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6	Study of three phase uncontrolled rectifier with R and RL load using MATLAB	02
7	Study of Boost and Buck converter with RLC loads using MATLAB	02
8	Study and solve Gauss seidel method using MATLAB program.	02
9	Study of economic dispatch and unit commitment modelling using GAMS	02
10	Study of DCOPF and ACOPF modelling with CPLEX, MILP and MINLP solver using GAMS	02
11	Study of load flow using modeling with ETAP	02
12	Study of load flow using modeling with CYME	02



Class:- T.Y. B. Tech.	Semester-V
Course Code : EE365	Course Name : Industrial Training

L	T	P	Credits
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Course Description:

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

Course Learning Outcomes:

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

1. Apply the Technical knowledge in real industrial situations.
2. Identify the industry problem on which they can do their final year project.
3. Formulate Technical reports/projects.
4. Demonstrate professional values and ethical standards.
5. Understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Prerequisite: Core courses of Electrical engineering, Professional Skill Development

1. EXPECTATIONS FROM STUDENTS:

Students are expected to:

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

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

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

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

3. INTERNSHIP REPORT

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, TPO and Faculty Mentor.

The Internship report will be evaluated on the basis of following criteria:

- i. Originality.
- ii. Adequacy and purposeful write-up.
- iii. Organization, format, drawings, sketches, style, language etc.
- iv. Variety and relevance of learning experience.
- v. Practical applications, relationships with basic theory and concepts taught in the course.

4. MONITORING & EVALUATION OF INTERNSHIP

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

- a) Evaluation by Industry.
- b) Evaluation through seminar presentation/viva-voce at the Institute.

a) Evaluation by Industry

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

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

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

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

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

References -

- AICTE INTERNSHIP POLICY: GUIDELINES & PROCEDURES



Class: T. Y. B. Tech.	Semester - V
Course Code: EE367	Course Name: MOOCS-II

L	T	P	Credits
-	-	-	1

Course Description:

Online courses offered through platforms like NPTEL, SWAYAM, and NASSCOM provide opportunities to deepen the understanding of advanced electronics concepts and technologies to Electrical Engineering students. These courses focus on critical domains such as circuit design, electrical machines, power systems, control systems and emerging fields like electrical vehicles. They blend theoretical foundations with practical applications, enabling students to strengthen problem-solving skills, engage with modern tools, and prepare for industry-oriented challenges, enabling lifelong learning. The objective of this course is to emphasize the development of skills and attitudes that enable continuous learning & adaption to new situations.

Course Learning Outcomes:

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

1. Explain advanced principles, methods, and technologies in various areas of electrical engineering.
2. Analyze electrical engineering problems using mathematical and engineering fundamentals.
3. Design solutions for electrical-based systems using modern engineering tools and platforms.
4. Apply programming and simulation techniques to develop and test electrical circuits and systems.
5. Demonstrate the ability to engage in independent and self-directed learning

Note:

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





K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
T. Y. B. Tech. Syllabus
To be implemented for 2023-27 NEP Batch
Department of Electrical Engineering

References-

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



Class:- T.Y. B. Tech.	Semester- VI
Course Code : EE314	Course Name : Power System Protection

L	T	P	Credits
2	--	--	2

Course Description:

'Power System Protection' is offered as the core course in Electrical Engineering under graduate program. This course focuses on various techniques of protection system applied in power systems. This course deals with operating principle and working of various circuit breakers, relays, fuses, advanced protection systems using microprocessor; its advantages and disadvantages.

Course Learning Outcomes:

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

1. Compare the different protective devices
2. Describe Relays for power system protection.
3. Identify the proper earthing system and selection of Lightning arrester
4. Explain digital relaying scheme

Prerequisite: Basic Electrical Engineering, Power System

Course Content		
Unit No	Description	Hrs
1	Protective Devices: Insulators, Fuse, MCB, MCCB, ELCB, Switch fuse unit (SFU), Location of protective devices, Advantages, Disadvantages, Applications, Advanced protective devices.	04
2	Protective Relays: Definition, classification and application of and Relays, Current-time characteristics, Induction disc Relays, pick up value, current setting, Plug setting multiplier, Time multiplier setting, Static Relays,. Advantages and disadvantages. Advanced protective relays	04
3	Circuit Breakers: Mechanism, types of circuit breakers- Oil circuit breaker, Air-circuit breaker, vacuum circuit breaker, SF6 Circuit breaker, HVDC circuit breaker, Rating of circuit breaker, Advantages and disadvantages, Advanced circuit breakers	04



4	Power system equipment protection: Transformer Protection- Different faults in transformer, Buchholz relay, differential relay, Generator Protection- Mertz prize protection, Stator and rotor protection, Transmission line protection - Distance relaying scheme and characteristics, Reactance, impedance and MHO relay, under reach, Overreach, Advanced techniques for equipment protection	04
5	Earthing and Lightening Arresters: Definition, Earthing procedure, Earthing Electrode, Earthing systems, Earthing testing, Applications, Lightening arresters-Rod gap, horn gap, MOA-characteristics, Surge absorber, advanced techniques for surge protection	04
6	Digital Relays: Microprocessor based- overcurrent relay, overvoltage relay and Impedance relay. Advantages of digital relaying, Numerical relay hardware-organization and facilities available in commercial numerical relays	04

References -

Text Books:

- Power system protection and switchgear, Badri Ram and Vishwakarma, Tata Macgrawhill publication
- Switchgear and Protection, Sunil S. Rao, Khanna Publishers

Reference Books:

- Power system Protection and Switchgear; Oza, Nair and Mehta, MCGrawHill Publication
- Principles of Power system. V. K. Mehta, S. Chands Publication
- Power system protection and switchgear, B. Ravindranath, New Age international publication

Class:- T.Y. B. Tech.	Semester- VI
Course Code : EE3044	Course Name : Power Electronics

L	T	P	Credits
3	--	--	3

Course Description:

The course introduces basics of power electronic devices and converters. Working principles, operating modes and analysis of AC-DC and DC-DC converters will be covered in detail. DC-AC inverter and AC-AC cyclo-converters will be introduced at the end of the course. This course also covers design and analysis of various power converters connected to different loads.

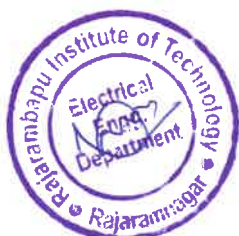
Course Learning Outcomes:

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

1. Explain power semiconductor devices based on working principle, structure and operating characteristics.
2. Estimate the performance parameters of uncontrolled rectifiers and phase-controlled converters for R, RL and RLE Load.
3. Analyze the performance of DC-DC converters with respect to configurations and control strategies
4. Draw waveforms and circuits of single phase and three phase inverter.
5. Describe working principle and applications of AC-AC converters.

Prerequisite: Analog Electronics, Basic Electronics, Electrical Circuit Analysis, Engineering Mathematics- Integration, Differentiation.

Course Content		
Unit No.	Description	Hrs
1	Power Diode and Transistor: Power Diodes: Introduction, Structure, V-I Characteristics, Reverse Recovery Characteristics, and types of power diode. Power Transistors – BJT, MOSFET, IGBT: Structure, Static and Dynamic Characteristics, Transfer and Output Characteristics	06
2	Thyristor: SCR: Structure, Two-Transistor Analogy, Turn-on Methods, V-I Characteristics, Switching Characteristics, Gate Characteristics, Ratings, Thermal Equivalent Circuit and Heat Sink Selection, Methods of Commutation. TRIAC: Structure and V-I Characteristic, Mode of Conduction	06



3	Diode Rectifiers: Single phase half wave rectifier with R and RL load, effect of freewheeling diode, Single phase full wave rectifier in mid-point and bridge configuration with R, RL and RLE load, Three phase bridge rectifiers with R and RL load, performance parameters of the rectifier,	06
4	Phase Controlled Rectifiers: Principle of phase control, Single phase half wave converter with R and RL load, effect of freewheeling diode, Single phase full controlled converter in mid-point and bridge configuration with R, RL and RLE load, Single phase semi converter, Three phase half wave converter with R and RL load, Three full controlled converter with R, RL load, Three phase semi converter, Dual converter	06
5	DC – DC Converter: Principle of step-down and step-up choppers, control strategies for chopper, chopper configurations and quadrants of operations, Buck, Boost and Buck-Boost converters	04
6	AC Converters: Inverter: Principle of inverter, PWM signal generation, Single phase half bridge and full bridge inverter, Voltage Source Inverter, Three phase- six-step inverter in 120 and 180-degree mode, Current Source Inverter Cycloconverter: Principle of AC voltage controllers, Single phase Cycloconverter mid-point and bridge configuration	08

References -

Text Books:

- P. S. Bimbhra. Power Electronics, Khanna Publishers, New Delhi.
- M. H. Rashid, Power Electronics-, PHI, New Delhi.

Reference Books:

- P.C. Sen, Power Electronics - Tata McGraw - Hill Publishing.
- Ned Mohan, Tore D. Udeland, William P. Robbins, Power Electronics – Wiley publications.
- M. D. Singh & K. B. Kanchandhani, Tata McGraw, Power Electronics Hill Publishing Company.
- M H Rashid , Power Electronics Handbook, B H Publications

Class:- T.Y. B. Tech.	Semester-VI
Course Code : EE316	Course Name: Research Methodology

L	T	P	Credits
2	--	--	2

Course Description:

The course introduces research methods as students apply to the higher education and their field of study. It gives an overview of research methodology including basic concepts employed in quantitative and qualitative research methods. The course covers all the conceptual and methodological issues that go into successful conduction of research. That includes philosophy of science, the methodological issues in measurement, proposing and testing hypotheses, scientific communication and the ethical issues in the practice of science.

Course Learning Outcomes:

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

1. Describe the research process and the principle activities, skills and ethics associated with the research process.
2. Formulate a research problem
3. Assess and critique a published journal article.
4. Identify the components of a literature review process
5. Construct an effective research article or proposal by following research ethics

Prerequisite: Engineering mathematics, statistics

Course Content		
Unit No	Description	Hrs
1	An Introduction to Research Methodology Research – Meaning, Objectives, Motivation; Types of Research; Research approaches; Significance; Research Methods versus Methodology.	04
2	Defining the Research Problem Research Problem; Selecting the problem; Necessity of defining the problem; Techniques involved in defining the research problem.	04
3	Research Design Need for research design; Features of a good design; Significant terms related to research design; Different research designs.	04

4	Hypotheses Hypothesis – meaning; basic concepts related to testing of Hypothesis. Procedure for Hypothesis testing; Limitations.	04
5	Literature Studies Effective literature studies approaches, Plagiarism, Research ethics, Approaches of investigation of solutions for research problem, Data collection and analysis, interpretation, Necessary instrumentation.	04
6	Interpretation and Report Writing Interpretation – techniques; precautions. Significance of report writing; Steps involved in report writing; types of reports; Oral presentations	04

References -

Text Books:

- J Ranjit Kumar, Research Methodology: A Step-by-Step Guide for beginners, SAGE Publication.
- C. R. Kothari, Research Methodology – Methods & Techniques, New Age International Ltd., Publishers.

Reference Books:

- Wayne Goddard and Stuart Melville, Research Methodology: An Introduction, Juta Academic
- Creswell, J. W. (2022). Research design: Qualitative, Quantitative and Mixed Methods Approaches, Sage Publications.
- Shyama Prasad Mukherjee, A Guide to Research Methodology – An Overview of Research Problems, Tasks and Methods, CRC Press, Taylor & Francis Group.

Class:- T.Y. B. Tech.	Semester-VI
Course Code : EE320	Course Name: Control System Design

L	T	P	Credits
3	--	--	3

Course Description:

Control systems design is an advanced field within electrical engineering, focusing on specialised techniques and applications. The subject covers sampled-data systems, using classical frequency-domain transfer function techniques to analyse and design controllers for plants. The course exposes students to control design for continuous-time linear time-invariant (LTI) systems. Students will model plants and controllers using the z-transform for system performance analysis. The subject also explores modern control design with time-domain state space techniques. Students will develop state models of continuous-time systems and design controllers using pole-placement, applying concepts like controllability, observability, and state feedback controller design. This ensures students gain practical and theoretical expertise in contemporary control systems design.

Course Learning Outcomes:

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

1. Design and fine tune PID controllers and understand the role P, I & D feedback control.
2. Design and analyze stability using Root Locus technique to achieve desired system performance using lead and lag compensators.
3. Design and analyze stability using frequency domain to achieve desired system performance using phase-lead and phase-lag compensators.
4. Design controllers for state-space modelled systems using pole-placement and state feedback controller.
5. Develop models of plants and controllers using the z-transform, leading to rational transfer functions and allowing for pole/zero terminology in sampled- data systems

Prerequisite: Linear Algebra, Control Systems, Electrical circuit analysis



Course Content		
Unit No	Description	Hrs
1	Linear Control Methods: Introduction to process control, Control objective, feedback control system characteristic, PID control and design methods, tuning, Implementation of PID Controllers, Special Control Structures-Feedforward and ratio control, Predictive control, Cascade control	06
2	Control System Design in time domain: Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain using root locus. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.	06
3	Control System Design in Frequency Domain: Lead compensator, Lag compensator, their design in frequency domain using Bode plots, and Lag-Lead compensator design in frequency domain and disturbance.	06
4	State Space Analysis of Continuous System: Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer.	06
5	Discrete System: Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modelling of sample hold circuit.	06
6	Analysis of Discrete Systems: Solution of state difference equations, steady state accuracy, Stability of discrete system synthesis -plane and Jury stability criterion, bilinear transformation.	06

References -

Text Books:

- K. Ogata, Modern Control Engineering Prentice Hall of India
- Norman S. Nise Control system engineering, John Wiley and sons

Reference Books:

- I.J. Nagarath and M.Gopal, Control Systems Engineering, New Age Int. (P) Ltd.
- B.C.Kuo, Automatic Control Systems Tata Mcgrawhill Education
- M. Gopal, Control Systems: Principles and Design, McGraw Hill Education

Class:- T. Y. B. Tech.	Semester-VI
Course Code : EE3064	Course Name : Electrical Energy Conservation and Auditing

L	T	P	Credits
3	--	--	3

Course Description:

This course provides a basic understanding of energy audit and management. One way to cope with the increase in energy demand is to increase the production of energy which demands more investment, and the other way is to conserve the energy as energy conserved/saved is twice the energy generated. Essential theoretical and practical knowledge about the concept of energy conservation, energy management, and different approaches to energy conservation in industries, economic aspects of energy conservation projects and energy audit and measuring instruments in the commercial and industrial sectors will be achieved through this course.

Course Learning Outcomes:

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

1. Explain the basic principles of Energy Management and Audit
2. Apply mathematical tools to solve energy economics
3. Select energy-efficient electrical technologies for electrical motors
4. Select energy-efficient Industrial technologies for energy saving
5. Apply energy-efficient technologies for energy saving

Prerequisite: Power Systems, Electrical Machines, Applied thermal ,hydraulic engineering

Course Content

Unit No	Description	Hrs
1	Basic Principles of Energy Audit: Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit. ECA 2001.	06

2	Energy Management and Audit: Definition, energy audit, need, types of energy audit and approach, understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies optimizing the input energy requirements, fuel & energy substitution, energy audit instruments	06
3	Economic Aspects: Economics Analysis-Depreciation Methods, time value of money, rate of return , present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment .	06
4	Energy Efficiency in Electrical Systems Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement benefits, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.	06
5	Energy Efficiency in Industrial Systems Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.	06
6	Energy Efficient Technologies in Electrical Systems Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology. .	06

References -

Text Books:

- Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1 to 4, (available online)
- W.R. Murphy, G. McKay Butter worth, Energy management, Heinemann Pub.
- Paul O'Callaghan, Energy management, McGraw Hill Book company

Reference Books:

- John .C. Andreas, Marcel Dekker, Energy efficient electric motors Inc Ltd.
- Amit kumar Tyagi, Hand book on Energy Audit and Management, TERI (Tata Energy Research Institute).



Class:- T. B. Tech.	Semester- VI	L	T	P	Credits
Course Code : EE318	Course Name : Battery Management Systems	3	--	--	3

Course Description:

The purpose of this course is to provide a basic understanding of battery management systems. This course focuses on lithium-ion cell, Lithium-Polymer battery and BMS. In addition, this course provides a foundation in battery estimation and battery testing terminology. This course deals with function of battery-management-system requirements as needed by various applications.

Course Learning Outcomes:

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

1. Discuss BMS for various applications.
2. Compare various batteries for specific applications
3. Illustrate battery parameters and battery testing
4. Explain battery management methods for a given system
5. Illustrate thermal management and aging of batteries for electric vehicles

Prerequisite: Power electronics, control systems.

Course Content		
Unit No	Description	Hrs
1	Introduction to BMS: General background on alternative energy sources and sustainability, Application Requirements for Batteries and BMS Electric Vehicle, Relevant R&D Indicators, Development Background of the Battery, Battery Management System, Functions of the Battery Management System, Topology of the BMS, Development Process of the BMS	06
2	Advanced Batteries: Li-ion batteries, Principle of operation, Battery components and design, cell and battery fabrications, Building block cells, battery modules and packs, battery modeling, types of batteries, Li-polymer batteries and applications Li-S battery, Li-Air battery, comparison of batteries.	06

3	Battery Parameter Estimation: Preliminary definitions, State of Charge Estimation, Classification of SOC estimation methods, SOC Modeling, Instantaneous SOC, Current Counting Method, Voltage Lookup Method. SOH Estimation, Classification of SOH, Estimation Methods, Parameterization for Environment and Aging, Capacity Estimation Based on SOC Estimation, Real-world issues pertaining to batteries. State of Power Estimation.	06
4	Battery Testing: Introduction to chargers and charging infrastructure and Battery swapping, Battery Test Platform, Charge and Discharge Test Equipment, Impedance Characteristic Test Equipment in Frequency Domain, Battery Test Process, Battery Test Data analysis, Constant current and constant voltage method, Introduction of Testing Standards.	06
5	Battery Management Methods: Fundamentals of battery management systems and controls, Topology of the BMS, Charging Protocols, Pulse Power Capability Dynamic Power Limits. Pack Management, Pack Dynamics, Cell Balancing, Regulations and Safety Aspects of High Voltage Batteries-Code and Standards	06
6	Thermal management and Aging of Batteries for EVs: Motivation for battery thermal management, Heat sources, sinks, and thermal balance, Design aspects of thermal management systems, Operational aspects, Aging effects, Aging mechanisms and root causes, Aging of battery packs, Testing, aging, modeling, Diagnostic methods, Extension of battery lifetime.	06

References -

Text Books:

- Rui Xiong, Battery Management Algorithm for Electric Vehicles, Springer
- Christopher D. Rahn and Chao-Yang Wang, Battery Systems Engineering, John Wiley & Sons, Ltd. Publication
- Online NPTEL resource on Electric vehicles by Prof. Zunzunwala and others from IIT Madras.

Reference Books:

- Bruno Scrosati, Jürgen Garche and Werner Tillmetz, Advances in Battery Technologies for Electric Vehicles, Woodhead Publishing, Springer
- H. A. Kiehne, Battery Technology Handbook, Marcel Dekker, NYC
- M. Ehsani, Y. Gao, S. Gay, A. Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles, CRC Press, NY.

Class: T.Y. B. Tech.	Semester: VI
Course Code: EE3104	Course Name: Advanced Control Systems

L	T	P	Credits
3	--	--	3

Course Description:

This subject deals with time domain, frequency domain and state space design methods of LTI systems, discrete time control systems and its stability analysis methods. Also it gives emphasis on MATLAB based case studies to understand computer based analysis of discrete time control systems

Course Learning Outcomes:

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

1. Design compensators for LTI systems.
2. Design state feedback controller and observer for the system models.
3. Examine stability of the state space models.
4. Analyze discrete time systems
5. Examine stability of discrete time systems

Prerequisite: Engineering mathematics, control systems, signals & systems

Course Content		
Unit No.	Description	Hrs
1	Design of compensator using root locus: Compensator design- lead, lag and lag-lead. Minor loop feedback compensation. Sensitivity of root locus.	06
2	Design of compensator using frequency response: Introduction, Reshaping Bode plot, Compensator design- lead, lag and lag-lead compensation.	06
3	State space design: Review on State Space Representation, State Transition Matrix, Canonical Forms, Tests for controllability and observability for continuous time systems – Time varying case, minimum Energy control, Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer.	06

4	Stability analysis in state space: Stability Analysis in State Space: Concept of Eigen values and Eigenvectors, Lyapunov Stability Analysis (Sylvester's Criterion), Lyapunov Stability Analysis (Stability Criterion), Lyapunov Stability Analysis (Direct Method)	06
5	Discrete Representation of Continuous Systems: Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.	06
6	Discrete Time control System Analysis: Review of Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s- plane to z plane. Solution of Discrete time systems. Time response of discrete time system. Stability analysis of closed-loop systems in z-plane using Jury test, bilinear transformation and root locus	06

References -

Text Books:

- M. Gopal, Modern Control System Theory, New Age International Publishers, 2nd edition
- B.C.Kuo, Automatic Control Systems, Tata Mcgrawhill Education,
- M. Gopal Digital Control engineering, New age international publication

Reference Books:

- K. Ogata Modern Control Engineering, Prentice Hall of India
- Stainslaw H. Zak, Systems and Control, Oxford Press
- K. Ogata, Discrete time control systems, Pearson Publisher

Class:- T.Y. B. Tech.	Semester- VI
Course Code : EE3124	Course Name: Application of Microcontrollers in Electrical Engineering

L	T	P	Credits
3	--	--	3

Course Description:

This course explores deeper into complex microcontroller architectures, advanced programming techniques, and sophisticated applications. This course covers the fundamentals of programming and interfacing with PIC microcontrollers, which are a family of microcontrollers developed by Microchip Technology. It is designed for individuals who already have a strong foundation in microcontroller programming and want to deepen their knowledge for more sophisticated applications.

Course Learning Outcomes:

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

1. Illustrate internal and external structure of PIC microcontroller
2. Make a use of instruction set to write assembly language programming
3. Develop embedded C language program of modern PIC microcontrollers
4. Design PIC microcontroller interfacing circuit for various I/O device

Prerequisite: Microprocessor 8085, Microcontroller 8051, C programming

Course Content		
Exp. No	Description	Hrs
1	PIC Architecture: PIC Architecture Comparison of CISC and RISC, RAM and Program memory organization, Program counters, Stack pointer, Bank Select Register, Status register, Data transfer instructions, Arithmetic and logical instructions.	06
2	Assembly language programming: Assembly language programming Addressing Modes for PIC 18 microcontroller, Branch instruction, CALL, RETURN, Bit addressable instruction. Assembly language programs I/O ports, SFR related to PORTs, I/O port programming.	06



3	Embedded C programming: Programming of PIC microcontroller in C Embedded C concepts, Header and source files and pre-processor directives, Data types, data structures, Control loops, functions, bit operations. I/O port programming in C, Delay programming. PIC 18 Timer 0 Programming in C	06
4	Special Hardware features and Programming: Timers required for CCP Applications, CCP module in PIC 18 microcontroller, Applications of CCP mode Generation of waveform using Compare mode of CCP module. Period measurement of a unknown signal using Capture mode in CCP module, Speed control of DC motor using PWM mode of CCP module	06
5	Interrupt programming; Interrupt Programming, Programming of Timer interrupts, Programming of External interrupts, Serial port programming. Interfacing of PIC18F458 8 bit model LCD(16x2)	06
6	Interfacing of PIC Microcontroller::; ADC, Programming of ADC using interrupts, Measurement of temperature and voltage Using PIC microcontroller. Interfacing DAC with PIC18F458, Interfacing of Electromechanical Relays and Opto-isolators.	06

References -

Text Books:

- Muhammad Ali Mazidi, Rolin McKinlay, and Danny Causey, PIC Microcontroller and Embedded Systems
- Tim Wilmshurst, Designing Embedded Systems with PIC Microcontrollers: Principles and Applications

Reference Books:

- Martin P. Bates, Programming 8-bit PIC Microcontrollers in C: With Interactive Hardware Simulation
- Han-Way Huang, PIC Microcontroller: An Introduction to Software & Hardware Interfacing

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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Outcomes:

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

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

Prerequisite: Engineering Mathematics

Course Content:

Unit No.	Description	Hrs.
1	Introduction to Reliability Engineering Reliability Engineering and Applications, failures and failure modes, reliability function, MTTF, MTBF, MTTR, repairable and non-repairable items, reliability economics, safety and reliability, quality and reliability, cost and system effectiveness, life characteristic phases, IoT in reliability analysis	06



2	System Reliability Modeling Discrete probability distribution, Continuous Probability Distributions, Reliability Block Diagram, Hazard rate and failure density, constant hazard rate model, increasing hazard rate models, decreasing hazard rate model, Series system, Parallel system, Series-Parallel system, Complex system, k-out-of-m systems	06
3	Reliability Allocation Definition, reliability allocation techniques, equal apportionment, AGREE method, ARINC method, feasibility of objectives apportionment technique, minimum effort method	06
4	Design for Reliability Reliability design process, reliability considerations in design, stress-strength interaction, factor of safety, margin of safety, loading roughness, redundancy, reliability improvement techniques, types of redundancy, Markov models, single unit, two unit and three unit Markov models	06
5	Techniques for Reliability Analysis Failure modes, effects and criticality analysis (FMECA), fault tree analysis, minimal cut set method, minimal tie set method, Ishikawa diagram, case study,	06
6	Reliability Testing Introduction to reliability testing, Accelerated Life Testing and Highly Accelerated Life Testing (HALT), Highly Accelerated stress Screening (HASS), software reliability : fundamental concepts, comparison and prevention, software testing	06



References –

Text Books:

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

Reference Books:

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



Class:- T. Y. B. Tech.	Semester- VI	L	T	P	Credits
Course Code : OE3084	Course Name : Materials Management	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

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

Course Content		
Unit No	Description	Hrs
1	Introduction to Material Management Importance of materials management, Materials function, Need of Integrated Concept, Scope of material management, Organizations for materials management, span of Control.	06
2	Codification and Standardization Standardization and simplification, Aim, Pro's and Con's and scope of Standardization, Classification and levels of standards. Codification, Nature, process, methods and advantages of codification.	06

3	Purchasing and vendor development Functions, steps, purchasing cycle, Types of buying, Details of International buying, Procedure, Relevance of Good Supplier Need for Vendor Evaluation-Goals of Vendor Rating-Advantages of Vendor Rating, Negotiation.	06
4	Warehousing and stores management Layout of stores and warehouse, material handling in stores, physical control of stocks: obsolete, surplus and scrap management, accounting and record keeping of stores	06
5	Inventory Management and Control ABC analysis- advantages, mechanism, purpose, objectives Importance & Scope of Inventory Control, Types of Inventory, Costs Associated with Inventory, Inventory Control, Selective Inventory Control, Economic Order Quantity, Safety Stocks	06
6	Materials Requirement Planning (MRP) Introduction, objectives, Terminology, Functions served by MRP, MRP Logic, systems and output, Management information form, Lot size consideration, Introduction to Manufacturing resource planning (MRP II)	06

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	–	–	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Basic Electrical Engineering.

Course Content		
Unit No	Description	Hrs
1	Introduction to industrial drives: Basic electric drives and its components, Types of loads, coupling systems, factors for choice of drives, Fundamental torque equation, speed torque conventions, equivalent values of drive parameters, thermal modelling of motor, classes of motor duty.	06
2	Energy conservation in industrial drives: Concept of energy conservation, losses in drive system, Measures for Energy Conservation in industrial drives, use of efficient converters, use of efficient motors, improvement of quality of supply, improvement of p.f. maintenance of drive system, safety and maintenance aspects in industrial drives	06

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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	--	--	3

Course Description:

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

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

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

Course Learning Outcomes:

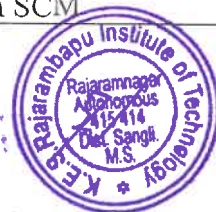
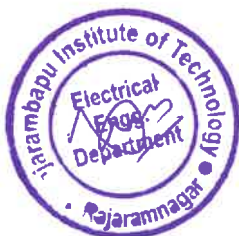
After successful completion of the course, students will be able to,

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

Prerequisite: Nil.

Course Content

Unit No	Description	Hrs
1	Understanding of Supply Chain: Objectives of a supply chains, decision phases, stages of supply chain, supply chain process view, cycle view of supply chain process, push/pull view of supply chain processes, key issues in SCM	06



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





K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
T. Y. B. Tech. Syllabus
To be implemented for 2023-27 NEP Batch
Department of Electrical Engineering

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

1. Identify, analyze & select business opportunity to suit his personality based on SWOT analysis
2. Make market research & survey for selected business
3. Prepare and apprise detailed Project Report
4. Formulate plan for financial management of project.
5. Apply managerial inputs for starting & establishing his own business

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

Course Content		
Unit No	Description	Hrs
1	Entrepreneurial motivation: Entrepreneur-Definition, Concept, importance, nature, types, entrepreneurial culture, growth, entrepreneurial traits & motivations. Entrepreneurship: Aspects, Barrier to entrepreneurship, Entrepreneur competencies, Industrial Economics,	06

2	Project identification: Concept of Project & classification, searching for business idea, opportunity finding, Scanning Business Idea & development. Selection of Product/Service, core competence, product life cycle, new product development process, creativity and innovation in product modification/development. Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection. Factors affecting selection of location for an industry. Importance of material handling and its relevance with facility location. Calculate capacity of plant and its relation with economies of scale. Including flexibility	06
3	Design Thinking: Steps in design thinking, application, case study Business Canvas: Importance, construction and application with case study Marketing: Market survey, 4 P of marketing, USP, Branding. JBTD: Jobs to be done	08
4	Setting Up of Enterprise: Steps for starting small scale industry, whom to approach for what, incentives and subsidies, Role of state development, finance corporations, nodal agencies, Role of consultancy Organization, Lead Bank, various clearances & certificate required for a particular industry, Start Up India & Make in India program. Factory design and Layout	04
5	Costing and Accounting: Financial appraisal, Direct and Indirect costs, Financial projections, Balance Sheet, Profit and loss account, Income tax, GST, Excise Tax, Long term loan, short term loan, over drafts, letter of credit, working capital management.	04
6	Project Report: Project Report preparation, Preliminary Project Report, feasibility report, marketing research, Project appraisal, statement of cash flow, accounting ratios, Break-even analysis	08





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T. Y. B. Tech. Syllabus

To be implemented for 2023-27 NEP Batch

Department of Electrical Engineering

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Basic Computer Technology

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

3	The Indian IT Act Cybercrime and Legal landscape around the world, cyber laws, challenges faced in designing cyber laws, IT Act: Cyber Crime (Section 65-74), Amendments to the Indian IT Act 2000.	05
4	Social Media Overview and Security Introduction to Social Networks. Types of social media, social media platforms, social media monitoring, Hashtag, Viral content, social media marketing, social media privacy, Challenges, opportunities and pitfalls in online social networks, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, best practices for the use of social media, Case studies.	06
5	E-Commerce and Digital Payments Definition of E-Commerce, Main components of E-Commerce, Elements of E-Commerce Security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stakeholders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act, 2007.	06
6	Digital Devices Security, Tools and Technologies for Cyber Security End Point device and mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third-party software, Device security policy, Cyber Security best practices, Significance of host firewall and Anti-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.	06

References -

Text Books:

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

Reference Books:

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

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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

1. Compare various conceptions of data mining as evidenced in both research and application
2. Apply Classification and Clustering techniques for real time problems
3. Characterize the various kinds of patterns that can be discovered by association rule mining
4. Analyze web mining techniques for structured/un-structured data patterns
5. Evaluate mathematical methods underlying the effective application of data mining

Prerequisite: Basic Mathematics, Descriptive statistical techniques.

Course Content		
Unit No	Description	Hrs
1	Introduction: Data Mining Tasks, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining, Data Pre-processing: Why Preprocessing, Cleaning, Integration, Transformation, Reduction, Discretization	06
2	Classification: Decision Trees, Bayesian Classification, Rule-Based Classification, Neural Network-Based Algorithms, Support Vector Machines, Classification by Association Rule Analysis, Nearest Neighbor Classifier	06
3	Clustering: Classification of clustering algorithms, Hierarchical Algorithms, Agglomerative Algorithms, Divisive Clustering, K-Means Clustering, Clustering Large Databases	06

4	Association Rules: What is an Association Rule?, Methods to Discover Association Rules, A Priori Algorithm, Partition Algorithm, FP-Tree Growth Algorithm, Generalized Association Rule	06
5	Web Mining: Web Mining, Web Content Mining, Web Structure Mining, Web Usage Mining, Text Mining, Unstructured Text, Text Clustering	06
6	Applications: Applications and Trends in Data Mining, Data Mining Applications, Social Impacts of Data Mining, Trends in Data Mining	06

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	--	-	3

Course Description:

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

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

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

Course Learning Outcomes:

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

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

Prerequisite: Write prerequisite required to study this course.

Course Content		
Unit No.	Description	Hrs
1	Understanding of Supply Chain: Introduction to Supply Chain Management, Evolution of Supply Chain Management, Analytics in Supply Chain Management, Supply Chain Planning, Different views of Supply Chain	06



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

References:

Text books:

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

Reference Books:

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

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

L	T	P	Credits
3	-	-	3

Course Description:

Mobile robotics refers to the field of robotics that focuses on the design, construction, operation, and use of robots that are capable of autonomous movement. Unlike stationary robots, mobile robots have the ability to navigate and operate in various environments, both indoor and outdoor, without being confined to a fixed location.

Key components and aspects of mobile robotics include 1. Sensors 2. Actuators 3. Control Systems 4. Power Systems 5. Communication 6. Autonomy.

One of the defining features of mobile robots is their ability to operate autonomously, meaning they can make decisions and navigate without direct human intervention. This autonomy can range from simple behaviors, like obstacle avoidance, to complex tasks such as mapping an unknown environment. Applications of mobile robotics are diverse and include Autonomous Vehicles: Self-driving cars, drones, and other autonomous vehicles are examples of mobile robots used for transportation and surveillance.

Warehouse Automation: Mobile robots are employed in warehouses for tasks such as inventory management, order picking, and transportation of goods.

Search and Rescue: Mobile robots equipped with sensors and cameras can be deployed in disaster-stricken areas to search for survivors or assess the situation.

Agriculture: Agricultural robots can be used for tasks like planting, harvesting, and monitoring crops.

Healthcare: Mobile robots can assist in hospitals for tasks like delivery of supplies, patient assistance, or disinfection.

Mobile robotics is an interdisciplinary field that combines elements of computer science, mechanical engineering, electrical engineering, and other related disciplines to create intelligent and adaptable robotic systems capable of navigating and performing tasks in dynamic environments. Advances in mobile robotics continue to drive innovation in various industries, making these systems increasingly capable and versatile.

Course Learning Outcomes:

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

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

Prerequisite: Basics of algebra, kinematics.

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

References -

Textbooks:

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

Reference Books:

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

Class:- T.Y. B. Tech.	Semester- VI	L	T	P	Credits
Course Code : OE348	Course Name : Information Technology Foundation Program	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

1. Solve the real-world problem using Programming Concept
2. Apply Data structure Algorithm to solve Computational Problem
3. Make use of an ER model for a given problem domain.
4. Relate the relationship between project integration, scope, cost and time Management System to improve quality of projects.

Prerequisite: Basic Knowledge of Computer System and Programming language

Course Content		
Unit No	Description	Hrs
1	Problem Solving Techniques Introduction to Logic, Problem Solving, Algorithms, and Flowcharts	06
2	Fundamentals of C and Data Structures Introduction to C, Basic Programming, Selection Control Structure, Iteration Control Structure, Demonstration of 1D and 2D arrays, Function, Strings. Introduction to basic data structures, Searching and Sorting Algorithms.	06
3	Programming Paradigm Introduction of Programming Paradigm, Coding Standards, Best Practices, , Introduction to code optimization, Modular approaches through Functions, Testing and Debugging	06

4	Object Oriented Concepts Introduction to Object Oriented Programming, C versus C++, Features of OOP, Constructor, Destructor, Inheritance, Polymorphism.	06
5	Relation Database Management Introduction, ER modelling, SQL Queries	06
6	Project Management Project Management Concepts, Project Management Activities, Project Estimation, Project Planning and Scheduling, Project Risk Management, Project Execution and Monitoring, Project Communication Management, Project Management Tools, Project Monitoring and Tools	06

References -

Text Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Possess basic knowledge of mathematics

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

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

References -

Reference Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

1. Explain different concepts and processes in digital image processing.
2. Apply different image processing operations on an image.
3. Analyze various operations on image using different tools.
4. Compare various filtering, enhancement, segmentation and classification techniques used in image processing.
5. Design various applications in Image Processing.

Prerequisite: Basic knowledge of Linear Algebra and programming language

Course Content		
Unit No	Description	Hrs
1	Digital Image Fundamentals Components of image processing system, human and computer vision, hierarchy of image processing system, applications, image formation and digitization, binary, gray scale and color images.	06
2	Image Enhancement & Image Filtering Gray level transformation function: Image Negatives, Log Transformations, Power Law Transformation, Piecewise Linear Transformation Functions, Histogram equalization, Basics of spatial filtering, smoothing and sharpening spatial filter.	06
3	Morphological Image Processing Dilation and erosion, opening and closing operation, Hit or miss transformation, Edge Detection, Applications of Morphological Image Processing.	06

4	Image Segmentation Thresholding, Role of illumination, global and adaptive thresholding, pixel-based segmentation, region-based segmentation and edge-based segmentation.	06
5	Image Shape and Classification Shape representation, Feature space, Clusters and classification techniques, Supervised and Unsupervised classification, Basic algorithms: Boundary extraction, region filling, thinning and thickening, skeletons.	06
6	Real Life Applications and Case Studies Face recognition, Object detection, Object Classification, various case studies and applications of Digital Image Processing.	06

References –

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Basic knowledge of probability and control system

Course Content		
Unit No	Description	Hrs
1	Foundations of Fuzzy Sets Fuzzy sets and membership, Universe of discourse, Classical sets operations and properties, Fuzzy sets operations and properties, Mapping of Classical Sets to Functions, Problems based on Fuzzy sets operations and properties.	06
2	Fuzzy Relations and Operations Cartesian product, Cardinality of Crisp Relation, crisp relations, fuzzy relations, Operations on Fuzzy Relations Properties of Fuzzy Relations, membership functions, Composition, Fuzzy Cartesian Product and Composition, Value Assignments, Problems based on relation and composition.	06

3	Membership Functions, Fuzzification and Defuzzification Features of the Membership Function, Fuzzification, Defuzzification to Crisp Sets, λ -Cuts for Fuzzy Relations, Defuzzification to Scalars, Problems based on λ -Cuts and Fuzzy Relations, Fuzzy Control system.	06
4	Introduction to Soft Computing and Neural Networks What is soft computing? Differences between soft computing and hard computing, Biological Neural Networks, The Journey of Neural Networks, Activation Function, Soft Computing constituents.	06
5	Neural Networks and Learning Mechanisms Learning, Supervised Learning; Unsupervised Learning, Supervised mechanism, Unsupervised Mechanism, Reinforcement Learning, Learning Rules, The Perceptron learning, Architecture of Neural Networks, Feedforward Networks, Multilayer feedforward network.	06
6	Advanced Neural Networks and Applications Recurrent Neural Network or Feedback Network, Backpropagation Networks, Radial Basis Function Network, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing.	06

References -

Text Books:

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

Reference Books:

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



Class:- T.Y. B. Tech	Semester-VI	L	T	P	Credits
Course Code : OE356	Course Name : Project Management	3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

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

Course Content		
Unit No	Description	Hrs
1	Overview of Project appraisal: Project Development Cycle, Identifying data requirements and analyzing their suitability for preparation of feasibility studies, project formulation, screening for pre-feasibility studies, stages of feasibility report preparation, Project Analysis including Market Analysis, Technical Analysis & Financial Analysis, applying various techniques and integrating the data gathered into a full-fledged business plan.	07
2	Project Analysis: Environmental Analysis, Risk Analysis, Infrastructure Development & Financing, Risk Management, Risk identification, Qualitative risk analysis, Quantitative risk analysis, Risk planning, Risk control, Evaluating the rewards & risks for sustainable opportunities. National Cost-Benefit Analysis, Financing Sustainable Opportunities.	06



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3	Project Planning: Planning fundamentals, project master plan, work breakdown structure & other tools of project planning, work packages project organization structures & responsibilities, responsibility matrix, Time and cost estimates with AON and AOA conventions, Budget estimates, Network analysis, Float analysis, crashing concepts	06
4	Project appraisal: Technical Appraisal: Operation and Production Plan: Types of production systems, Product design and analysis, New product development, location and layout decisions, project layout, plant and technology choices, product specification and customer needs, production planning and control, Commercializing Technologies	06
5	Commercial Appraisal: Economic feasibility and commercial viability, market analysis, Market Research, Industry Analysis, Competitor analysis, defining the target market, market segmentation, market positioning, building a marketing plan, market strategy. Financial Appraisal: Pro-forma income statements, financial projections, working capital requirement, funds flow and Cash flow statements; Ratio Analysis.	06
6	PERT, CPM, Resource allocation: Tools & techniques for scheduling development, crashing of networks, time-cost relationship, and resource levelling multiple project scheduling. Computer applications and Software for Project Management	05





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References -

Text Books:

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

Reference Books:

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





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Class:-T. Y. B. Tech.	Semester-VI	L	T	P	Credits
Course Code : OE358	Course Name :Plumbing (Water and Sanitation)	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

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

Course Content		
Unit No	Description	Hrs
1	Importance of Codes, Architectural and Structural Coordination Codes and Standards: Scope, purpose; codes and standards in the building industry, UIPC-I, NBC and other codes, Local Municipal Laws, approvals, general regulations, standards. Architectural and Structural Coordination: Provisions for plumbing systems, coordination during the planning stage, various agencies involved and their roles, space planning for plumbing systems, plumbing shafts, basements and terraces planning, sunken toilets, location of columns and beams, slabs position, the importance of ledge walls, protection of pipes and structures, waterproofing.	06
2	Plumbing Terminology Plumbing Fixtures: readily accessible, aerated fittings, flood level rim, floor sink, flushometer valve, flush tanks, lavatories, macerating toilet, plumbing appliances: Traps, Drainage, Valves and Water supply meter.	06



3	Plumbing Fixtures and Fittings Introduction to Drainage Fixture Units (DFU): pipes, water closets, bidets, urinals, flushing devices, washbasins, bath/shower, toilets for differently abled, kitchen sinks, water coolers, drinking fountain, clothes washer, dishwasher, mop sink, overflows, strainers, prohibited fixtures, floor drains, floor slopes, hot water temperature controls, installation standard dimensions in plan and elevation, introduction to vent size and vent requirement, the purpose of venting, vent connections, vent stacks, cleanouts, venting of interceptors,	06
4	Sanitary Drainage and Storm Drain One pipe and Two pipe systems, different pipe materials and jointing methods, special joints, hangers and supports, protection of pipes and structures, alternative materials, workmanship, prohibited fittings and practices, T and Y fittings, cleanouts, pipe grading, fixtures below invert level, sizing case study as per NBC, safety,	05
5	Water Supply, Grey and Reclaimed Water Sources of water, potable and non-potable water, reclaimed water, calculating daily water requirement and storage, hot and cold water distribution system, backflow prevention, air gap, cross connection control, controls and thermal expansion fixtures its installation and testing, protection of underground pipes, introduction to Water Supply Fixture Units (WSFU) and sizing.	05
6	Introduction to WTP and STP Need to reduce and reuse, 24x7 water supply, metering and sub-metering, typical daily water and wastewater calculations for a project. Sources, utility and treatment of water, parameters of water quality, parts of water treatment plant (WTP), disinfection methods, storage conditions, RO water systems, rainwater harvesting treatment, desalination. Grey water and black water, characteristics of domestic sewage, sewage treatment methods, aerobic and anaerobic treatment, level of treatment, reclaimed water.	08



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References -

Codes of Practice:

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

Reference Books:

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



Class:- T.Y. B. Tech.	Semester- VI	L	T	P	Credits
Course Code : OE362	Course Name : Flexible Manufacturing Systems	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Nil

Course Content		
Unit No	Description	Hrs
1	Introduction Flexible and rigid manufacturing, F.M. Cell and F.M. System concept, Types and components of FMS, Tests of flexibility, Group Technology and FMS, unmanned factories, Economic and Social aspects of FMS. Advantages and disadvantages of FMS Group technology	06
2	Control structure of FMS Architecture of typical FMS, Automated work piece flow, Control system architecture – Factory level, Cell level; hierarchical control system for FMS, LANs - characteristics, transmission medium, signalling, network topology and access control methods.	06

3	Scheduling & Loading Of FMS Introduction, Scheduling of operations on a single machine, 2 machine flow shop scheduling, 2 machine job shop scheduling, scheduling 'n' operations on 'n' machines, Scheduling rules, loading problems, Tool management of FMS, material Handling system schedule. Problems.	06
4	FMS hardware and software FMS computer hardware and software, general structure and requirements, PLCs, FMS installation and implementation, acceptance testing Characteristics of JIT pull method, small lot sizes, work station loads, flexible work force, line flow strategy. supply chain management	06
5	Cellular Manufacturing Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing. Various case studies of implementation of FMS at industries.	06
6	Additive Manufacturing Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Classification of AM processes-Benefits- Applications.	06

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Basics of Manufacturing, Python Programming.

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



4	Predictive Maintenance Predictive maintenance in manufacturing, AI techniques for fault prediction in mechanical systems, Use cases of AI in equipment maintenance, Vibration analysis and failure prediction.	06
5	Inferencing on Edge and Demand Forecasting Edge inferencing, edge inferencing in manufacturing, demand forecasting, solving problem in manufacturing using demand forecasting.	06
6	AI Ethics and Responsible AI AI Ethics, Importance of AI Ethics in manufacturing, Responsible AI, frameworks for developing responsible AI.	06

References -

Text Books:

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

Reference Books:

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

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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

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

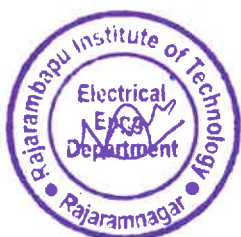
Course Content		
Unit No	Description	Hrs
1	Foundations of AI-Driven Cybersecurity Overview of Cybersecurity and AI concepts, Intersection of Cyber Security and Artificial Intelligence (AI), Applications of AI for solving real-world challenges, CIA Triad Modelling-Addressing trade-offs and conflicting priorities, Cybersecurity Framework Prevention, detection, and response, NIST AI Risk Management Framework, Traditional cyber threats, Introduction to OWASP Frameworks and risks documentation	06
2	Machine Learning and Generative Models for Cybersecurity AI applications in cybersecurity, AI project cycle, future trends in AI-cybersecurity integration, Python Libraries Scikit-learn, TensorFlow and scripting for cybersecurity tasks. Supervised Learning: Basics, malware	06



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





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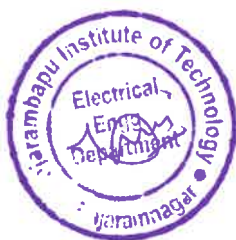
References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

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

Course Content		
Unit No	Description	Hrs
1	Introduction to AI in Agriculture Role of AI in agriculture, types and domains of AI, relevance to SDGs, overview of AI Project Cycle, introduction to AI Ethics.	06
2	Problem Scoping and Data Acquisition Problem scoping in agriculture, challenges in Agri-domain, data types, sources, data acquisition, data handling and visualization, AIoT.	06
3	AI Modeling and Deployment Introduction to modeling, training and testing datasets, model evaluation metrics, deployment, practical examples of AI models in Agri-apps.	06
4	Statistical AI Techniques in Agriculture Statistical data analysis, regression and classification techniques, crop yield and damage prediction, introduction to generative AI for data.	06



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5	AI Applications: CV and NLP in Agriculture CV techniques and use cases (e.g., crop/rice/livestock), NLP applications (chatbots, market intelligence), ethical implications, generative AI in CV/NLP.	06
6	Policy, Ethics, and Future Trends in AI for Agriculture Ethical considerations in deploying AI solutions in agriculture, privacy and data protection issues, AI policy frameworks, government initiatives, global and national regulations, future trends and opportunities in AI-driven agriculture.	06

References

Text Books:

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

Reference Books:

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





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

L	T	P	Credits
3	-	-	3

Course Description:

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

The course will be Open Elective choice for all students

Course Learning Outcomes:

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

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

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

Course Content		
Unit No	Description	Hrs
1	Introduction to AI and Sustainability Introduction to Sustainability, Approaches to Sustainability, Dimensions of Sustainability, Introduction to AI and Domains of AI, AI Ethics, AI Contributing to Green Skills, AI's role in achieving sustainability goals	06
2	AI Foundations Supervised, unsupervised, reinforcement learning, Introduction to Neural networks and deep learning, Tools and frameworks for AI: Python, TensorFlow, Scikit-learn	06



3	Environmental Sustainability Introduction to Environmental Sustainability, Business Approach for Environmental Sustainability, AI for Environmental Sustainability, Environmental Challenges for AI, AI in Clean water and sanitation, AI in Climate Action, AI in Affordable and Clean Energy	06
4	Social Sustainability Introduction to Social Sustainability, Business Approach for Social Sustainability, AI for Social Sustainability, Social challenges for AI, AI in Zero Hunger, Good Health and Well-being, AI in Accident Detection	06
5	Economic Sustainability Introduction to Economical Sustainability, Business Approach for Economical Sustainability, AI for Economical Sustainability, Economical Challenges for AI, AI in Decent Work and economic growth, AI in Industry Innovation and Infrastructure, AI in Intelligent Recycling	06
6	Case Studies and AI Projects Steps in AI Project Development, AI in Quality Education, Transportation, healthcare chatbot, Fraud Detection Predictive Maintenance, Sentiment Analysis for Social Media	06

References -

Text Books:

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

Reference Books:

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





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

L	T	P	Credits
3	-	-	3

Course Description:

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

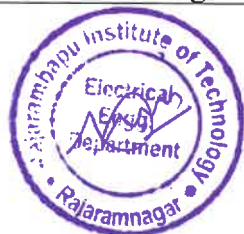
Course Learning Outcomes:

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

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

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

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



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

References -

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

After successfully completing the course, student will able to:

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

Prerequisite: Basic knowledge of Environmental Science.

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

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

References:

Text Books:

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

Reference Books:

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

Class:- T.Y. B. Tech	Semester-VI	L	T	P	Credits
Course Code: CSMD302	Course Name: Artificial Intelligence	3	--	--	3

Course Description:

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

Course Learning Outcomes: on completing this course, students will be able to

1. Understand the basic concepts and techniques of Artificial Intelligence.
2. Apply AI algorithms for solving typical practical problems.
3. Describe appropriate knowledge representation schemes in AI.
4. Apply reasoning schemes in AI.
5. Analyze the planning schemes for goal stack.
6. Evaluate performance of solution for constraint satisfaction problem.

Prerequisites: Basic knowledge of logical reasoning and Probability theory.

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



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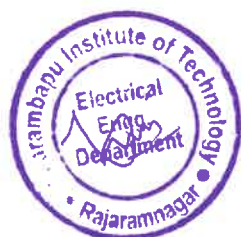
References:

Text Books:

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

References:

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



Class: - T.Y. B. Tech.	Semester- VI
Course Code: EEMD302	Course Name: Smart Grid

L	T	P	Credits
3	--	--	3

Course Description:

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

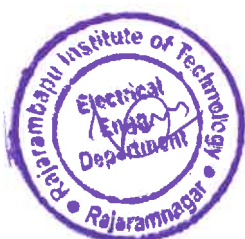
Course Learning Outcomes:

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

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

Prerequisite: Power system, Renewable energy sources, power system economics

Course Content		
Unit No	Description	Hrs
1	Introduction to smart grid: Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India, comparison between smart grid and micro grid. Grid Codes.	06
2	Smart grid architecture: Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, centralized, distributed and hierarchical control strategies, power line communications, supervisory control and data acquisition system.	06
3	Communication technology in smart grid:	06



	Introduction to communication technology, Home Area Network (HAN), Neighborhood Area Network (NAN) and Wide Area Network (WAN), two-way digital communications paradigm, synchro-phasor measurement units (PMUs) – wide area measurement systems (WAMS), Introduction to Internet of things (IoT)- Applications of IoT in Smart Grid.	
4	Information technology in smart grid: Data communication, dedicated and shared communication channels, switching techniques- circuit switching, message switching, packet switching, virtual packet switching, datagram packet switching, standards for information exchange, information security for the smart grid,	06
5	Distributed generation and storage: Introduction to distributed energy sources, solar PV system, wind energy system, microgrids, microgrid architecture, AC micro grid, DC microgrid, storage technologies- battery, super capacitor, compressed air energy storage, pumped hydro energy storage, introduction electric vehicles- vehicle to grid (V2G), grid to vehicle (G2V), vehicle to vehicle (V2V) and vehicle to home (V2H) operation in smart grid.	06
6	Smart metering & distribution automation: Evolution of electricity metering, key components of smart metering, overview of the hardware used, communications infrastructure for smart metering and protocols for smart metering, equipment's used in smart grid - current transformers, voltage transformers, intelligent electronic device, bay controller, remote terminal units, components for fault isolation and restoration, fault location.	06

References -

Text Books:

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

Reference Books:

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

Class: -T.Y. B. Tech.	Semester-VI
Course Code : ECMD302	Course Name : Industrial Electronics

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

1. Identify basics Power Electronics devices and components.
2. Illustrate use of Power Electronics.
3. Develop PLC logic using ladder programming.
4. Analyze industrial electronics applications.

Prerequisite: Knowledge of basic electronics and programming.

Course Content		
Unit No	Description	Hrs
1	Power Electronic Components: Applications of power electronics, Power Electronic System, Power semiconductor devices: power diode, power BJT, Power MOSFET, IGBT, SCR, Diac, TRIAC, Ratings, control characteristics of power devices, Characteristics and specifications of switches, Types of power electronic circuits.	06
2	Power Converters: AC-DC Converters (Rectifiers), DC-DC converters (choppers), DC-AC converter (Inverters), AC-AC Converters (1-phase, 3-phase) Cycloconverters	06
3	DC and AC Drives: Basic characteristics of DC motor, operating modes, DC motor control using choppers and rectifiers, Torque-speed characteristics of induction motor, speed control techniques of AC motor: stator-voltage, rotor resistance, and v/f control, basic equations, characteristics.	06

4	Introduction to PLC: Introduction about industrial automation, History of industrial automation Need of automations in industries, Automation control circuit and power circuit, Control system in Industry, Types of PLCs	06
5	PLC Programming: Types of Programming Languages, Introduction about PLC Programming software, Ladder logic diagram, Structure of program, Procedure for creating ladder diagram, Logical function done by ladder program in software.	06
6	Applications: Industrial conveyor systems, Automatic Bottle Filling System, Traffic Light Control system, UPS, Battery charging circuits and management Systems, Induction heating and dielectric heating.	06

References -

Text Books:

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

Reference Books:

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

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

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Fundamentals of Computers

Course Content		
Unit No	Description	Hrs
1	Software Requirements, Analysis and Specification Software requirement analysis and specification, problem analysis, Requirement Specification, Validation, effort estimation, risk management, software testing types	06
2	Software Process Models Waterfall model, V model, Prototyping, Spiral model, Agile software development	07



3	Function-oriented Design Design principles, module level concepts, Design notation and specification, structured design methodology, Verification	05
4	Structural Modeling using UML Classes, Relationships, Common mechanisms. Diagrams, Class Diagrams, Interfaces, Types and Roles, Packages, Instances and Object Diagram	06
5	Behavioral Modeling and Architectural Modeling using UML Interactions, Use cases, Use case diagram, Activity diagrams, Events and signals, State Machines, Components, Deployment, Collaboration, Patterns and Frame works, Component diagrams and Deployment Diagrams	06
6	Case studies: A. Case study on DFD for Hospital Management System, Library Management System, Railway Reservation System and Online Shopping System. B. Case study design using UML on Banking system, College management system, online food ordering system.	06

References -

Text Books:

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

Reference Books:

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



Class: - T. Y. B. Tech.	Semester-VI	L	T	P	Credits
Course Code: MEMD304	Course Name: Marketing and Business Fundamentals for New Products	3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

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

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

References: -

Textbooks:

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

Reference Books:

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

Class: - T.Y. B. Tech.	Semester-VI	L	T	P	Credits
Course Code: MCMD302	Course Name: Industrial Robotics	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: Sensor and Instrumentation

Course Content		
Unit No.	Description	Hrs.
1	Fundamentals of Robotics: History of Robotics, Definitions of Industrial Robot, Type and Classification of Robots, Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot.	06
2	Grippers for Robotics: Grippers, Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper systems.	06
3	Sensors for Robotics: Types of Sensors used in Robotics, Touch Sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure sensors, Application of Sensors, Characteristics of Sensing devices, Selection for Particular application Case study.	06
4	Drives and Control for Robotics: Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system, Types of Controllers, Introduction to closed loop control.	06
5	Programming and Languages for Robotics: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, ROS.	06

6	Application of Robotics in Industry: Application of robot in welding, machine tools, material handling, and assembly operations, parts sorting and parts inspection, AI in robotics, Introduction to Cobots, Future Application and Challenges and Case Studies.	06
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References -

Text Books:

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

Reference Books:

- James A Rehg, Introduction to Robotics in CIM Systems, Prentice Hall of India,
- Deb S R, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi,
- Janaki Raman P A, Robotics and Image Processing, Tata McGraw Hill,
- Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition,.



Class: - T.Y B. Tech	Semester – VI	L	T	P	Credits
Course Code: AIMD302	Course Name: Principles of AI	3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

1. Articulate basic concepts and techniques of Artificial Intelligence.
2. Apply AI algorithms for solving typical practical problems.
3. Designate appropriate knowledge representation schemes in AI.
4. Analyze reasoning schemes in AI.

Prerequisite: Basic knowledge of logical reasoning, Probability theory.

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



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(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
T. Y. B. Tech. Syllabus
To be implemented for 2023-27 NEP Batch
Department of Electrical Engineering

6	Reasoning schemes in AI: Introduction to nonmonotonic reasoning, default reasoning, statistical reasoning, probability and Bayes' theorem, combining uncertain rules.	06
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References -

Text Books:

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

Reference:

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





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Class: T. Y. B. Tech.	Semester- VI	L	T	P	Credits
Course Code: RAMD302	Course Name: Industrial Automation & Control	3	-	-	3

Course Description:

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

Course Outcomes:

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

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

Prerequisite: NIL

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



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

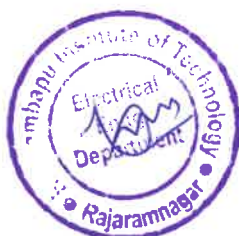
References –

Text Books:

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

Reference Books:

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



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

L	T	P	Credits
2*	--	--	Audit

Course Description: Quantitative and Reasoning tests form a major part of most of the competitive exams and recruitment processes. They evaluate numerical ability and problem solving skills of candidates. Along with the arithmetic abilities, candidate's patience while reading through the question is also tested. Decision making is also a crucial part of the process with a question having multiple solutions and the candidate has to choose the most efficient one. Fast calculations have become an integral part of a candidate's career. Calculating the remuneration and efficiency, estimating profits and interests on the principal, using a logical approach towards solving a problem is now a routine affair for a professional.

Course Learning Outcomes:

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

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

Prerequisite: Fundamentals of various Mathematical and Arithmetic operations, Calculations.

Course Content		
Unit No	Description	Hrs.
1.	Speed Time Distance Average Speed, Special Cases of Average Speed, Relative Speed, Cases of relative speed Circular motion, Applications of STD	03

2.	Trains Stationary Object with Negligible length, Stationary Object with considerable length, Moving object with negligible length, Moving object with considerable length, Including-Excluding Stoppages.	02
3.	Boat & Streams Upstream case, Downstream case, Perpendicular movement	02
4.	Races Head Start, Dead heat, defeat, 3 man participating in race, ratio related examples,	02
5.	Permutation & Combination Difference between P & C, Theorems of Permutation Theorems of Combination, Counting numbers of squares & rectangles, Triangle	02
6.	Probability Introduction, Range of Probability, Sum & Product Rule, Coins, Dice, Cards, Bags & Balls	02
7.	Geometry Triangles, Quadrilaterals, Circles, Polygons	02
8.	Mensuration Cube, Cuboid, Cylinder, Cone Sphere, Prism	02
9.	Clock Basic, Time lag constant, Standard time of coincidence, Various concepts of hour and minute hand, Questions on strikes of clock, Find time in the mirror, Questions based on faulty clock, Time gains or loss	02
10.	Calendar Leap year, Odd day concept, Month code, century codes, Same Calendar concept, Finding day or date (Box method)	02
11.	Seating Arrangement Type of arrangements, Types of information, Data extraction, Linear-Non Linear movement, Advance movement	02



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12.	Analytical Reasoning I Figure Counting, Pattern Completion / Figure Matrix, Embedded Figures / Hidden Figures,	03
13.	Analytical Reasoning II Water images , Mirror Images , Cubes and Dice , Paper Folding and Cutting	02
14.	Statements & Conclusion Understanding the Premise, Identifying Logical Deductions, Cause and Effect	02
	Total Hours	30

References -

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



Class:- T.Y. B. Tech.	Semester- VI
Course Code : EE3544	Course Name : Power Electronics Laboratory

L	T	P	Credits
–	–	2	1

Course Description:

This course deals with the demonstration of operating characteristics of power electronic devices. It emphasizes practical demonstration and analysis of various power converters connected to different loads.

Course Learning Outcomes:

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

1. Implement triggering circuits and operating characteristics of power semiconductor devices.
2. Demonstrate performance of power electronic converters connected to resistive load
3. Analyze performance of power electronic converters based on output parameters and operating characteristics.
4. Design power electronics converters for specific applications
5. Perform simulation of power electronic converters

Prerequisite: Analog Electronics Laboratory, Basic Electronics Laboratory

Expt. No.	Description	Hrs
1	Plot V-I Characteristics of SCR	02
2	Plot Operating Characteristics of Power BJT, MOSFET and IGBT	02
3	Demonstrate Triggering circuits of SCR	02
4	Perform Simulation: Single Phase Full Wave Controlled Rectifier: Bridge Configuration	02
5	Perform Simulation: RC Low Pass and High Pass Passive Filter for Rectifier Circuit	02
6	Analyze performance of Single Phase Full Bridge Controlled Rectifier for R-Load	02
7	Analyze performance of Three Phase Full Bridge Controlled Rectifier R-Load	02
8	Analyze performance of Three Phase Half Bridge Controlled Rectifier R-Load	02



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9	Demonstrate Chopper Circuit with high frequency switching.	02
10	Demonstrate Multi- Quadrant Chopper Circuit	02
11	Analyze performance of Three Phase Cyclo-converter	02
12	Perform Simulation: Single Phase Inverter	02



Class:- T.Y. B. Tech.	Semester- VI	L	T	P	Credits
Course Code: EE360	Course Name: Automation and Control Lab	--	--	2	1

Course Description:

This Course offers an opportunity for the learners to have practical knowledge of the industrial automation and technologies. This laboratory course is to inculcate the practices followed in the automation industry along with the use of sensors and actuators. Programmable Logic Controller (PLC) is the main focus of this course and students are asked to develop the relay ladder logic (RLL) for the given problem statement. Also, other IEC programming languages are introduced to them. Study of SCADA, HMI and its applications also enhances their skills.

Course Learning Outcomes:

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

1. Design relay logic-based control system for the given applications.
2. Implement IEC based programming languages for various PLCs.
3. Develop Relay Logic Ladder for the real-time PLC based control applications.
4. Design SCADA based GUI system for the real time applications.
5. Develop GUI based monitoring system of the real time applications using HMI.

Prerequisite: Write prerequisite required to study this course.

Expt. No.	Description	Hrs
1	Study Hardware components and software related to PLC	02
2	Use IL, RLL, FBD IEC based programming languages for various applications	02
3	Implementation of PLC based logic gates and case studies.	02
4	Implementation of DOL starter with Latch (L) and Unlatch (U) coils and case studies.	02
5	Implementation of PLC based timer applications	02
6	Implementation of PLC based counter applications	02
7	Implementation of PLC based compare and math instructions	02



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8	Study of SCADA based application.	02
9	Implementation of Analog PLC Operations.	02
10	Study of HMI based ON/OFF control.	02



Class:- T.Y. B. Tech.	Semester- VI	L	T	P	Credits
Course Code : EE364	Course Name : Power System Protection Laboratory	--	--	2	1

Course Description:

'Power System Protection' laboratory is offered as the core course in Electrical Engineering under graduate program. This course focuses on various techniques of protection system applied in power systems. This course deals with the practical performance, Hands on practice and panel demonstrations for power system protection schemes.

Course Learning Outcomes:

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

1. Explain different types of power system schemes.
2. Compare the Electromagnetic, static and microprocessor based relays
3. Describe Current-time and voltage-time characteristics of relays.
4. Demonstrate faults on power system fault simulation panels
5. Illustrate the proper earthing system and safety precautions in Electrical systems

Prerequisite: Basic Electrical Engineering, Power System, Power system analysis.

Expt. No	Description	Hrs
1	Study the characteristics of MCCB and ELCB	02
2	Plot Current-Time characteristic of Fuse and MCB	02
3	Plot Current-Time characteristic of Induction disc relay	02
4	Plot Voltage-Time characteristic of static overvoltage relay	02
5	Plot Voltage-Time characteristic of static under voltage relay	02
6	Plot Current-Time characteristics of Microprocessor based relay a) Definite time b) Normal inverse	02
7	Plot Current-Time characteristics of Microprocessor based relay a) very inverse b) Extreme inverse	02
8	Simulate faults on transformer protection demo panel	02





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9	Simulate faults on generator protection demo panel	02
10	Obtain Break down voltage (BDV) of solid insulator on high voltage test kit	02
11	Obtain Break down voltage (BDV) of liquid insulator on high voltage test kit	02
12	Study of Numerical Relay	02





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Class: T. Y. B. Tech.	Semester: VI	L	T	P	Credits
Course Code: EE3584	Course: Capstone Project Phase -I	--	--	2	1

Course Description:

This course gives opportunity for the students to offer engineering solutions to a relevant problem by working in a group. Apart from technical knowledge, he/she can explore interpersonal skills as well as ability to plan, executive and justify the tasks. This course brings the awareness about systematic and logical report writing and presentation of the technical efforts.

Course Outcomes:

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

1. Carry out literature survey and identify as well as select a problem.
2. Communicate problem, methodology and outcomes systematically and effectively in the form of a technical report.
3. Work as a member and a team leader in engineering teams / multidisciplinary teams.
4. Demonstrate an ability to use different tools and techniques to solve the given problem.
5. Comprehend and analyze an engineering problem and report findings to provide an appropriate solution.

Course Content:

The department always encourages projects which are related to industrial problems or of interdisciplinary nature to provide opportunity for the students to work on real life problems.

Guidelines:

1. The Project group in (T. Y. Second Term) sixth semester will continue the project work in (B. Tech. First Term) seventh semester.
2. The group should maintain a logbook of activities.
3. Assessment of the project for award of ISE marks shall be done by the guide and a departmental committee (consisting of minimum two faculty members) as per the guidelines given by department.
4. The candidate shall submit the synopsis of the project work to the evaluation committee at the starting of sixth semester.
5. It shall include the problem definition, literature survey, approaches for handling the problem, finalizing the methodology and estimation of time and cost for the project work and design calculations / experimental design etc.

