B. Tech. in Computer Science & Engineering (Artificial Intelligence and Machine Learning) with Multidisciplinary Minor

Rajarambapu Institute of Technology
CSE (AI&ML) Engg Department
415 414
Rajaramnagar

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

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 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)
Class: S. Y. B. Tech **Semester:** III

Course Code	Course	Teaching Scheme						Evaluation Scheme				
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %) Max	Theory (Marks %) Min. for passing	Practical (Marks %) Max.	Practical (Marks %) Min. for passing
AI221	Mathematics for AI and Statistics and Fuzzy Systems	3	-	-	54	90	3	ISE	20	40 / 40	----	----
								UT1	15		----	----
								UT2	15		----	----
								ESE	50	40	----	----
AI2031	Data Structures and Algorithms	3	-	-	54	90	3	ISE	20	40 / 40	----	----
								UT1	15		----	----
								UT2	15		----	----
								ESE	50	40	----	----
AI223	Discrete Mathematical Structures and Graph Theory	3	-	-	54	90	3	ISE	20	40 / 40	----	----
								UT1	15		----	----
								UT2	15		----	----
								ESE	50	40	----	----
AI2071	Principles of Artificial Intelligence	3	-	-	54	90	3	ISE	20	40 / 40	----	----
								UT1	15		----	----
								UT2	15		----	----
								ESE	50	40	----	----
	Multidisciplinary Minor-I	3	-	-	54	90	3	ISE	20	40 / 40	----	----
								UT1	15		----	----
								UT2	15		----	----
								ESE	50	40	----	----
SH2175	Environmental Science	1	-	2	24	60	2	ISE	50	40 / 40	---	---
								ESE	50	40	---	---
AI225	Web Technology Lab	2	-	2	54	90	3	ISE	----	----	50	50
								ESE	----	----	50	50
AI2111	Data Structures and Algorithms Lab	-	-	2	06	30	1	ISE	----	----	50	50
								ESE	----	----	50	50
AI2171	Python Programming Lab	2	-	2	54	90	3	ISE	----	----	100	50
	Professional Skills Development and Foreign Languages	-	-	2	06	30	1	ISE	-	----	100	50
	TOTAL	**20**	**-**	**10**								
	TOTAL CONTACT HOURS	**30**			**414**	**750**	**25**					

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, TW: Term Work, SL: Self Learning

Total Contact Hours/week : 30
Total Credits : 25

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Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

Sr. No.	Subject Name		Course Code
1.	Professional Skills Development and Foreign Languages	Professional Leadership Skills	SH2635
2.		Interpersonal Skills	SH2615
3.		Innovation Tools and Methods for Entrepreneurs	SH2695
4.		Personal Effectiveness and Body Language	SH2595
5.		German Language - Level III	SH2735
6.		Japanese Language - Level III	SH2715

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

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max	Min. for passing		Max.	Min. for passing
AI204	Machine Learning	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
AI208	Database Management Systems	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
AI228	Software Engineering and Project Management	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			--	---
								UT2	15			---	---
								ESE	50	40		---	---
AI230	Natural Language Processing	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			--	---
								UT2	15			---	---
								ESE	50	40		---	---
AI232	Operating Systems	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			--	---
								UT2	15			---	---
								ESE	50	40		---	---
	Multidisciplinary Minor - II	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
AI210	Machine Learning Lab	-	-	4	12	60	2	ISE	---	---	---	50	50
								ESE	---	---	---	50	50
AI212	Database Management Systems Lab	-	-	2	6	30	1	ISE	---	---	---	50	50
								ESE	---	---	---	50	50
AI230	OOP using Java Lab	2	-	2	54	90	3	ISE	---	---	---	50	50
								ESE	---	---	---	50	50
AI226	MOOC - I**	-	-	-	30	30	1	ISE	---	---	---	100	50
	Professional Skills Development and Foreign Languages-II	-	-	2	6	30	1	ISE	---	---	---	100	50
	TOTAL	**20**	**-**	**10**									
	TOTAL CONTACT HOURS	**30**			**426**	**780**	**26**						

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, TW: Term Work, SL: Self Learning

Total Contact Hours/week : 30
Total Credits : 26

- **Note: Students are required to undergo industrial / field training of minimum two weeks in the vacation of Semester-IV and its evaluation will be carried out in the Semester-V.**
- **Note**: MOOC-I course certification marks will be caried out for the credits.**

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414 Rajaramnagar

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

Sr. No.	Subject Name		Course Code
1.	Professional Skills Development and Foreign Languages	Professional Leadership Skills	SH2635
2.		Interpersonal Skills	SH2615
3.		Innovation Tools and Methods for Entrepreneurs	SH2695
4.		Personal Effectiveness and Body Language	SH2595
5.		German Language – Level IV	SH2645
6.		Japanese Language – Level IV	SH2625

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Curriculum Structure and Evaluation Scheme
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)
Class: T. Y. B. Tech **Semester:** V

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max	Min. for passing		Max	Min. for passing
AI329	Deep Learning and Optimization Techniques	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
AI331	Automata Theory	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
	Program Elective - I	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
	Open Elective - I	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
	Multidisciplinary Minor - III	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
	Multidisciplinary Minor - IV	2	-	-	24	60	2	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
AI333	Deep Learning and Optimization Techniques Lab	-	-	2	6	30	1	ISE	---	---	---	50	50
								ESE	---	---	---	50	50
AI335	LLM Lab	1	-	2	24	60	2	ISE	---	---	---	50	50
								ESE	---	---	---	50	50
AI3271	Mini Project	-	-	6	18	90	3	ISE	---	---	---	50	50
								ESE	---	---	---	50	50
AI3191	Summer Internship/ Professional Certification	-	-	-	30	30	1	ISE	---	---	---	100	50
AI325	MOOC - II**	-	-	-	30	30	1	ISE	---	---	---	100	50
SH3036	Scholastic Aptitude - I	2*	-	-			Audit	ISE	100	50 (P/ NP)	---	---	---
	TOTAL	**18+ 2***	**-**	**10**	**402**	**750**	**25**						
	TOTAL CONTACT HOURS	**28+2*=30**											

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, P: Pass, NP: Not Pass, TW: Term Work, SL: Self Learning

Total Contact Hours/week : 30
Total Credits : 25

Rajarambapu Institute of Technology Rajaramnagar CSE (AI&ML) Engg. Department 415 414

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

- **Note*: Students should complete 5 days (30 Hours) of Scholastic Aptitude training program organized by the Institute.**
- **Note**: MOOC course certification marks will be carried out for the credits.**

Program Elective-I

Sr. No.	Course Code	Domain	Course
1	AI305	Internet of Things	Sensor Actuated Technology
2	AI307	Computer Vision	Computer Graphics and Vision
3	AI337	Intelligent Interactive Systems	Sentiment Analysis
4	AI339	Secure Computing Systems	Cyber Security

Open Elective - I

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

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Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)

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

Course Code	Course	Teaching Scheme						Evaluation Scheme					
									Theory (Marks %)			Practical (Marks %)	
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Max	Min. for passing		Max.	Min. for passing
AI330	Computer Networks	2	-	-	36	60	2	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
AI306	Research Methodology	2	-	-	36	60	2	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
	Program Elective - II	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
	Open Elective - II	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
	Multidisciplinary Minor-V	3	-	-	54	90	3	ISE	20	40	40	---	---
								UT1	15			---	---
								UT2	15			---	---
								ESE	50	40		---	---
AI324	Higher-Level Coding	2	-	-	36	60	2	ISE	---	---	---	100	50
AI332	Network Applications Lab	-	-	2	6	30	1	ISE	---	---	---	50	50
								ESE	---	---	---	50	50
AI334	Full Stack Development Lab	1	-	2	24	60	2	ISE	---	---	---	100	50
								ESE					
AI328	Minor Project	-	-	12	36	180	6	ISE	---	---	---	100	50
								ESE					
SH3066	Scholastic Aptitude - II	2*	-	-			Audit	ISE	100	50 (P/NP)			
	TOTAL	**16+ 2***	**-**	**16**	**336**	**720**	**24**						
	TOTAL CONTACT HOURS	**32+2*=34***											

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam, P: Pass, NP: Not Pass, TW: Term Work, SL: Self Learning

Total Contact Hours/week : 34*
Total Credits : 24

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

Program Elective - II

Sr. No.	Course Code	Domain	Course
1	AI308	Internet of Things	Smart Cities
2	AI310	Computer Vision	Augmented & Virtual Reality
3	AI336	Intelligent Interactive Systems	Conversational AI and Dialogue System
4	AI338	Secure Computing Systems	Cryptography and Network Security

Open Elective - II

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

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Curriculum Structure and Evaluation Scheme
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)

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

Course Code	Course	Teaching Scheme						Evaluation Scheme					
		L	T	P	TW+SL	Total Hr.	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max	Min. for passing		Max.	Min. for passing
AI401	Social and Ethical issues in AI	2	-	-	36	60	2	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
AI405	Cloud Computing	3	-	-	54	90	3	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
AI437	Business Intelligence	3	-	-	54	90	3	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
	Program Elective - III	3	-	-	54	90	3	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
	Program Elective - IV	3	-	-	54	90	3	ISE	20	40	40	---	---
								MSE	30			---	---
								ESE	50	40		---	---
	Program Elective Lab - I	-	-	2	6	30	1	ISE	--	---	---	50	50
								ESE	--	---	---	50	50
AI423	Cloud Computing Lab	-	-	2	6	30	1	ISE	--	---	---	50	50
								ESE	--	---	---	50	50
AI439	AI for Edge Device Lab	1	-	2	24	60	2	ISE	--	---	---	50	50
	TOTAL	**15**	**-**	**6**	**288**	**540**	**18**						
	TOTAL CONTACT HOURS	**21**											

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

Total Contact Hours/week: 21
Total Credits : 18





Program Elective - III

Sr. No.	Course Code	Domain	Course
1	AI407	Internet of Things	Intelligent Transportation System
2	AI409	Computer Vision	Pattern Recognition
3	AI441	Intelligent Interactive Systems	Explainable AI and Responsible AI
4	AI443	Secure Computing Systems	Blockchain Technology

Program Elective - IV

Sr. No.	Course Code	Domain	Course
1	AI415	Internet of Things	Robotics
2	AI417	Computer Vision	Game designing
3	AI445	Intelligent Interactive Systems	Agentic & Generative AI
4	AI447	Secure Computing Systems	Secure Cloud and AI Security

Program Elective Lab - I

Sr. No.	Course Code	Domain	Course
1	AI427	Internet of Things	Robotics Lab
2	AI429	Computer Vision	Game designing Lab
3	AI449	Intelligent Interactive Systems	Agentic AI and Conversational Systems Lab
4	AI451	Secure Computing Systems	Cyber Security and Blockchain Lab

Rajarambapu Institute of Technology CSE (AI&ML) Engg Department 415 414 Rajaramnagar

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

Choice based Internship Model

Model I: Industry Internship (II)

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

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

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

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.

Rajarambapu Institute of Technology CSE (AI&ML) Engg Department 415 414 Rajaramnagar

Rajarambapu Institute of Technology Rajaramnagar 415414

Model II: Research Internship (RI)

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

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

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

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.

Rajarambapu Institute of Technology CSE (AI&ML) Engg Department 415 414 Rajaramnagar

Rajarambapu Institute of Technology Rajaramnagar 415414

Model III: Entrepreneurial Internship (EI)

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

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

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

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

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414 Rajarammagar

Multidisciplinary Minor

- Students 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 25-29					
MDM Basket Name	**Sr. No.**	**Course Code**	**Course Name**	**Semester**	**Offered by Department**
Construction Engineering	1	CEMD2011	Building Construction and Planning	III	Civil Engineering
	2	CEMD2021	Building Estimation and Valuation	IV	
	3	CEMD3011	Infrastructure Engineering	V	
	4	CEMD3031	Smart Cities and Sustainable Development	V	
	5	CEMD3021	Environmental Engineering	VI	
Software Programming	1	CSMD2011	Introduction to Data Structures	III	Computer Science & Engineering
	2	CSMD204	Fundamentals of Database Systems	IV	
	3	CSMD305	Software Testing	V	
	4	CSMD3031	Object-oriented Programming in Python	V	
	5	CSMD3021	Artificial Intelligence	VI	
Electrical Power System	1	EEMD2011	Electrical Power Generation	III	Electrical Engineering
	2	EEMD2021	Power System	IV	
	3	EEMD3011	Electrical Machines	V	

	4	EEMD3051	Electrical Technology	V	
	5	EEMD3021	Smart Grid	VI	
Electronics System Design	1	ECMD2011	Electronics Devices and Applications	III	Electronics &Telecommunication Engineering
	2	ECMD2021	Electronics Communication Systems	IV	
	3	ECMD3011	Advanced Communication Systems	V	
	4	ECMD3031	Electronic Product Design	V	
	5	ECMD3021	Industrial Electronics	VI	
Software Development	1	CIMD2011	Data Structures	III	Computer Science & Information Technology
	2	CIMD2021	Computer Algorithms	IV	
	3	CIMD3011	Introduction to DBMS	V	
	4	CIMD3031	OOP using Java	V	
	5	CIMD3021	Software Engineering	VI	
Product Design and Development	1	MEMD2031	Design Thinking	III	Mechanical Engineering
	2	MEMD2041	Behavioral Engineering and Design	IV	
	3	MEMD3051	Product Design Tools and Techniques	V	
	4	MEMD3071	Design and Prototyping	V	
	5	MEMD3041	Marketing and Business Fundamentals for New Products	VI	
Automobile Engineering	1	MEMD205	I. C. Engine	III	Mechanical Engineering
	2	MEMD206	Automotive Drivetrain	IV	
	3	MEMD309	Automotive Chassis Systems	V	

	4	MEMD311	Automotive Engineering Laboratory	V	
	5	MEMD306	Electric Vehicles	VI	
Mechatronics Engineering	1	MCMD2011	Fundamentals of Mechatronics	III	Mechatronics Engineering
	2	MCMD2021	Industrial Fluid Power	IV	
	3	MCMD3011	Sensor and Instrumentation	V	
	4	MCMD3031	Industrial Automation	V	
	5	MCMD3021	Industrial Robotics	VI	
Artificial Intelligence	1	AIMD2011	Object Oriented Programming	III	Computer Science & Engineering (AI&ML)
	2	AIMD2021	Data Structures and Algorithms	IV	
	3	AIMD3011	Machine Learning	V	
	4	AIMD3031	Business Intelligence	V	
	5	AIMD3021	Principles of AI	VI	
Robotics & Automation	1	RAMD2011	Fundamentals of Robotics & Automation	III	Robotics & Automation
	2	RAMD2021	Sensors and Actuators	IV	
	3	RAMD3011	Kinematic & Dynamics for Robots	V	
	4	RAMD3051	Robot Programming	V	
	5	RAMD3021	Industrial Automation & Control	VI	

B. Tech. in Computer Science & Engineering (Artificial Intelligence and Machine Learning) with Double Minor (Multidisciplinary and Specialization Minor)

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414 Rajaramnagar

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

Double Minor

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	AIDM3XXX
2	IV	DM – II	AIDM4XXX
3	V	DM – III	AIDM5XXX
4	VI	DM – IV	AIDM6XXX
5	VII	DM – V	AIDM7XXX
6	VIII	DM – VI	AIDM8XXX

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

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

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

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

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

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

B. Tech. in Computer Science & Engineering (Artificial Intelligence and Machine Learning) with Honor and Multidisciplinary Minor

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CSE (AI&ML) Engg. Department 415 414

Rajarambapu Institute of Technology
Rajaramnagar Autonomous 415414

Honors with Multidisciplinary Minors

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

Cloud Computing			
Sr. No.	**Course Code**	**Course Name**	**Semester**
1	AIHO201	Cluster and Grid Computing	III
2	AIHO202	Cloud Computing Applications	IV
3	AIHO301	Cloud Virtualization	V
4	AIHO302	DevOps	VI
5	AIHO401	Cloud Security	VII
6	AIHO402	NPTEL/Swayam/Certification	VIII

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

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

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

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

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

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

B. Tech. in Computer Science & Engineering (Artificial Intelligence and Machine Learning) - 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 Computer Science & Engineering (Artificial Intelligence and Machine Learning)-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	TW-SL	Total Hr.	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max.	Min. for passing		Max.	Min. for passing
REH401	Intellectual Property Rights	-	-	-	60	60	2	ISE	50	40	40	---	---
								ESE	50	40		---	---
REH403	Research project (Synopsis) phase - I	-	-	-	60	60	2	ISE	--	--	--	50	50
								ESE	--	--		50	50
REH405	Research Specific core course - I (Online NPTEL course)	-	-	-	90	90	3	ISE	50	40	40	--	--
								ESE	50	40		--	--
	TOTAL	-	-	-	**210**	**210**	**7**						

ISE = In Semester Evaluation, ESE = End Semester 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	TW-SL	Total Hr.	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
									Max.	Min. for passing		Max.	Min. for passing
REH402	Research project phase - II	-	-	-	330	330	11	ISE	--	--	--	50	50
								ESE	--	--		50	
	TOTAL	-	-	-	**330**	**330**	**11**						

ISE = In Semester Evaluation, ESE = End Semester Exam

K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Second Year B. Tech. Syllabus
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Class:- **Second Year B. Tech.**	Semester- **III**
Course Code: **AI221**	Course Name: **Mathematics for AI and Statistics and Fuzzy Systems**

L	T	P	Credits
3	-	-	3

Course Description:

The students will understand the foundation of Statistics and Fuzzy system. They will learn to apply different Fuzzy techniques.

Course Learning Outcomes:

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

1. Apply the Probability distributions, random number generation and density estimations to perform analysis of various kinds of data.
2. Develop the fundamental concepts such as Fuzzy sets, operations and Fuzzy relations.
3. Apply the schemes of Fuzzification of scalar variables and the Defuzzification of membership functions.
4. Develop Fuzzy decision making techniques.

Prerequisite: Basic Concepts of Mathematics.

Course Content

Unit No	Description	Hrs
1.	**Introduction: Descriptive Statistics** Diagrammatic representation of data, measures of central tendency, measures of dispersion, measures of skewness and kurtosis, Scattered diagram, Correlation, Types of Correlation, Correlation coefficient, bivariate correlation, multiple correlations.	06
2.	**Elements of Probability** Introduction (Sample space and events, axioms of probability, sample space having equally likely outcomes, basic principle of counting), conditional probability, Bayes' formula, independent events, random variables, types of random variables, Discrete Probability Distributions, Continuous Probability Distributions, Joint Probability Distributions.	06
3.	**Classical sets and Fuzzy Sets**	06

	Classical Sets, Fuzzy Sets, Classical Relations and Fuzzy Relations: Cartesian Product, Crisp Relations, Fuzzy Relations, Tolerance and Equivalence Relations, Fuzzy Tolerance and Equivalence Relations, Value Assignments, Other forms of Composition Operation.	
4.	**Properties of Membership Functions, Fuzzification, Membership Valus Assignments, and Defuzzification** Features of the membership functions, Various Forms, Fuzzification, Membership Value Assignments, Rank Ordering, Defuzzification to Crisp sets, λ – Cuts for Fuzzy Relations, Defuzzification to Scalars	**06**
5.	**Logic and Fuzzy Systems with Rules Inferences** Introduction (Classical Logic), Fuzzy Logic, Approximate Reasoning, Other forms of Implication Operation. Fuzzy Systems: Natural language, Linguistic hedges, fuzzy (rule based) systems, Rule Inferences and Output Evaluation (Mamdani Systems, Sugeno models, Tsukamoto models).	**06**
6.	**Decision Making with Fuzzy Information** Fuzzy Synthetic Evaluation, Fuzzy Ordering, Nontransitive Ranking, Preference and Consensus, Multiobjective Decision Making.	**06**

References -

Text Books:

- Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Press.
- Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.

Reference Books:

- S.C. Gupta & V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons
- N. P. Padhy, "Artificial Intelligence and Intelligent Systems" Oxford University Press.

K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Second Year B. Tech. Syllabus
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Class:- **Second Year B. Tech.**	Semester- **III**
Course Code: **AI2031**	Course Name: **Data Structures and Algorithms**

L	T	P	Credits
3	-	-	3

Course Description:

This course introduces fundamental data structures and algorithmic techniques essential for efficient problem solving and software development. This course will introduce core concepts such as arrays, linked lists, stacks, queues, trees, graphs, and basic algorithmic paradigms. This course provides a clear understanding of data structures and algorithms to solve computational problems, analyze algorithm efficiency using time and space complexity, and evaluate alternative solutions based on performance and scalability. Through programming assignments and theoretical exercises, students will design and implement optimized algorithms for real-world applications, enabling them to develop logically sound, efficient, and maintainable programs suitable for advanced computing and industry practices.

Course Learning Outcomes:

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

1. Explain fundamental data structures and algorithmic concepts, including arrays, linked lists, stacks, queues, trees, graphs, and searching and sorting techniques.
2. Apply appropriate data structures and algorithms to solve standard computational and programming problems.
3. Analyze the time and space complexity of algorithms using asymptotic notations to determine efficiency.
4. Compare and evaluate different data structures and algorithms to select optimal solutions for given problem scenarios.
5. Design and implement efficient algorithms and data structure–based solutions for real-world applications using a programming language.

Prerequisite: Knowledge of problem-solving techniques, basic mathematics, and discrete concepts such as sets, relations, and logical reasoning.

Course Content		
Unit No	**Description**	**Hrs**
1	**Linear Data Structures: introduction to data structures**	**06**

	Stack: Definition, Representation and Applications of Stack. Queue: Queue and its sequential representation, Applications of queue	
2	**Linked Lists** Introduction, insertion and deletion operations in lists, linked implementation of stack, Linked implementation of queue. Other list structures: circular list and doubly linked list.	**06**
3	**Trees** Binary trees, Applications of binary trees (binary search tree), Binary tree representations, Binary tree traversals, Threaded binary tree.	**06**
4	**Performance Analysis of Algorithms** Space and time complexity, asymptotic notations, performance measurement. Introduction to algorithmic techniques (Divide and Conquer, Greedy technique, Dynamic programming, Backtracking and Branch and Bound technique)	**06**
5	**Divide and Conquer and Greedy Method** Divide and Conquer: General method, Binary search, merge sort, quick sort.Greedy Method: General method, Kanpsack problem, Minimum cost spanning tree, Single source shortest path.	**06**
6	**Dynamic Programming** General method, All pair shortest path, Single - source shortest path, the travelling sales persons problem.	**06**

References -

Text Books:

- Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, Data Structures Using C, PEARSON Education Inc.
- Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran: Fundamentals of Computer Algorithms, Universities Press.

Reference Books:

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

Rajarambapu Institute of Technology CSE (AI&ML) Engg Department 415 414 Rajaramnagar

Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Second Year B. Tech. Syllabus
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Class:- **Second Year B. Tech.**	Semester- **III**
Course Code: **AI223**	Course Name: **Discrete Mathematical Structures and Graph Theory**

L	T	P	Credits
3	-	-	3

Course Description:

This course introduces students to the fundamental concepts and techniques of Discrete Mathematics used in science, engineering, and computer science. It develops logical thinking and mathematical reasoning skills for effective problem solving. Topics include logic and proofs, set theory, functions, algebraic systems, lattices, probability, and graph theory with their basic concepts and applications. The course emphasizes the use of discrete mathematical structures in areas such as algorithms, programming languages, cryptography, and software development.

Course Learning Outcomes:

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

1. Explain and apply the concepts of mathematical logic and truth tables to construct and validate logical arguments in programming and system design.
2. Apply and analyze set theory concepts and classify relations and functions based on their properties.
3. Analyze algebraic structures and lattices and simplify Boolean functions using appropriate mathematical techniques.
4. Apply graph theory concepts to model and solve problems related to graphs and networks and interpret their applications.
5. Apply counting principles, permutations, combinations, and probability to solve combinatorial problems involving discrete random variables.

Prerequisite: Mathematics - Probability theory, Set theory.

Course Content		
Unit No	**Description**	**Hrs**
1.	**Mathematical Logic** Statements and logical notations, Logical connectives: negation, conjunction, disjunction, conditional, biconditional, Truth tables and well-formed formulas, Tautologies and equivalence of formulas, Duality law and tautological implications, Normal and principal normal	**06**

	forms (CNF, DNF), Theory of inference: rules of inference and validity of arguments.	
2.	**Set Theory and Mathematical Induction** Basic concepts of sets, Set operations and identities, Ordered pairs and Cartesian product, Partition and covering of sets, Well-ordering principle, Fundamental theorem of arithmetic, Principle of mathematical induction and simple applications.	**06**
3.	**Relations and Functions** Relations and properties of binary relations, Matrix and graph representation of relations, Equivalence relations and partitions, POSET and Hasse diagram, Functions: types of functions (one-one, onto, bijection), Composition and inverse of functions.	**06**
4.	**Lattices and Boolean Algebra** Lattices as POSETs: definition, examples and properties, Lattices as algebraic systems, Special lattices, Boolean algebra: definition and properties, Boolean functions, Representation and minimization of Boolean functions	**06**
5.	**Graph Theory and Matchings** Introduction to graphs and terminology, Paths, walks, circuits, connectivity, Matrix representation of graphs, Trees and properties of trees, Euler and Hamilton paths and circuits, Planar graphs and Euler's formula, Matchings and coverings in bipartite graphs, PERT and basic applications.	**06**
6.	**Combinatorics and Probability** Rule of sum and rule of product, Pigeonhole principle, Permutations and combinations, Generating and counting functions (basic), Random experiments, sample space and events, Discrete probability and conditional probability, Discrete random variables, Expectation and linearity of expectation, Bernoulli and Binomial random variables	**06**

References -
Text Books:

- J. P. Tremblay & R. Manohar, "Discrete mathematical structures with application to computer science", MGH International.
- Kenneth H. Rosen, "Discrete mathematics and its applications", AT&T Bell Labs.

Reference Books:

- Semyour Lipschutz, Marc Lipson, "Discrete mathematics", MGH, Schaum's outlines.
- Bernard Kolman, Robert Busby, S.C. Ross and Nadeemur Rehman, "Discrete Mathematical Structures", Pearson Education.
- J. A. Bondy and U.S.R. Murty, "Graph Theory with Applications", North-Holland

K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Second Year B. Tech. Syllabus
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Class:- **Second Year B. Tech.**	Semester- **III**
Course Code: **AI2071**	Course Name: **Principles of Artificial Intelligence**

L	T	P	Credits
3	-	-	3

Course Description:

This course introduces students to the fundamental principles, concepts, and techniques of Artificial Intelligence. It covers core topics such as problem-solving methods, search strategies, knowledge representation, reasoning, and basic learning approaches. By the end of the course, students will be able to design and implement basic AI algorithms to solve real-world computational problems.

Course Learning Outcomes:

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

1. Interpret the fundamental concepts, terminology, and application areas of Artificial Intelligence.
2. Apply problem-solving and heuristic search techniques to solve AI-related problems.
3. Analyze game-playing and constraint satisfaction problems using appropriate AI strategies.
4. Design knowledge representation and reasoning models using logic-based techniques.

Prerequisite: Basic knowledge of logical reasoning and Probability theory.

Course Content

Unit No	Description	Hrs
1.	**Introduction** Introduction to Artificial Intelligence, The four categories of definitions of AI, Concept of rationality, The AI Problems, Artificial Intelligence Techniques, Risks & Benefits of AI.	06
2.	**Intelligent Agents** Concept of intelligent agents, PEAS description of task environments, types of agents: simple reflex agents, model-based agents, goal-based agents, utility-based agents, and learning agents, advantages of	06

	intelligent agents, impact of AI, examples and application domains of Artificial Intelligence.	
3.	**Problem Solving Techniques** Problem-solving agents, state space representation, control strategies, problem characteristics, heuristic search techniques, generate-and-test, hill climbing, best-first search, A* search algorithm.	**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 proportional logic and predicate logic, Clause form, unification algorithm.	**06**
6.	**Reasoning schemes in AI** Introduction to nonmonotonic reasoning, default reasoning, statistical reasoning, probability and Bayes' theorem, combining uncertain rules.	**06**

References -

Text Books:

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

Reference Books:

- Artificial Intelligence | Electrical Engineering and Computer Science | MIT Open Course Ware.

Links:

- https://onlinecourses.nptel.ac.in/noc24_cs08/preview? An Introduction to Artificial Intelligence – Prof. Mausam (IIT Delhi)

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414 Rajaramnagar

K.E. Society's Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Second Year B. Tech. Syllabus
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Class: **S. Y. B. Tech.**	Semester-**III**
Course Code: **CEMD2011**	Course Name: **Building Construction and Planning**

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Outcomes:

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

1. Suggest appropriate materials for building construction applications.
2. Prepare a functional design of components of the building.
3. Design and draw residential building using principles of planning and bye-laws.
4. Prepare plumbing and electrification plan for the building.
5. Explain properties of building finishing materials and application procedure.

Prerequisite: Basic knowledge of mathematics.

Course Content

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

3.	**Components of Building II** Building components in superstructure: Column, Beam, Wall, Sill, Lintel, Chajja, Slab, Ventilator, Roofing, Parapet wall, Ramp, ladder, lift and escalator. Doors, Windows and Staircase: Technical terms, classification, functional design and drawing.	**06**
4.	**Planning of Buildings and Bye-laws** Types of buildings, Site Selection criteria, Concept of Planning, Principles of planning. Bye-laws: Definition, Necessity, Procedure for obtaining Development permission/Building permission /Commencement permission, General land development requirements, General building requirements: Setback, Marginal distance, height and FSI as per Unified Development Control and Promotion Regulations for Maharashtra State. Introduction and necessity of building drawings, concept of scale, Types of building drawings-layout plan, site plan, measured, submission, working and perspective drawing. Preparation of building plans using principles of planning and bye-laws.	**07**
5.	**Building Services** Concept of Plumbing & Drainage plan, plumbing systems, Types of traps, Fittings, Septic Tank, Soak pit, Rainwater harvesting, and Plumbing layout for buildings, Preparation of Plumbing and Electrification layouts for building.	**07**
6.	**Building Finishes** Plastering and pointing. Paints-Characteristics of ideal paints, constituents, classification, suitability, applying procedure and applications, defects. Varnishes- Characteristics of good varnish, ingredients, types, suitability, applying procedure and applications. Distemper- ingredients, applying procedure and applications. White washing and colour washing.	**06**

References-

Text Books:

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

References Books:

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

Government Rules & Regulations:

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

K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Syllabus of Second Year B. Tech. CSE(AI&ML)
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Class: - **S.Y. B. Tech.**	Semester - **III**
Course Code: **CSMD2011**	Course Name: **Introduction to Data Structures**

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite:

- Basic knowledge of C programming.
- Knowledge of basic mathematical concepts.

Course Content

Unit No	Description	Hrs
1.	**Introduction to Data Structures** Primitive and non-primitive data structures, Operations on data structures, Algorithms, Abstract Data Types (ADT).	05

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414
K.E.S. Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

2.	**Stack** Definition & Concepts, Operations on Stack, Applications of Stack, Polish expressions, Reverse Polish Expression and conversions, Recursion.	**06**
3.	**Queue** Queue and its sequential representation, Simple Queue, Circular Queue, Double Ended Queue, Priority Queue, Applications of Queue.	**07**
4.	**Linked List** Definition and structure of singly linked list, doubly linked list and circular linked list. Operations: creation, traversal, insertion, deletion.	**07**
5.	**Trees** Definitions and concepts, Terminology, Binary trees, Binary Tree Representations, Binary Tree Traversals, Binary Search Tree, Insertion and Deletion in BST, Applications of Tree.	**05**
6.	**Graphs** Definition and concepts, Graph Representation, Graph Terminology, Graph Traversals – Depth First Search and Breadth First Search. Applications of Graph.	**06**

References –

Text Books:

- Seymour Lipschutz, "Data structures", MGH, Schaum's Outlines.
- Amol M. Jagtap & Ajit S. Mali, "Data Structures using C, A Practical Approach for Beginners", Taylor & Francis Group, USA.

Reference Books:

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

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Class:- **S. Y. B. Tech.**	Semester- **III**
Course Code: **EEMD2011**	Course Name: **Electrical Power Generation**

L	T	P	Credits
3	--	--	3

Course Description:

The overarching aim of the course is to allow students to develop an understanding of the fundamental principles and performance of devices / components that are associated with Generation of Electrical Energy. Electricity is a secondary energy source. It is produced through conversion of primary energy sources as coal, hydro, natural gas, nuclear, solar, and wind into electrical energy. Electricity is also a critical energy carrier, facilitating both transfer of energy and conversion to other forms, such as mechanical, chemical, etc. This course is designed with multi-disciplinary approach to embark importance of electrical energy among the students from different programs.

Course Learning Outcomes:

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

1. List the main components of different power plants.
2. Describe the operation of various power plants used for electrical power generation.
3. Explain working principles of various power plants.
4. Compare different power plants based on advantages, limitations and future prospects
5. Draw layout of electrical power plants.
6. Explore alternate electrical energy resources for future needs and challenges.

Prerequisite:

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

Course Content

Unit No	Description	Hrs

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

References –

Text Books:

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

Reference Books:

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

Class:- **S. Y. B. Tech.**	Semester- **III**
Course Code: **ECMD2011**	Course Name: **Electronics Devices and Applications**

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

1. Describe the fundamental concepts of electronics and working principles of different devices.
2. Analyze different analog and digital electronics circuits.
3. Design digital electronics circuits with truth table and logic diagram.

Prerequisite:

- Fundamental concepts of Mathematics and Physics.

Course Content

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

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

References –

Text Books:

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

Reference Books:

- Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Tata McGraw Hill.
- R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill.

Class:- **S.Y. B. Tech**	Semester-**III**
Course Code: **CIMD2011**	Course Name: **Data Structures**

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite:

- Basics of C language.

Course Content

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

2.	**Array Data Structures** Introduction of Array, Representation of Array, Memory allocation of Array, types of arrays, operation in array, Applications of Array, Advantages and Disadvantages of Array.	**04**
3.	**Stack and Queue** Stack: Definition, Representation, Operations and Applications of Stack. Queue: Definition, Representation, Operations and Applications of Linear Queue, Circular queue, Deque, Priority Queue.	**07**
4.	**Linked Lists** Definition, Terminologies, Representation, Operations, Singly linked list, Doubly linked list, Circular linked list, Stack using linked list, Queue using linked list.	**07**
5.	**Trees Terminology in data Structure** Tree definition, Terminologies and Applications, Binary trees and types. Binary tree traversals, Binary search trees, AVL tree, B tree.	**06**
6.	**Graphs Terminology in data Structure** Graph Definition, Terminologies and Applications, Types of graphs, Representation of graph using adjacency matrix and adjacency list, Graph traversal Techniques: Depth first and Breath first search.	**06**

References –

Text Books:

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

Reference Books:

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

Class:- **S.Y. B. Tech.**	Semester-**III**
Course Code: **MEMD2031**	Course Name: **Design Thinking**

L	T	P	Credits
3	--	--	3

Course Description:

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

- Discovery - opportunity identification
- Design - concept and product design, development and evaluation

Course Learning Outcomes:

This course is designed to familiarize students with the principles and practices in the development, design, Development and introduction of new products and services. After successful completion of the course, student 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 design process.
4. Assimilate the various product characteristics to design a novel product.
5. Participate effectively in group work sessions and teams to become acquainted with the importance of teamwork and collaboration that is critical to new product success.

Prerequisite:

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

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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.	**06**
2.	**Creativity and Innovation** Definition, relevance of Creativity and Innovation in new product design, Improving creativity and innovation, hindrances to creative thinking, importance and formation of teams.	**06**
3.	**Identifying Customer Needs** Understanding customer needs, Voice of the customer, Gathering customer needs, organizing and prioritizing needs, Product mission statement, establishing product function.	**06**
4.	**Establishing Product Specification** Product Teardown and Experimentation, Benchmarking, Quality Function Deployment (QFD)	**06**
5.	**Product Portfolios and Portfolio Architecture** Product Architecture-types, establishing architecture, Modular design-basic clustering method, advanced functional methods.	**06**
6.	**Product Concept Generation, Selection and Testing** Concept generation process and methods, Concept selection mechanism and techniques, Concept Testing-Purpose, process and methods.	**06**

References –

Reference Books:

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

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Class: **S. Y. B. Tech.**	Semester: **III**
Course Code: **MEMD205**	Course Name: **I. C. Engines**

L	T	P	Credits
3	--	--	3

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

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

1. Explain construction and working of SI and CI engines
2. Perform a primary thermodynamic analysis of Otto and diesel cycle engines.
3. Select proper fuel system for IC engine
4. Evaluate engine emissions and pollution norms.
5. Interpret modern engine technologies

Prerequisite: Nil.

Course Content

Unit No	Description	Hrs
1.	**Basics of I. C. Engines** Introduction, Classification of I. C. Engines, Basic engine components and nomenclature, applications, Difference between two stroke and four stroke engine, difference between SI and CI engines.	06
2.	**Engine Cycles** Theoretical cycles (Air standard cycles and Fuel Air cycles), Deviation of actual cycles from theoretical cycles, Various losses in actual cycles, Valve timing diagram for high and low speed engine, Port timing diagram.	06
3.	**Engine Systems** Heat rejection and cooling, Air cooling, liquid cooling, Introduction to lubrication systems, Types of lubrication systems, Air intake system, filters & manifolds, Mufflers and resonators, Supercharging, Turbocharging.	06
4.	**Fuel Systems in I. C. Engines**	06

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	Carburetion, A/F ratio, Mixture requirements at different loads and speeds, Simple carburetor, Complete carburetor systems, Introduction to MPFI system, Requirements of injection systems, types of injection system, CRDI systems and its comparison with other systems, Injection pumps, injectors, nozzles, Governors, trouble shooting in in fuel systems.	
5.	**Engine emissions and control methods** Emissions from SI and CI engines, need to control emissions, emission Standards, pollution norms like EURO, BHARAT etc. methods to control emissions like catalytic converter.	**06**
6.	**Recent trends in I C Engines** Alternative Fuels Homogeneous Charge Compression, Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine, Four Valve and Overhead cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine.	**06**

References-

Text Books:

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

Reference Books:

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

Class: **S.Y. B. Tech**	Semester: **III**
Course Code: **MCMD2011**	Course Name: **Fundamentals of Mechatronics**

L	T	P	Credits
3	-	--	3

Course Description:

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

Course Learning Outcomes:

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

1. Identify various elements of mechatronics systems.
2. Select appropriate sensor/Actuator/controller/control algorithm for different applications.
3. Develop PLC/ microcontroller-based applications.

Prerequisite:

- The students should have knowledge of basic electronics.

Course Content

Unit No.	Description	Hrs.
1.	**Introduction** Introduction to Mechatronics, Key elements of Mechatronics, Block diagram of mechatronics system, Control systems and Modes of control, Difference between traditional and concurrent design process.	02
2.	**Sensors and transducers** **Transducers-** classification, Development in Transducer technology **Sensors** - Introduction, Need of Sensors, Classification, Working and Application of- Potentiometer Sensors, Strain Gauge Elements. Capacitive Elements, Eddy Current, Proximity Sensors, Inductive, Proximity Sensors, Light Sensors, Pressure Sensors, Pneumatic Sensors, Pyro electrical Sensors, Piezoelectric Sensors, Shaft Encoders. Selection of Sensors.	08
3.	**Drives and Actuators**	06

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

References –

Textbooks:

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

Reference Books:

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

K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Syllabus of Second Year B. Tech. CSE(AI&ML)
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Class:- **S. Y. B. Tech.**	Semester- **III**
Course Code: **AIMD2011**	Course Name: **Object Oriented Programming**

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

The course should enable the students to,

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

Prerequisite:

- Basic Programming Skills.

Course Content

Unit No	Description	Hrs
1.	**Oops Concepts and Java Programming** OOP concepts: Procedural and object-oriented programming paradigm, Classes and objects, data abstraction, encapsulation, constructors, inheritance, polymorphism and overloading, Java programming: History of java, comments data types, variables, constants, scope and life time of variables, operators, control flow statements, arrays, console input and output, garbage collection, exploring string class.	06
2.	**Multiple Inheritance, Interfaces and Packages** Inheritance: Inheritance hierarchies, super and subclasses, preventing inheritance, Polymorphism: dynamic binding, method overriding, Interface: Interfaces VS Abstract classes, implement interfaces, accessing	06

	implementations through interface references, Packages: Defining, creating and accessing a package, importing packages.	
3.	**Introduction to Python fundamentals** Python introduction, Python syntax, Python comments, Python variables, Python data types, Python numbers, Python casting, Python strings, Python Booleans, Python operators.	**06**
4.	**Lists, Tuples, Sets, Dictionaries** Access, change, add and remove list elements, loop lists, list comprehension, list methods, access, update, unpack tuples, loop tuples, tuple methods, Access, add, remove set items, set methods, access, add, change, remove dictionary items, nested dictionaries, dictionary methods.	**06**
5.	**Python conditional statements** If-else, while, for, lambda, arrays, Python Iterators, Python scope. **Python classes and objects:** Classes, objects, parameterized and non-parameterized init constructor, object methods, self-parameter, association, aggregation and inheritance using python.	**06**
6.	**Python for Machine Learning** Numpy, Pandas, Matplotlib and Seaborn,	**06**

References –

Text Books:

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

Reference Books:

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

Class: **S.Y. B. Tech.**	Semester - **III**
Course Code: **RAMD2011**	Course Name: **Fundamentals of Robotics & Automation**

L	T	P	Credits
3	-	--	3

Course Description:

This course provides an in-depth understanding of the fundamental concepts and applications of robotics and automation. It provides an introduction to robotics, it's history and development, various types of end effectors, grippers, kinematic and dynamics of robotics, robot drive systems, sensors and actuators and fundamentals of robot programming and applications. This course also introduces the need for automation, its types and various applications of automation technology in industries.

Course Outcomes:

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

1. Differentiate various robotic configurations and performance metrics.
2. Compare various end effectors, sensors, and drive systems in robotic applications.
3. Illustrate kinematic and dynamic principles applied to robotic systems.
4. Outline robot programming solutions for diverse applications.
5. Distinguish various types and aspects of automation.
6. Relate the knowledge of Programmable Logic Controllers (PLCs) to industrial automation tasks.

Prerequisite:

- Engineering Science Courses.
- Engineering Mathematics.
- Basic Mechanics.
- Programming Fundamentals.

Course Content		
Unit No.	**Description**	**Hrs**
1.	**Introduction to Robots**	**06**

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	Definition - Historical background - Various generations of robots – Robot Anatomy - Robot configuration: Polar, Cylindrical, Cartesian coordinate, Joint-arm configuration - Degree of freedom - Work volume and Dead zone - Dynamic performance: Speed of response and Stability - Precision of movement: Spatial Resolution, Accuracy, Repeatability and Compliance.	
2.	**Robot End Effectors, Sensors and Drive Systems** End Effectors: Characteristic features - Types: Mechanical grippers, Magnetic grippers, Vacuum cups, Adhesive gripper, Hooks and Scoops - Tools as end effectors - Robot / End-effectors interface - Consideration in Gripper selection and Design. Sensors: Transducers and Sensors - Sensors in Robotics: Tactile, Proximity and Range Sensors, Miscellaneous sensors and sensor based systems - Robot Vision System. Robot Drive System: Hydraulic, Electric and Pneumatic.	**06**
3.	**Robot Kinematics & Dynamics** Representation of objects in 3-D space-position and orientation, representation of orientation using roll, pitch and yaw angles, representation of orientation using Euler angles. Denavit - Hartenberg notations- link and joint parameters-rules for coordinate assignments, forward and inverse kinematics, Introduction to inverse and forward dynamics, determination of inertia tensor, Lagrange-Euler formation for joint torque.	**06**
4.	**Robot Programming and Its Applications** Lead-through Programming, Walk-through Programming, Use of Teach pendants - Capabilities and limitations. Textural Programming: requirements of robot programming language, problems pertaining to robot programming languages, Common languages/Software used- - Robot program as a path in space Applications: Factors influencing the selection of Robots - Robots for Materials handling, Assembly, Agriculture and Chemical Plants - Advanced applications. Intelligent Robots - Introduction to Mobile Robots, Legged Robots and Remote Controlled Robots, Automated Guided Robots, Micro Robots - Control and Safety Issues.	**06**
5.	**Introduction to Automation** Mechanization and Automation - History of Automation - Reasons for automation - Merits and limitations - Automation systems - Types of Automation: Fixed, Flexible and Programmable Automation - Intelligent Industrial Automation - Automation and Robotics.	**06**
6.	**Introduction to Programmable Logic Controller (PLCs)**	**06**

	Principles of operation of Programmable Logic Controller (PLC), PLC verses computer, PLC hardware components, Scan time of a cycle, Industrial PLC, Application of PLCs.	

References-

Text Books:

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

Reference Books:

- John J Craig, "Introduction to Robotics", Pearson Edu.
- Fu K.S, "Robotics", McGraw Hill.
- Niku SB, "Introduction to Robotics – Analysis, Control, Applications", John Wiley & Sons Ltd.

NPTEL Course on Robotics:

- https://onlinecourses.nptel.ac.in/noc19_me74/preview
- https://onlinecourses.nptel.ac.in/noc20_de11/preview

Class:- **Second Year B. Tech.**	Semester- **III**
Course Code: **SH2175**	Course Name: **Environmental Science**

L	T	P	Credits
1	-	2	2

Course Description:

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

Course Learning Outcomes:

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

1. Apply interdisciplinary knowledge in environmental science by integrating concepts and principles from various fields of science and engineering to address environmental issues.
2. Evaluate environmental impacts of human activities on ecosystems and on the environment.
3. Use scientific approach to identify and solve environment related problems.
4. Design sustainable solutions to address environmental challenges by considering renewable energy sources, waste management strategies conservation measures, and environmental policies.
5. Participate in group work to become acquainted with the importance of teamwork, collaboration.
6. Develop presentation and report writing skills.

Course Content

Unit No.	Description	Hrs.
1.	**Natural Resources and Ecosystem**	04

	Renewable and Non-renewable resources, Forest resources, water resources, Mineral resources, food resources, Energy resources, alternative energy resources Land resources, Structure and Functions of ecosystem, biotic and abiotic components, food chains, food web Biodiversity, types of biodiversity, conservation of biodiversity.	
2.	**Environmental Pollution and Health** Environmental Pollution, types of pollution, Air pollution, Water Pollution, Noise Pollution, Soil Pollution, Marine Pollution, Radioactive Pollution, Thermal Pollution (Causes, sources and effects, abatement methods), Pollution Case studies-Bhopal Gas Tragedy, Chernobyl Accident: A nuclear Disaster, Ganga Water Pollution. Solid Waste management (Causes, sources, effects & control measures), Hazardous waste management, Plastic waste management, E-waste management. Disaster management and risk analysis.	**04**
3.	**Climate change and Sustainable development** From unsustainable to sustainable development, Urban problems related to energy, Water conservation: Rainwater harvesting, Watershed management, Climate change, Global Warming, Ozone layer depletion, Acid Rain, Consumerism & waste Products, Concepts of Eco-labeled products, Eco-mark, Awareness of Environmental Legislation.	**04**

Guidelines for Project:

- The distribution of project group will be done by project coordinator and respective head of the department to the faculty.

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

Rajarambapu Institute of Technology Rajaramnagar CSE (AI&ML) Engg. Department 415 414

K.E. Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

Reference-

Text Books:

- D. K. Asthana, Meera Asthana, "A Textbook of Environmental Studies", S. Chand Publication.
- S. Deswal& A. Deswal, "Basic course in environmental Studies", Dhanpat Rai & Co ltd., Delhi.

Reference Books:

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

Class:- **Second Year B. Tech.**	Semester- **III**
Course Code: **AI225**	Course Name: **Web Technology Lab**

L	T	P	Credits
2	-	2	3

Course Description:
This course introduces the fundamentals of web development, covering HTML for page structure, CSS and Bootstrap for styling and responsive design, JavaScript and jQuery for interactivity, basic server-side development using Servlets and databases, and React JS for building modern single-page applications. By the end of the course, students will be able to design and develop functional web applications using current web technologies.

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

1. Comprehend the fundamentals of web development, including web architecture, HTML structure, and semantic elements.
2. Apply CSS and Bootstrap to design responsive, visually appealing, and user-friendly web pages.
3. Implement client-side functionality using JavaScript concepts such as variables, control structures, functions, events, and form validation.
4. Manipulate web page elements dynamically using JavaScript DOM, jQuery, and AJAX techniques to create interactive web applications.
5. Develop and deploy full-stack web applications using backend APIs, React JS, Git/GitHub, and modern hosting platforms with basic web security considerations.

Prerequisite:

- Basic knowledge of computers, familiarity with programming concepts.
- Basic knowledge of the Internet and web browsing concepts.

Course Content		
Unit No	**Description**	**Hrs**
1.	**HTML Fundamentals** Introduction to Web Development tools and editors, creating basic HTML documents, HTML structure and standard tags, Text formatting, lists, hyperlinks, and images, creating tables and forms, Form elements and validation using HTML5, Use of semantic HTML elements.	**04**
2.	**CSS and Bootstrap**	**04**

	Applying CSS to HTML pages, CSS selectors, properties, and box model, Styling text, images, and layouts, Introduction to Bootstrap, Bootstrap grid system, Bootstrap components: navbar, cards, buttons, forms, modals.	
3.	**JavaScript Fundamentals** Introduction to JavaScript, Variables, data types and operators, Conditional statements and loops, Functions and events, Arrays and objects, Basic form validation using JavaScript.	**04**
4.	**JavaScript DOM & jQuery** Understanding the Document Object Model (DOM), DOM element selection and manipulation, Event handling in JavaScript, Introduction to jQuery, jQuery selectors and events, jQuery effects and animations, Form handling using jQuery, AJAX basics using jQuery.	**04**
5.	**Backend Basics & Database Integration** Introduction to Backend and Web APIs, Client–Server architecture, JSON data format, REST API concepts, connecting web pages to backend using Fetch/AJAX, Introduction to database concepts (CRUD operations), Using Firebase / MySQL / MongoDB via APIs	**04**
6.	**React JS & Web Deployment** Introduction to React and SPA concept, React environment setup, JSX syntax, Functional components, Props and state management, Event handling in React, React Hooks: useState and useEffect, Concepts of web hosting and deployment, Git and GitHub for version control, Hosting using GitHub Pages, Netlify, and Vercel, Deployment of React applications, Basic web security concepts.	**04**

Lab Content		
Experiment No	**Description**	**Hrs**
1.	Design a basic static web page for an educational institute using HTML. The page should include headings, paragraphs, text formatting, lists, hyperlinks, images, and semantic HTML elements such as header, section, article, and footer.	**02**
2.	Create a student registration web page using HTML5 that includes tables and a form. The form should collect user details and perform input validation using HTML5 form attributes.	**02**

3.	Develop a web page and apply CSS to enhance its appearance by using different selectors, colors, fonts, layouts, and the CSS box model.	**02**
4.	Design a responsive website layout using Bootstrap that includes a navigation bar, grid-based content layout, cards, buttons, and forms, ensuring proper display on different screen sizes.	**02**
5.	Create a web page that uses JavaScript to perform basic operations such as arithmetic calculations, conditional checks, looping, and event handling based on user input.	**02**
6.	Develop a web form and implement client-side validation using JavaScript to verify user inputs such as name, email, password, and phone number before form submission.	**02**
7.	Design a dynamic web page that allows users to add, modify, and delete HTML elements at runtime using JavaScript DOM manipulation and event handling techniques.	**02**
8.	Develop an interactive web application using jQuery to handle events, animations, and form submissions, and use AJAX to retrieve and display data asynchronously without reloading the page.	**02**
9.	Develop a web application that consumes data from a REST API (using Fetch/AJAX) and displays JSON data dynamically on a web page (e.g., weather app / student data dashboard).	**02**
10.	Develop and deploy a simple full-stack web application that integrates a backend database (Firebase / MySQL / MongoDB) to perform CRUD operations, uses a React-based user interface, and is hosted on cloud-based platforms such as GitHub Pages, Netlify, or Vercel using Git version control.	**02**

References -

Text Books:

- Terry Felke Morris, Web Development and Design Foundations, Pearson Education.
- Jon Duckett, HTML and CSS: Design and Build Websites, John Wiley & Sons.
- Jon Duckett, JavaScript and jQuery: Interactive Front-End Web Development, John Wiley & Sons.

Reference Books:

- Roger S. Pressman, David Lowe, Web Engineering: A Practitioner's Approach, Tata McGraw-Hill.
- Herbert Schildt, Java: The Complete Reference, Tata McGraw-Hill.

Links:

- https://www.coursera.org/learn/web-development?

K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Syllabus of Second Year B. Tech. CSE(AI&ML)
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Class:- **Second Year B. Tech.**	Semester- **III**
Course Code: **AI2111**	Course Name: **Data Structures & Algorithms Lab**

L	T	P	Credits
-	-	2	1

Course Description:
The Data Structures and Algorithms Lab is an interactive and hands-on course that complements the theoretical concepts covered in the corresponding Data Structures and Algorithms lecture. This lab focuses on practical implementation, analysis, and experimentation with various data structures and algorithms. Students will gain valuable experience through programming assignments and problem-solving exercises. They will learn to design efficient algorithms, analyze their time and space complexity, and implement them using programming languages such as C or C++. The lab provides a supportive environment for students to explore fundamental data structures like linked lists, trees, graphs, and hash tables, and apply key algorithmic techniques such as sorting, searching, and graph traversal.

Course Learning Outcomes:
After successful completion of the course, students will be able to:
1. Implement linear and non-linear data structures for efficient data handling.
2. Apply programming techniques to perform operations on stacks, queues, linked lists, and trees.
3. Analyze searching and sorting algorithms using time and space complexity measures.
4. Implement Divide and Conquer, Greedy, and Dynamic Programming algorithms for problem solving.
5. Develop logical and analytical skills for designing efficient data structure and algorithm solutions.

Prerequisite:
- Basic knowledge of C programming.
- Knowledge of basic mathematical concepts.

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

Course Content		
Unit No	**Description**	**Hrs**

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414 Rajaramnagar
K.E.S. Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

1.	Implement Stack using array and Queue using array.	**02**
2.	Implement to check balanced parentheses and evaluate postfix expressions using stack.	**02**
3.	Implement basic operations on Singly linked lists, such as insertion, deletion, and traversal.	**02**
4.	Implement basic operations on Doubly linked lists, such as insertion, deletion, and traversal.	**02**
5.	Implement basic operations on Circular Singly/Doubly linked lists, such as insertion, deletion, and traversal.	**02**
6.	Implement a Stack and Queue using a linked list.	**02**
7.	Create a binary tree and perform inorder, preorder, and postorder traversals.	**02**
8.	Implement BST operations such as insertion, deletion, and searching.	**02**
9.	Analyze time and space complexity of searching and sorting algorithms using Big-O notation	**02**
10.	Implement Binary Search, Merge Sort, and Quick Sort using divide and conquer technique.	**02**
11.	Implement Greedy algorithms such as Minimum Cost Spanning Tree (Prim's/Kruskal's) and Single Source Shortest Path (Dijkstra's).	**02**
12.	Implement Dynamic Programming algorithms such as All-Pair Shortest Path (Floyd-Warshall) or Travelling Salesperson Problem.	**02**

References -

Text Books:

- A. M. Tanenbaum, Y. Langsam, M. J. Augenstein, "Data Structure using C and C++", PHI.
- Amol Jagtap & A. S. Mali, "Data Structures using C, A practical Approach for Beginners", Taylor & Francis Group, USA.

Reference Books:

- "Data Structure using C", ISRD Group (TMH) ACE series.

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K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Syllabus of Second Year B. Tech. CSE(AI&ML)
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Class:- **Second Year B. Tech.**	Semester- **III**
Course Code: **AI2171**	Course Name: **Python Programming Lab**

L	**T**	**P**	**Credits**
2	-	2	3

Course Description:
This course introduces Python programming with focus on problem solving, data handling and AI/ML applications. Students learn Python basics, decision making, loops and data structures to build programs. The course covers functions, object-oriented programming and modular development for writing structured and reusable code. Students also learn to work with real-world datasets using NumPy, Pandas and data visualization tools. Finally, the course introduces data preprocessing, basic machine learning workflow, API usage and automation so that students can develop small real-world applications and become industry ready.

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

1. Explain Python programming fundamentals including syntax, data types, operators and program execution.
2. Apply decision-making statements, loops and Python data structures to solve computational problems.
3. Develop modular and object-oriented Python programs using functions, modules and packages.
4. Analyze real-world datasets using NumPy, Pandas and data visualization techniques.
5. Evaluate Python-based solutions for data preprocessing, basic machine learning workflow and automation tasks.

Prerequisite:
Basic programming concepts, problem-solving skills and familiarity with algebra and arithmetic.

Course Content

Unit No	**Description**	**Hrs**
1.	**Python Fundamentals** Python installation and IDE setup, Running Python programs, Variables and data types, Operators and expressions, Input and output operations, String handling and formatting, Simple real-life programming examples.	**04**
2.	**Decision Making & Iteration**	**04**

	Conditional statements (if, elif, else), Nested conditions, Loops (for, while), break, continue, pass, Pattern programs and problem solving, Real-life examples using loops	
3.	**Data Structures in Python** Lists, tuples, sets, dictionaries, Indexing and slicing, Searching and sorting, List comprehension, Applications in data organization.	**04**
4.	**Functions and Modular Programming, OOP** Functions and recursion, Lambda functions, Classes and objects, Constructors, Inheritance, encapsulation, polymorphism, Modules and packages, Building small applications using OOP.	**04**
5.	**Data Analysis Libraries** NumPy arrays and operations, Pandas Series and DataFrames, Data filtering and aggregation, Handling missing values, Introduction to Matplotlib and Seaborn.	**04**
6.	**Data Preprocessing & Visualization** Data cleaning and preprocessing, normalization and encoding, basic Exploratory Data Analysis (EDA) with correlation analysis, visualization using histograms and boxplots, introduction to Scikit-learn dataset preparation, and simple API integration in Python.	**04**

Exp No	Description	Hrs
1.	**Python Basics and Operators** Develop a basic application to perform arithmetic and logical operations.	**02**
2.	**Conditional Statements and Looping** Design a program that uses decision-making and iteration to automate real-world calculations.	**02**
3.	**Python Collections** Create an application to manage and organize data using lists, tuples, sets, and dictionaries.	**02**
4.	**Functions and Modular Programming** Develop a program using user-defined functions to implement reusable and structured code.	**02**
5.	**Classes and Objects** Implement an application using object-oriented programming concepts.	**02**
6.	**Modules and Packages**	**02**

	Build a reusable application by organizing code into modules and packages.	
7.	**NumPy and Pandas Libraries** Perform data analysis and manipulation using Python scientific computing and data analysis libraries.	**02**
8.	**Data Preprocessing Techniques** Apply data cleaning, normalization, and transformation techniques on real-world datasets.	**04**
9.	**Exploratory Data Analysis (EDA) Mini Project** Analyze a real-world dataset to identify patterns, trends, and insights using visualization and statistics.	**02**
10.	**AI/ML-Based Python Application** Develop a simple machine learning application for prediction, classification, or recommendation.	**04**

References -

Text Books:

- Payne James, "Beginning Python", Wiley India Pvt. Ltd.
- Reema Thareja, "Python Programming: Using Problem Solving Approach", Oxford University Press.

Reference Books:

- Bill Lubanovic, "Introducing Python", O'Reilly Media.
- Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning.

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

Professional Skills Development and Foreign Languages Courses

1. Professional Leadership Skills (SH2635)
2. Interpersonal Skills (SH2615)
3. Innovation Tools and Methods for Entrepreneurs (SH2695)
4. Personal Effectiveness and Body Language (SH2595)
5. German Language - Level III (SH2735)
6. German Language - Level IV (SH2645)
7. Japanese Language - Level III (SH2715)
8. Japanese Language - Level IV (SH2625)

An Important Notes:

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

Class: - **S.Y. B. Tech.**	Semester-**III/IV**
Course Code: **SH2635**	Course Name: **Professional Leadership Skills**

L	T	P	Credits
-	-	2	1

Course Description

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

Course Leaning Outcomes:

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

1. Explain the traits of a leadership through real life examples.
2. Exhibit the ability to work effectively in team.
3. Prepare a presentation as per the audience and context requirements.

Prerequisite:

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

Minimum 12 sessions will be conducted from the following list.

Course Content		
Unit No	**Description**	**Hrs**
1.	**SMART Goal Setting, SWOT/C Analysis and Action Plan** Discussion on Dos and Don'ts, Advantages, and Generation of the Document by Students and its Assessment.	**02**
2.	**Assertiveness and Positive Thinking** Types of Behaviour, Benefits of Being Assertive and Positive Thinking, Developing Positive Attitude, Case Studies and Presentations.	**02**
3.	**Self Management**	**02**

	Need of Self Management, Developing Self Acceptance, Steps of Self Management, Individual Classroom Activity and its Assessment.	
4.	**Leadership Styles and Change Management** Introduction to Different Types of Leaderships, Effective Organizational Change Management, Individual Classroom Activity and its Assessment.	**02**
5.	**Team Formation and Leading a Team-I** Why Teams? Roles and Responsibilities in Teams, Strategies for Team Development, Barriers to Teams, Steps of Team Development.	**02**
6.	**Team Formation and Leading a Team-I** Why Teams? Roles and Responsibilities in Teams, Strategies for Team Development, Barriers to Teams, Steps of Team Development.	**02**
7.	**Team Formation and Leading a Team – II** Case Studies of Teams and Student Presentations.	**02**
8.	**Business Meetings and Decision Making – I** Preparing for the Meeting, Role of Chairperson and Participants in Meetings.	**02**
9.	**Business Meetings and Decision Making – II** Mock Meetings, Decision Making Case Studies and Feedback.	**02**
10.	**Conflict Management** Types of Personalities, Possible Reasons of Conflicts at Work Place, Conflict Resolution Strategies, Conflict Management Case Studies and Feedback.	**02**
11.	**Time Management** Time Management Techniques, Introduction to Time Management Tools, Benefits of Time Management, Case Studies and Presentations.	**02**
12.	**Presentation Skills – I** Preparation, Types of Presentations - Informative, Instructional, Arousing, Persuasive, Decision-making, Presentation Tools.	**02**
13.	**Presentation Skills – II** Body Language, Managing Questions and Student Presentations Student Presentations and Feedback, Student Presentations and Feedback.	**02**
14.	**Creative and Critical Thinking** Approaches to Creative Thinking, Strategies for Creative Thinking, Characteristics and Strategies of Critical Thinking.	**02**

References –

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

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

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

Class: - **S.Y. B. Tech.**	Semester-**III/IV**
Course Code: **SH2615**	Course Name: **Interpersonal Skills**

L	T	P	Credits
-	-	2	1

Course Description:

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

Course Leaning Outcomes:

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

1. Exhibit interpersonal communication skills.
2. Demonstrate decision-making skills.
3. Apply conflict resolution styles appropriate in different situations.
4. Demonstrate skills to manage balance in work and life.

Prerequisite:

- Adequate knowledge of basic grammar of English language.
- Intermediate level vocabulary of English language.
- Communicate moderately using English language.

Minimum 12 sessions will be conducted from the following list.

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

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

Rajarambapu Institute of Technology CSE (AI&ML) Engg Department 415414 Rajaramnagar

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

11.	**Cross cultured sensitizations & Adaptability** Adapting multinational & multicultural environment, embracing diversity, culturally sensitive and bonding to colleagues and stakeholders, sense of belongings and promotion of unity at work place.	**02**
12.	Evaluation of Students for their Understanding of Various Concepts Discussed.	**02**

References –

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

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

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

Class: - **S.Y. B. Tech.**	Semester-III/IV
Course Code: **SH2695**	Course Name: **Innovation Tools and Methods for Entrepreneurs**

L	T	P	Credits
-	-	2	1

Course Description:

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

Course Leaning Outcomes:

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

1. Explain structured approach to define the problem with every possible detail, identify conflicts and solve them.
2. Apply User Journey Map to the selected problem to show user interaction at various stages.
3. Analyze the solutions provided by competitors for effectiveness and gaps if any.

Prerequisite:

- Creativity and Innovativeness, Problem identification.
- Apply design thinking approach to develop working prototype.
- Structured approach to problem solving.

Minimum 12 sessions will be conducted from the following list.

Course Content		
Exp. No.	**Description**	**Hrs.**
1.	**Systematic Innovation** Define the problem in depth with all details, Trend prediction, Modeling the problem to identify tradeoffs and contradictions.	**02**
2.	**TRIZ** Theory of Inventive problem solving (TRIZ), HIT Matrix, Scamper, Algorithms of brain storming and innovation, Functional analysis.	**02**

3.	**Frugal and Disruptive Innovation** Biomimicry and frugal innovation for prototyping, Disruptive innovation.	**02**
4.	**User Journey Map** Map showing user interaction at every stage of product/service. Step-by step process of UJM creation.	**02**
5.	**Competitor analysis** Analysis of competitor and users for similar products, effectiveness of existing solutions and identifications of gaps.	**02**
6.	**Product/Software Design Specifications** Detailed specifications for better product design, detailed UI for software for clarity on user interaction, specify USPs of the product in comparison to the competitors.	**02**
7.	**Business Canvas** A. Definition of a Business Model B. The 9 Building Blocks: 1. Customer 2. Value Propositions 3. Channels, distribution, 4. Customer relationships 5. Revenue 6. Key Resources 7. Key Activities 8. Key Partnerships 9. Cost Structure	**02**
8.	**Design Thinking (Part I)** Customer Insights, Ideation, Visual Thinking.	**02**
9.	**Design Thinking (Part II)** A. Prototyping. B. Storytelling. C. Scenarios	**02**
10.	**Institutional arrangement for Entrepreneurship Development** Institutional arrangement for Entrepreneurship Development – DIC, ITCOT, SIDCO, NSIC, SISI, TIIC, SIDBI, Commercial Banks.	**02**
11.	**Project Report**	**02**

	a) Economic Aspects b) Technical Aspects c) Financial Aspects d) Production Aspects e) Managerial Aspects	
12.	**Investor Pitch Tool** a) Introduction b) Helpful Tips about preparation, pitching and content sharing c) Does and Don'ts d) Introduction e) Problem f) Solution/Product/Service g) Traction h) Market Opportunities/ Size i) Competition j) Go To Market Strategies k) Financials l) Team	**02**
13.	**Revision -I**	**02**
14.	**Revision-II**	**02**

References –

- J. Knapp, "Design Sprint", Simon & Schuster Publisher.
- Silverstein, "The Innovator's Toolkit", Wiley Publishing House.
- M. A. Orloff, "ABC-TRIZ: Introduction to creative design thinking with modern TRIZ modelling", Springer Publication.
- M. Laverty, "Entrepreneurship", OpenStax Publication.

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

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

Class: - **S.Y. B. Tech.**	Semester-**III/IV**	**L**	**T**	**P**	**Credits**
Course Code: **SH2595**	Course Name: **Personal Effectiveness and Body Language**	**-**	**-**	**2**	**1**

Course Description:

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

Course Leaning Outcomes:

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

1. Develop skills to build self-esteem and positive attitude.
2. Develop interpersonal skills characterized by effective communication and conflict resolution.
3. Discover ways to overcome procrastination.
4. Demonstrate responsiveness towards stress and health issues.
5. Interpret the non-verbal behaviour of a person.

Prerequisite:

- Adequate knowledge of basic grammar of English language.
- Intermediate level vocabulary of English language.
- Communicate moderately using English language.

Minimum 12 sessions will be conducted from the following list.

Course Content		
Exp. No.	**Description**	**Hrs.**
1.	**Self-awareness and Self Esteem** Meaning, Factors influencing self-esteem- environmental and social factors Developing self-esteem- strategies for building self-esteem.	**02**
2.	**Goal Setting** Long term and short-term goals, Steps in goal setting (SMART)- - identify strategies - consider possible blocks and ways to deal with them - outline the steps - set deadlines.	**02**

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

	Vocalics, Haptics, Appearance	

References –

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

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

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

Class: - **S.Y. B. Tech.**	Semester-**III**	**L**	**T**	**P**	**Credits**
Course Code: **SH2735**	Course Name: **German Language- III**	-	-	**2**	**1**

Course Description:

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

Course Leaning Outcomes:

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

1. Interpret the language if the next person is speaking slowly and clearly.
2. Make use of the language in routine life with the routing topics like family, shopping, work etc.
3. Demonstrate the language by self-introduction in German with simple sentences.

Prerequisite:

- Adequate knowledge of basic grammar of German language.
- Intermediate level vocabulary of German language.
- Communicate moderately using German language.

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

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

References –

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

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

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

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

Class: - **S.Y. B. Tech.**	Semester- **III**
Course Code: **SH2715**	Course Name: **Japanese Language – III**

L	T	P	Credits
-	-	2	1

Course Description:

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

Course Leaning Outcomes:

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

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

Prerequisite:

- Knowledge of basic grammar of Japanese Language.
- Communicate moderately using Japanese Language.

All the 15 lab sessions will be conducted to meet the needs of following content delivery.

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

9.	Rules for adjective – adjective combinations in one sentence.	**02**
10.	How to make ない　forms of the verbs.	**02**
11.	Use of ない　forms of the verbs to ask or to tell someone not to do something.	**02**
12.	Must do pattern using なければ　なりません。	**02**
13.	How to make dictionary forms of the verbs.	**02**
14.	Uses Potential form できる	**02**
15.	How to express the hobby.	**02**

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

References –

- Minna No Nihongo I (3A Corporation, Japan), Publications: Goyal publishers.
- Nihongo shouhou, Publication: JALTAP

Other reference material, practice papers & CDs for listening practice.

The extra notes will be provided to the students as per the requirement of the syllabus.

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

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

Class:- **S. Y. B. Tech.**	Semester- **IV**
Course Code: **AI204**	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. Realize machine learning and learn the basic theory underlying machine learning.
2. Describe the differences in approaches and applicability of regression, classification, and clustering
3. Apply decision-based, instance-based, kernel-based, and Bayesian learning techniques to solve basic Machine Learning problems.
4. Apply unsupervised learning techniques for clustering and dimensionality reduction to identify meaningful patterns in data.
5. Evaluate Machine Learning models using appropriate performance measures to assess their effectiveness for different learning tasks.

Prerequisites:

- Basic knowledge of Probability theory.
- Basic knowledge of 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, Types of ML problems, Classification of ML algorithms, Data Partitioning Methods, Performance evaluation.	06
2.	**Regression Based Learning**	06

	Regression Analysis, Covariance, Correlation Coefficient, Regression Methods, Simple linear regression, Multiple Regression, Polynomial regression, Generalized linear models, Regularization, Logistic regression.	
3.	**Decision tree** Purpose and uses, Constructing a decision tree, Gini Index, Gain ratio, ID3, C4.5, CART, Benefits of decision tree, Ensemble Learning- bagging, boosting, Random forest, Adaboost, XG Boost.	**06**
4.	**Instance Based Learning and Kernel-Methods Based Learning** KNN algorithm, Determining K, distance measures in KNN, Case based Reasoning, Support vector Machines (SVM), Linear SVM, Non-linear SVM, Kernel Functions.	**06**
5.	**Bayesian learning** Classical, Empirical, Subjective methods, Types of events, Types of probabilities, Normal Distribution, Bayes' Theorem, Naïve Bayes' classifier, Bayesian Network.	**06**
6.	**Unsupervised Learning** Types of clustering, K-means clustering algorithm, Advantages and dis-advantages of K-means clustering, Distance measures. Hierarchical Clustering, DBSCAN, Dimensionality Reduction: Principal Component Analysis (PCA), t-SNE.	**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.

Online courses links:

- https://machinelearningmastery.com/
- https://www.udacity.com/course/intro-to-machine-learning--ud120

Class:- **Second Year B. Tech.**	Semester- **IV**
Course Code: **AI208**	Course Name: **Database Management Systems**

L	T	P	Credits
3	-	-	3

Course Description:
This course introduces fundamental data structures and algorithm design techniques for efficient problem solving and software development. It covers linear and non-linear data structures such as stacks, queues, linked lists, trees, and binary search trees along with their operations and applications. The course also emphasizes algorithm analysis using Big-O notation and explores advanced design paradigms including Divide and Conquer, Greedy Method, and Dynamic Programming for solving computational problems efficiently.

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

1. Identify and describe various components of DBMS.
2. Construct Entity-Relationship Model for given applications and demonstrate it as a relational model.
3. Design optimal (SQL) query statement, Apply normalization to database design.
4. Improve efficiency in data retrieval using indexing and solve analytical problems on serializability, concurrency and recovery.
5. Develop applications using relational and NoSQL database.

Prerequisite:
Knowledge of problem-solving techniques, basic mathematics, and discrete concepts such as sets, relations, and logical reasoning.

Course Content

Unit No	Description	Hrs
1.	**Introduction to Database Systems** Databases and Database users: Introduction, An example, Characteristics of Database Approach, Data Models, Schemas and Instances, Three-schema Architecture and Data Independence. Data Modeling Using the Entity-Relationship Model- High-Level Conceptual Data Models for Database Design, Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types.	06
2.	**Relational Model and Relational Algebra**	06

	Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations and Dealing with Constraint Violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION. Introduction to SQL- SQL Data Definition, Specifying Constraints in SQL, Basic Queries in SQL; Insert, Delete and Update Statements in SQL More Complex SQL Retrieval Queries.	
3.	**Relational Database Design** Functional Dependencies – Definition, Inference Rules, Equivalence of sets of FD's, Minimal Set of FD's ; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Properties of Relational Decompositions	**06**
4.	**Transaction Processing Concepts** Introduction to transaction processing, Transaction states and additional operations, Desirable properties of transaction, Schedules of transactions. Characterizing schedules based on Serializability: Serial, Non serial and Conflict- Serializable schedules, Testing for Conflict serializability of schedule.	**06**
5.	**Concurrency Control Techniques** Two phase locking techniques for concurrency control, types of locks and system lock tables	**06**
6.	**Introduction to NoSQL** Aggregate data models: aggregates, key-value and document data models. Distribution models: sharding, master-slave replication, peer-peer replication – combining sharding and replication	**06**

References -

Text Books:

- Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education.
- Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database system concepts", Fifth Edition, McGraw Hill International.
- Raghu Ramkrishnan, Johannes Gehrke, "Database Management Systems", Second Edition, McGraw Hill International.
- Seema Acharya and Subhashini Chellappan. Big Data and Analytics. Wiley India Pvt. Ltd

Reference Books:

- Pramod J Sdalage, Martin Fowler: NoSQL A brief guide to the emerging world of Polyglot Persistence, Addison-Wesley

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Class:- **S. Y. B. Tech.**	Semester- **IV**
Course Code: **AI228**	Course Name: **Software Engineering and Project Management**

L	T	P	Credits
3	-	-	3

Course Description:
This course introduces students to the fundamental concepts and practices of Software Engineering and Software Project Management. It covers the process of gathering, analyzing, and documenting software requirements, along with a study of different software development life cycle (SDLC) models and Agile practices. Students learn Object-Oriented Analysis, Design, and UML-based modelling techniques to represent software systems. The course also covers project planning, estimation, scheduling, and risk management, along with software testing strategies, maintenance practices, and quality assurance standards. By the end of the course, students will be able to analyze, design, manage, and assure the quality of software systems.

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

1. Analyze fundamental concepts of software engineering and the software development life cycle.
2. Prepare software requirement specifications for the undertaken software problems.
3. Practice software process models for the undertaken software problems.
4. Design object-oriented models using UML for the undertaken software problems.
5. Apply project management concepts, including estimation and scheduling, for the undertaken software problems.
6. Compare software testing techniques and illustrate quality assurance practices in software development.

Prerequisites:
- Fundamentals of Object-Oriented Programming

Course Content

Unit No	Description	Hrs
1.	**Introduction to Software Engineering**	04

	Software Engineering Basics and Scope, Software Engineering Problems and Approaches, Software Crisis, Software Myths: Management Myths, Customer Myths, Practitioner's Myths, Software Quality Attributes, Characteristics of Good Software, Software Process Framework	
2.	**Requirement Engineering** Requirements Engineering: Need and Importance, Requirement Engineering Process, Functional Requirements, Non-functional Requirements, Requirements Elicitation, Requirements Analysis, Requirements Specification, Requirements Validation, Requirements Management, Software Requirements Specification (SRS) Document, Characteristics of a Good SRS, IEEE Standards for SRS, Case study to prepare an SRS	**06**
3.	**Software Process Models** Software Process Models: need for a process model, Waterfall Model, V-shaped Model Prototyping Model, Incremental Model, Spiral Model, Iterative Enhancement Model, Agile Model, Extreme Programming (XP): planning, design, coding, testing, XP practices, Scrum framework: product backlog, sprint backlog	**06**
4.	**Object-Oriented Analysis, Design and UML** Object-Oriented Analysis (OOA), Object-Oriented Design (OOD), Introduction to UML, Use Case Diagram, Class Diagram, Object Diagram, Sequence Diagram, Collaboration Diagram, Data Flow Diagram (DFD), Entity Relationship Diagram (ERD), Case study on Class, Object, Sequence, Collaboration diagrams and DFD for systems such as Hospital Management System, Library Management System, Banking System, Railway Reservation System and Online Shopping System	**07**
5.	**Software Project Management and Estimation** Project Planning: Project planning, process database, process assets and project planning infrastructure. Effort Estimation and Scheduling: Estimation concepts, effort estimation and project scheduling. Quality and Risk Management: Quality planning, defect prevention, risk assessment and risk control. Project Monitoring and Control: Project tracking, reviews, milestone analysis, monitoring and control. Project Management Tools: Asana, Bitrix24 and Zapier.	**07**

6.	**Software Testing, Maintenance and Quality Assurance** Verification and Validation Activities, Testing Principles & Strategies, Testing Levels: Unit Testing, Integration Testing, White Box Testing, Black Box Testing, Grey Box Testing, Software Maintenance and Types of Software Maintenance, Overview of Software Configuration Management, Quality Assurance and Quality Control, Quality Assurance vs Quality Control, Quality Standards – ISO, Process Improvement Models: CMM, CMMI	**06**

References -

Text Books:

- Roger S. Pressman and Bruce R. Maxim, "Software Engineering: A Practitioner's Approach", McGraw-Hill
- Ian Sommerville, "Software Engineering", Pearson.
- Pankaj Jalote, "An Integrated Approach to Software Engineering", Narosa Publication House.
- Pankaj Jalote, "Software Project Management in Practice", Pearson Education.

Reference Books:

- Roger S. Pressman, "Software Engineering - A Practitioner's Approach", TATA McGraw-Hill.

Class:- **S. Y. B. Tech.**	Semester- **IV**
Course Code: **AI230**	Course Name: **Natural Language Processing**

L	T	P	Credits
3	-	-	3

Course Description:
This course introduces the fundamental concepts and techniques of Natural Language Processing (NLP). It covers text preprocessing, linguistic analysis, text representation, and statistical language models. Students will learn classical machine learning approaches for solving NLP problems such as text classification and sentiment analysis. The course also introduces important NLP applications including information retrieval, text summarization, and information extraction. Practical examples enable students to develop basic NLP solutions for real-world applications.

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

1. Use fundamental linguistic concepts and levels of language analysis to address basic Natural Language Processing tasks.
2. Apply appropriate text preprocessing and linguistic analysis techniques to transform unstructured textual data into meaningful linguistic information.
3. Construct textual representations using Bag-of-Words, TF-IDF, n-grams, similarity measures, and introductory word embedding techniques for NLP tasks.
4. Apply statistical language models and classical machine learning algorithms to perform basic Natural Language Processing tasks.
5. Demonstrate the application of NLP techniques to information extraction and selected real-world applications while considering performance, limitations, ethical issues, and bias.

Prerequisites:

- Basic knowledge of Python programming, data structures, probability and statistics, Artificial Intelligence, and Machine Learning.

Course Content

Unit No	Description	Hrs
1.	**Introduction** Introduction to NLP, applications of NLP, challenges in NLP, levels of language analysis, Natural Language Understanding and Generation, ambiguity in natural language, NLP pipeline, linguistic resources and corpora	06
2.	**Text Processing and Linguistic Analysis**	06

	Text normalization, sentence segmentation, word tokenization, stop-word removal, stemming, lemmatization, spelling correction, n-grams, Part-of-Speech (POS) tagging, chunking, Named Entity Recognition (NER), regular expressions for NLP	
3.	**Text Representation and Feature Engineering** Bag-of-Words model, binary and frequency-based representations, TF-IDF, term-document matrix, word co-occurrence, similarity measures, cosine similarity, feature selection for text, dimensionality reduction, introduction to Word2Vec and GloVe concepts.	06
4.	**Statistical Language Models** Probabilistic language models, N-gram language models, Smoothing techniques ,Maximum Likelihood Estimation (MLE),Hidden Markov Models (HMMs),Viterbi Algorithm, Part-of-Speech tagging with HMMs	06
5.	**Classical Machine Learning for NLP** Supervised and unsupervised learning in NLP, Naive Bayes, Decision Trees, Maximum Entropy, Support Vector Machines, Neural Networks	06
6.	**NLP Applications and Information Extraction** Information retrieval, text similarity, document clustering, topic modeling, text summarization, question answering, machine translation concepts, dialogue systems and chatbots, information extraction, NLP applications in healthcare, education, and social media, ethical issues and bias in NLP	06

References -

Text Books:

- Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson.
- Christopher D. Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press.
- Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O'Reilly Media.

Reference Books:

- James Allen, Natural Language Understanding, Pearson.
- Frederick Jelinek, Statistical Methods for Speech Recognition, MIT Press.
- Philipp Koehn, Statistical Machine Translation, Cambridge University Press.

K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Syllabus of Second Year B. Tech. CSE(AI&ML)
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Class:- **Second Year B. Tech.**	Semester- **IV**
Course Code: **AI232**	Course Name: **Operating Systems**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides a comprehensive exploration of the fundamental principles and architectural components of modern Operating Systems (OS), bridging the gap between hardware and user-level applications. Here we delve into core functional areas including process management (scheduling and concurrency), memory management (paging and virtual memory), and file system structures, while learning how an OS ensures system stability through security, protection, and deadlock handling. By analyzing the interaction between the CPU, memory hierarchy, and I/O devices, we will gain a technical understanding of how an operating system act as both a resource manager and a secure environment for program execution.

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

1. Define the fundamental components of an operating system and explain the functional interaction between the CPU, memory hierarchy, and I/O interrupts within various computing environments.
2. Apply various CPU scheduling algorithms, page replacement strategies, and disk scheduling methods to optimize resource allocation and system performance.
3. Analyze the mechanisms of process synchronization and deadlock handling to identify and resolve concurrency issues within a multi-threaded environment.
4. Evaluate the efficacy of different memory management schemes and security protocols to design a robust framework for data protection and system integrity.

Prerequisite:
Basic computer knowledge. A fundamental understanding of how hardware components interact is essential.

Course Content

Unit No	Description	Hrs
1.	**Introduction** Goals of an OS, Functions of an OS: Program management, Resource management and Security & protection. Features of computer system from OS viewpoint: CPU, MMU, Memory Hierarchy, Input/Output, Interrupts. System calls, Computing environments and classes of OS. Structure of an OS.	06
2.	**Process Management**	06

	Process Concept: The process, Process states, Process control Block, Threads. Process Scheduling: Scheduling queues, Schedulers, Context Switch.**Scheduling-** Non-preemptive: FCFS, SRN, HRN Preemptive: RR, LCN, STG.	
3.	**Process Synchronization** Process Synchronization: Background, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors. Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.	**06**
4.	**Memory Management and Virtual Memory** Memory Management: Background, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation. Virtual Memory: Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing.	**06**
5.	**File System and Disk scheduling** File Structure, File Types, File Access, File Attributes, File Operations, Single-Level Directory Systems, Two-level Directory Systems, Hierarchical Directory Systems. Disk scheduling: Disk Structure, Disk Attachment, Disk Scheduling, RAID Structure.	**06**
6.	**Security** Threats, Intruders, Accidental Data Loss, Basics of Cryptography, Secret-Key Cryptography, Public-Key Cryptography, One-Way Functions, Digital Signatures.	**06**

References -

Text Books:

- Dhananjay M. Dhamdhere, "Operating Systems – A Concept – Based Approach", Tata McGraw–Hill.
- Silberschatz, Galvin, Gagne, "Operating System Concepts" John Wiley.
- Andrew S. Tanenbaum, Modern Operating Systems, Prentice Hall PTR

Reference Books:

- William Stallings, "Operating Systems–Internals and Design Principles" Pearson
- Charles Crowley, "Operating Systems-A Design Oriented approach", McGraw Hill

Class: **S. Y. B. Tech.**	Semester-IV
Course Code: **CEMD2021**	Course Name: **Building Estimation and Valuation**

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Outcomes:

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

1. Explain the types and basic requirements of the estimate.
2. Explain measurement sheet, abstract sheet, and detailed specifications of different construction items.
3. Prepare detailed estimate of load bearing structure and framed structure.
4. Prepare rate analysis and bar bending schedule of different construction items.
5. Explain the tenders and contracts.
6. Describe basic terms of valuation.

Prerequisite:

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

Course Content

Unit No.	Description	Hrs.
1.	**Introduction SSR** General introduction to Quantity surveying, Purpose of estimates, Types of Estimates- Approximate and Detailed, Various items to be included in estimates of building, road and culvert with their modes of measurement, I.S. 1200, Prime cost, Provisional sums, Provisional quantities, Administrative approval and technical sanction to estimates. Introduction to S.S.R., General notes and guide lines.	06
2.	**Specifications**	06

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

References –

References Books: -

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

I. S. Code:-

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

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Class:- **S. Y. B. Tech.**	Semester- **IV**
Course Code: **CSMD204**	Course Name: **Fundamentals of Database Systems**

L	T	P	Credits
3	-	-	3

Course Description:

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

Course Learning Outcomes:

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

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

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

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, Structured Query Language (SQL): Data Definition Language, Data Manipulation Language, Aggregate functions, Set Operations.	06
3.	**Integrity Constraints and Database Design**	06

	Domain Constraints, Referential Integrity, Functional Dependencies, Decomposition, Normalization: 1NF, 2NF, 3NF	
4.	**Data Storage and Indexes** File Organization, Data Dictionary Storage, Indexing: B+ tree indexing and B tree indexing, Hashing: Static and Dynamic.	**06**
5.	**Basic of Transactions** 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. Crash Recovery: Failure Classification, Log-Based Recovery, Checkpoints.	**06**

References –

Text Books:

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

Reference Books:

- Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson/Addision wesley.

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K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Syllabus of Second Year B. Tech. CSE(AI&ML)
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Class:- **S. Y. B. Tech.**	Semester- **IV**
Course Code: **EEMD2021**	Course Name: **Power System**

L	T	P	Credits
3	--	--	3

Course Description:

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

Course Learning Outcomes:

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

1. Write the basic working principles of different generating sources.
2. Analyze different types of loads.
3. Explain importance of power factor and tariffs in power system.
4. Identify various components in power transmission and distribution system.
5. Select substation equipment's as per requirement.

Prerequisite:

- Basic Electrical Engineering, Basic Mathematics and Physics.

Course Content

Unit No	Description	Hrs
1	**Power Generation** Structure of power system, generating stations – operation and working of conventional and nonconventional energy sources. Comparison between them.	06
2	**Variable load on power stations** Load curves and types of loads – base and peak loads, cost of electrical energy, depreciation and its methods.	06
3	**Power factor and Electric Tariff** Power triangle, power factor and causes of low power factor and methods of power factor improvement. Tariff and its characteristics.	06
4	**Electrical and Mechanical Design of Transmission lines** Construction of transmission lines and its components, line resistance, inductance and capacitance. Sag and its calculation, String efficiency.	06

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414 Rajaramnagar

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5	**Supply system** AC and DC transmission systems and comparison. Overhead and underground system, Construction of cables and types.	**06**
6	**Substation** Classification of substations, outdoor and indoor substations. Symbols for equipments in substations and their functions,	**06**

References –

Text Books:

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

Reference Books:

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

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To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Class:- **S.Y. B. Tech.**	Semester- **IV**
Course Code: **ECMD2021**	Course Name: **Electronics Communication Systems**

L	T	P	Credits
3	-	-	3

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

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Describe different communication systems.
2. Explain applications of analog and digital modulation techniques.
3. Analyze different modulation and demodulation techniques.
4. Explain the use of satellite communication.

Prerequisite:
- Fundamental concepts of engineering and Mathematics.

Course Content

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

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	And Data Formats Data Formats, ASK, FSK, PSK, coherent and non-coherent reception, BPSK, DPSK, QPSK, 16-QAM, MSK, Waveforms and Comparison of digital modulation.	
5.	**Satellite Communication** Basic concepts of Satellite Communications, Satellite subsystems, Satellite Link design, Orbital Mechanics.	**06**
6.	**Satellite Application** DBS, VSAT, GPS, Case Studies – Mars Mission, Chandrayan.	**06**

References –

Text Books:

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

Reference Books:

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

Class:- **S.Y. B. Tech**	Semester-**IV**
Course Code: **CIMD2021**	Course Name: **Computer Algorithms**

L	T	P	Credits
3	–	–	3

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

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Analysing asymptotically the performance of algorithms.
2. Compare and analyse searching and sorting algorithms.
3. Apply different algorithm design techniques to solve problems like job sequencing, knapsack, TSP, finding shortest path etc.
4. Apply backtracking method to solve problems like N-queens, graph coloring, sum of subsets etc.
5. Describe computational complexity theory to classify computational problems according to their inherent difficulty.

Prerequisite:
- Basic knowledge of Mathematics.

Course Content

Unit No	Description	Hrs
1.	**Introduction** Introduction, Characteristics of algorithm, Pseudocode conventions, Recursive algorithms, Performance analysis – time and Space complexity, asymptotic notations.	05
2.	**Searching and Sorting Methods** Linear Search, Binary Search, Bubble sort, Quick Sort, Merge Sort, Selection Sort, Insertion sort, Radix Sort, Bucket Sort. Divide and Conquer- General method, Finding the maximum and minimum, Strassen's matrix multiplication.	07
3.	**Greedy Method**	05

	General method, Knapsack problem, Job sequencing with deadlines, Minimum-cost spanning trees – Prim's and Kruskal's algorithms, Optimal storage on tapes, Single source shortest paths.	
4.	**Dynamic Programming** General method, Multistage graphs, All pair shortest paths, 0/1 Knapsack problem, Reliability design, Traveling sales person problem.	**07**
5.	**Backtracking** General method, n-Queens problem, Subset sum problem, Graph coloring problem, Travelling sales person problem.	**06**
6.	**Introduction to Complexity Theory** The P and NP Classes, Polynomial, time reductions, NP- Hard and NP-Complete classes. NP-Hard graph problems- Clique decision problem, Vertex cover problem, Travelling sales person decision problem, Randomized algorithms.	**06**

References -

Text Books:

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

Reference Books:

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

Class:- **S. Y. B. Tech.**	Semester-IV
Course Code: **MEMD2041**	Course Name: **Behavioral Engineering and Design**

L	T	P	Credits
3	--	--	3

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

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

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

Prerequisite:

- Course on Design Thinking.

Course Content

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

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

References –

Text Books:

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

Class: **S. Y. B. Tech**	Semester: IV
Course Code: **MEMD206**	Course Name: **Automotive Drivetrain**

L	T	P	Credits
3	–	–	3

Course Description:

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

Course Learning Outcomes:

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

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

Prerequisite: NIL

Course Content		
Unit No	**Description**	**Hrs**
1.	**Introduction to Automotive Drivetrain** Layout of automobile power transmission system, Types of drivetrains: FWD, RWD, AWD, 4WD, Requirements of a good drivetrain, Torque, power flow, and losses in drivetrain	**06**
2.	**Clutches** Functions and requirements of a clutch, Single plate, multi-plate, cone, and centrifugal clutches, Clutch materials and wear characteristics, Hydraulic and electronic clutch actuation.	**06**
3.	**Gearboxes and Transmission Systems** Manual transmission: sliding mesh, constant mesh, synchromesh, Automatic transmission: torque converter and planetary gear sets, Introduction to Continuously Variable Transmission (CVT), Dual Clutch Transmission (DCT) and Automated Manual Transmission (AMT)	**06**
4.	**Propeller Shafts and Universal Joints** Construction and function of propeller shafts, universal joints and constant velocity (CV) joints, slip joints, driveline vibration issues, torque transmission characteristics of shaft systems.	**06**
5.	**Differential and Final Drive Systems** Construction and working of differential systems, open differential, limited slip differential, locking differential, axle arrangements, final drive ratios, effect of differential action during vehicle cornering and traction conditions.	**06**
6.	**Modern and Electric Vehicle Drivetrains** Hybrid electric drivetrain configurations – series, parallel, and power-split systems; electric vehicle drivetrain architecture, regenerative braking systems, drivetrain efficiency and energy management, future trends in automotive drivetrain technology.	**06**

References –

Text Books:

- Kripal Singh, "Automobile Engineering", Vol. I Standard publisher's distributors.
- Dr. N. K. Giri, "Automobile Engineering", Khanna Publishers.
- S Srinivasan, "Automotive Mechanics" Tata McGraw Hill Publication.
- K K Ramalingam, "Automobile Engineering" SCITECH publication.
- R. K. Rajput, "Automobile Engineering" Laxmi Publications.
- G. B. S. Narang, "Automobile Engineering;" Khanna Publishers.

Reference Books:

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

Class: **S. Y. B. Tech.**	Semester: **IV**
Course Code: **MCMD2021**	Course Name: **Industrial Fluid Power**

L	T	P	Credits
3	-	--	3

Course Description:
Fluid power has the highest power density of all conventional power-transmission technologies. Learn the benefits and limitations of fluid power, how to analyse fluid power components and circuits, and how to design and simulate fluid power circuits using Automation Studio for applications. In this course, you will be introduced to the fundamental principles and analytical modelling of fluid power components, circuits, and systems. You will learn the benefits and limitations of fluid power compared with other power transmission technologies; the operation, use, and symbols of common hydraulic & pneumatic components; how to formulate and analyse models of hydraulic & pneumatic components and circuits; and how to design and predict the performance of fluid power circuits.

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

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

Prerequisite:

- Fundamental concepts of fluid mechanics.
- Basic electrical engineering, and engineering mechanics.

Course Content

Unit No.	Description	Hrs.
1.	**Fluid Power Systems and Fundamentals** 1. Introduction to fluid power, Advantages of fluid power. 2. Application of fluid power system. 3. Types of fluid power systems, Properties of hydraulic fluids, General types of fluids. 4. Fluid power symbols. (ISO/JIC) 5. Use of Automation studio to draw circuits.	06
2.	**Hydraulic System and Components (Pumps and Actuators)** 1. Pumping theory, Pump classification. 2. Gear pump, Vane Pump, construction and working of pumps, pump performance, piston pump 3.	06

Rajarambapu Institute of Technology CSE (AI&ML) Engg Department 415 414 Rajaramnagar
K.E.S. Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

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

References –

Text Books:

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

Reference Books:

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

Class:- **S.Y. B. Tech.**	Semester- **IV**
Course Code: **AIMD2021**	Course Name: **Data Structures & Algorithms**

L	T	P	Credits
3	--	--	3

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

Course Learning Outcomes:
The course should enable the students to:

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

Prerequisite:

- Basic knowledge of C programming.
- Knowledge of basic mathematical concepts.

Course Content

Unit No	Description	Hrs
1.	**Introduction to Data Structures** Primitive and non-primitive data structures, Operations on data structures, Algorithms, Abstract Data Types, Complexity Analysis.	05
2.	**Linear Data Structures** **Stack:** Definition, Representation and Applications of Stack. **Queue:** Definitions, Representation and Applications of Linear Queue, Circular Queue, and Priority Queue.	06
3.	**Linked Lists**	07

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414 Rajaramnagar

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

	Definition, Representation, Operations and Applications of singly linked list, doubly linked list, circular linked list, Application of linked list-Stack & queue, Introduction to Sparse matrix, representation of sparse matrix using linked list.	
4.	**Searching, Sorting and Hashing Techniques:** Linear search, Binary search, Bubble sort, insertion sort, Merge sort, Quick sort, Selection sort, Radix sort, Heap sort, Complexity of algorithms. **Hashing**: Definition, Hash functions, Overflow, Collision, Open Hashing, closed hashing, Rehashing Techniques.	**07**
5.	**Trees** Basic Technology, Binary Tree, Traversal methods, Binary search tree, AVL Tree, B tree, B+ tree, Heaps - operations and their applications.	**06**
6.	**Graphs** Basic concepts of graph theory, Storage representation, Operations on graphs, Traversing a graph, Shortest path algorithm.	**05**

References –

Text Books:

- Seymour Lipschutz, "Data structures", MGH, Schaum's Outlines.

Reference Books:

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

Class: **S. Y. B. Tech.**	Semester: **IV**
Course Code: **RAMD2021**	Course: **Sensors & Actuators**

L	T	P	Credits
3	-	-	3

Course Description:
The goal of this course is to give senior and graduate students in engineering a hands-on introduction to the fundamental technology and practical applications of sensors. Various sensors, including capacitive, inductive, ultrasonic, accelerometers, image sensors and others will be covered in the course. Instrumentation techniques incorporating computer control, sampling, and data collection and analysis are reviewed in the context of real-world scenarios. There will be weekly laboratory assignments where students will have hands on experience with various sensors.
The course is based around a custom board equipped with various sensors, such as a high speed camera, touch sensor, humidity sensor, temperature sensor, pressure sensor, accelerometer and position sensor. Additional peripheral sensors using the PMOD interface standard can also be attached to the sensor board. The board interfaces with these sensors via an FPGA device and it can also communicate with a PC via USB 3.0 interface. Students will use Verilog language to program the FPGA and communicate with various sensors and PC.

Course Outcomes:
After successful completion of the course, students will be able to,
1. Explain the functioning of various sensors and transducers.
2. Calibrate the transducers such as accelerometers, microphones and strain gauges.
3. Explain the characteristics of various sensors and transducers.
4. Describe the process and need for calibration.
5. Choose the sensor for measurement of few parameters.
6. Use the appropriate sensor and calibrate.

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

Course Content

Unit No.	Description	Hrs.
1.	**Sensors** Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signals: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.	06

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

References –

Text Book:

- DVS Murthy, "Transducers and Instrumentation", PHI.
- D Patranabis, "Sensors and Transducers", PHI.
- S. Gupta, J.P. Gupta, "PC interfacing for Data Acquisition & Process Control", Instrument Society of America.
- Gary Johnson, "Lab VIEW Graphical Programing", McGraw Hill.
- Patranabis. D, "Sensors and Transducers", Wheeler publisher.
- Sergej Fatikow and Ulrich Rembold, "Microsystem Technology and Microbotics", Springer –Verlag NEwyork, Inc.
- Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourth edition, Springer.

Reference Books:

- Arun K. Ghosh, "Introduction to measurements and Instrumentation", PHI.
- A.D. Helfrick and W.D. cooper, "Modern Electronic Instrumentation & Measurement Techniques", PHI.
- Hermann K.P. Neubert, "Instrument Transducers", Oxford University Press.

Class:- **Second Year B. Tech.**	Semester- **IV**
Course Code: **AI210**	Course Name: **Machine Learning Lab**

L	T	P	Credits
-	-	4	2

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

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Explore dataset and its associated characteristics using python libraries.
2. Implement various supervised learning algorithms for given dataset.
3. Implement various Unsupervised learning algorithms for given dataset.
4. Design solution for real world problem by implementing ML algorithms.
5. Develop, report and present implementation of typical Mini Project in ML.

Prerequisite:
- Basic knowledge of Probability theory.
- Basic knowledge of python programming

Laboratory work consists of minimum 10 experiments based on the syllabus.
Tentative experiment list is mentioned below.

Course Content		
Unit No	**Description**	**Hrs**
1.	**Basics of Python programming** Implement the programs that demonstrate basic statistic description of data.	**04**
2.	**Decision tree** Implement and evaluate ID3 / C4.5 algorithm on given dataset.	**04**
3.	**Random Forest** Implement and evaluate Random Forest algorithm on given dataset.	**04**
4.	**KNN algorithm** Implement and evaluate KNN algorithm on given dataset.	**04**
5.	**K-Means algorithm** Implement and evaluate K-Means clustering algorithm.	**04**

6.	**Naïve Bayes' Classifier** Implement and evaluate Naïve Bayes' Classifier algorithm.	**04**
7.	**Regression** Implement and evaluate Linear / multiple regression algorithm.	**04**
8.	**Logistic Regression** Implement and evaluate Logistic Regression algorithm on binary classification problem.	**04**
9.	Develop a mini project (as a team work) for a typical application of ML.	**04**
10.	Prepare report and present the development of the mini project (as a team work) for the typical application of ML.	**04**

References -

Text Books:

- Sunila Gollapudi "Practical Machine Learning" PACKT Publishing
- Mitchell, Tom. M., "Machine Learning", McGraw-Hill Education.
- https://machinelearningmastery.com/

Reference Books:

- Stephen Marsland, "Machine Learning An Algorithmic Perspective", CRC Tylor and Francis Publication
- https://www.udacity.com/course/intro-to-machine-learning--ud120
- https://www.coursera.org/learn/machine-learning-duke

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Rajarambapu Institute of Technology, Rajaramnagar
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Class:- **Second Year B. Tech.**	Semester- **IV**
Course Code: **AI212**	Course Name: **Database Management Systems Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This course provides practical exposure to the design and implementation of database management systems using relational and NoSQL databases. It focuses on ER modeling, SQL query processing, normalization, indexing, concurrency control, PL/SQL programming, and database connectivity through hands-on experiments and real-world applications.

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

1. Sketch E-R diagram for given Case Study/ Problem Statement.
2. Implement SQL query for various operations like retrieval, insertion, manipulation of data, PL/SQL cursor, procedure and triggers.
3. Design relational database using Normalization and Functional Dependency.
4. Apply hashing mechanism to build hash index file on given records.
5. Develop a program to connect a database to an application program.

Prerequisite:

- Basic knowledge of the file system and how it works.
- Basic knowledge of storage mechanisms.

Course Content

Unit No	Description	Hrs
1.	**ER Diagrams** Demonstrate the ER Model by Drawing Diagrams using an open-source tool.	02
2.	**Data Definition Language (DDL)** Implement the Queries based on creating, destroying databases and database objects.	02
3.	**Data Modeling Language (DML)** Implement the Queries based on inserting, deleting and updating data in a database.	02

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414 Rajaramnagar
Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

4.	**String, Set operations, aggregate functions, Group by, Order by clause** Implement the Queries based on the above commands.	**02**
5.	**Database joins** Implement the Queries based on qui-join, inner joins & view creation.	**02**
6.	**Basics of PL/SQL** Implement PL/SQL using cursors and triggers.	**02**
7.	**Constraints** Implement the Queries based on primary key, foreign key, not null, unique & check constraints.	**02**
8.	**Database Design** Database design using closure of Functional dependencies and canonical, cover and various normal forms.	**02**
9.	**Indexing & Hashing** Implementation of dense and sparse index.	**02**
10.	**Concurrency Control** Write a program to simulate any one concurrency control Protocol.	**02**
11.	**JDBC-ODBC** Implementation of a student database using JDBC-ODBC.	**02**
12.	**NoSQL – MongoDB** Implement basic CRUD and aggregation operations using **MongoDB**.	**02**

References -

Text Books:

- F. Korth, Abraham Silberschatz, Sudarshan, "Data Base System Concept", McGraw Hill Inc.
- Ram Krishnan and Johanses Gehrke, "Database Management System", McGraw Hill Inc.

Reference Books:

- J.D. Ullman, "Principles of DataBase Systems", Galgotia Publications.
- Masri, Navathe, "Fundamentals of Database Systems", Bengamin Cummings, Publications.

Class:- **Second Year B. Tech.**	Semester- **IV**
Course Code: **AI230**	Course Name: **OOP using Java Lab**

L	T	P	Credits
2	-	2	3

Course Description:
This course introduces the principles of Object-Oriented Programming using Java, focusing on core concepts such as encapsulation, inheritance, polymorphism, and abstraction. It covers Java fundamentals, interfaces, packages, collections, exception handling, and multithreading for building robust applications. The course also emphasizes GUI development using AWT and Swing, along with event-driven programming. Additionally, students gain practical experience in developing data-centric applications through database connectivity using JDBC.

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

1. Apply core object-oriented concepts such as classes, objects, encapsulation, inheritance, polymorphism, and abstraction using Java.
2. Design and implement Java programs using interfaces, packages, constructors, method overloading, and overriding to achieve modularity and code reusability.
3. Utilize Java Collection Framework and exception handling mechanisms to develop efficient, reliable, and maintainable applications.
4. Develop concurrent Java applications by applying multithreading concepts including thread creation, synchronization, and inter-thread communication.
5. Design and implement Java-based GUI and database-driven applications using AWT/Swing components, event handling, and JDBC for CRUD operations.

Prerequisite:

- Basics of C programming language

Course Content		
Unit No	**Description**	**Hrs**
1.	**OOPS Concepts and Java Programming** OOP concepts: Classes and objects, data abstraction, encapsulation, inheritance, polymorphism, Java programming: History, scope and life time of variables, operators, control structure, simple java standalone	**04**

	programs, arrays, console input and output, constructors, overloading methods.	
2.	**Interfaces and Packages** Interface: Interfaces VS Abstract classes, defining and implementing interfaces, Packages: Defining, creating and accessing a package, importing packages.	**04**
3.	**Collection Framework** Collection, Collection Framework, List: ArrayList, LinkedList, Vector and Stack, Queue, Set: TreeSet and HashSet, Map: Hash Table and Hash Map.	**04**
4.	**Exception Handling and Multithreading** Exception Handling: Benefits, exceptions hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes. Multithreading: Thread states, creating threads, interrupting threads, thread priorities, synchronizing threads.	**04**
5.	**GUI Programming and Event handling** Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Event-Driven Programming in Java Event-Handling Process.	**04**
6	**Database connectivity** Introduction to JDBC, JDBC Drivers & Architecture CRUD operation Using JDBC.	**04**

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

Exp. No	Description	Hrs
1.	**Introduction to Java Programming**: Java programs to demonstrate the basic structure of Java, use of data types, operators, and control statements.	**02**
2.	**Classes, Object, and Method:** Java programs to create a class with data members and methods, and instantiate objects to access them.	**02**

3.	**Constructor, Method Overloading:** Java programs to demonstrate the use of constructors and implement method overloading for different parameter lists.	**02**
4.	**Inheritance and Method Overriding:** Java program to implement inheritance and demonstrate method overriding to achieve runtime polymorphism.	**02**
5.	**Interface and Abstract Classes:** Java programs to implement interfaces and abstract classes to achieve abstraction.	**02**
6.	**Collection Framework:** Java programs to demonstrate the use of Collection Framework classes	**02**
7.	**Exception Handling and Packages:** Java programs to handle different types of exceptions and create user-defined packages.	**02**
8.	**Multithreading:** Java programs to create multiple threads, set thread priorities, and implement synchronization.	**02**
9.	**GUI Programming and Event Handling:** Java program to design a GUI application and handle user-generated events	**02**
10.	**Database Connectivity:** Java program to establish database connectivity using JDBC and perform basic CRUD operations.	**02**

References -

Text Books:

- Herbert Schildt, "Complete Reference JAVA 2", TMGH Publication.
- Ken Arnold, James Gosling, David Holmes, "The Java Programming Language", Addison Wesley Professional.
- Cay S. Horstmaan, Gary Cornell, "Core Java 2 volume II –Advanced Features", Prentice Hall.

Reference Books:

- Deitel and Deitel, "Java How to Program", Prentice Hall.
- Niemeyer & Leuck, "Learning Java", O'REILLY (SPD).
- https://onlinecourses.nptel.ac.in/noc26_cs36/preview
- https://www.udemy.com/course/oop-with-java/

Class:- **S.Y. B. Tech.**	Semester- **IV**
Course Code: **AI226**	Course Name: **Massive Open Online Course (MOOC) - I**

L	T	P	Credits
-	-	-	1

Course Description:
Online courses offered through platforms like NPTEL, SWAYAM, and NASSCOM provide Computer Science & Engineering (CSE) students with valuable opportunities to advance their understanding of modern computing concepts and technologies. These courses cover key domains such as algorithms and data structures, software engineering, database systems, operating systems, computer networks, cybersecurity, cloud computing, and emerging fields like Artificial Intelligence, Machine Learning, and Data Science. By combining strong theoretical foundations with hands-on practical applications, they help students enhance problem-solving abilities, work with state-of-the-art tools, and prepare for real-world, industry-oriented challenges. The objective of such courses is to cultivate skills and mindsets that encourage continuous learning, adaptability to new technologies, and readiness to thrive in an ever-evolving tech landscape.

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

1. Explain fundamental principles, core concepts, and commonly used technologies in computer science and engineering.
2. Analyze basic computing problems using mathematical reasoning and engineering principles, and develop algorithms to solve them effectively.
3. Design and implement simple computer programs and system components using standard programming languages and software tools, demonstrating an ability to test and debug them.

Note:

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

References -

e-References :

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

Choice Based Professional Skills Development and Foreign Languages Programme

for

Second Year B. Tech.

(Sem. III and IV)

Professional Skills Development and Foreign Languages Courses

1. Professional Leadership Skills (SH2635)
2. Interpersonal Skills (SH2615)
3. Innovation Tools and Methods for Entrepreneurs (SH2695)
4. Personal Effectiveness and Body Language (SH2595)
5. German Language - Level III (SH2735)
6. German Language - Level IV (SH2645)
7. Japanese Language - Level III (SH2715)
8. Japanese Language - Level IV (SH2625)

An Important Notes:

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

K.E. Society's
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Class: - **S.Y. B. Tech.**	Semester-**III/IV**
Course Code: **SH2635**	Course Name: **Professional Leadership Skills**

L	T	P	Credits
-	-	2	1

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

Course Leaning Outcomes:
After successful completion of the course, students will be able to,
1. Explain the traits of a leadership through real life examples.
2. Exhibit the ability to work effectively in team.
3. Prepare a presentation as per the audience and context requirements.

Prerequisite:
- Adequate knowledge of basic grammar of English language.
- Intermediate level vocabulary of English language.
- Ability to communicate moderately in English.

Minimum 12 sessions will be conducted from the following list.

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

Rajarambapu Institute of Technology CSE (AI&ML) Engg. Department 415 414 Rajaramnagar
K.E.S. Rajarambapu Institute of Technology Rajaramnagar Autonomous 415414

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

References –

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

Evaluation Scheme: ISE – 100% (Minimum Passing: 50%)
Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

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Class: - **S.Y. B. Tech.**	Semester-**III/IV**
Course Code: **SH2615**	Course Name: **Interpersonal Skills**

L	T	P	Credits
-	-	**2**	**1**

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

Course Leaning Outcomes:
After successful completion of the course, students will be able to,
1. Exhibit interpersonal communication skills.
2. Demonstrate decision-making skills.
3. Apply conflict resolution styles appropriate in different situations.
4. Demonstrate skills to manage balance in work and life.

Prerequisite:
- Adequate knowledge of basic grammar of English language.
- Intermediate level vocabulary of English language.
- Communicate moderately using English language.

Minimum 12 sessions will be conducted from the following list.

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

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

11.	**Cross cultured sensitizations & Adaptability** Adapting multinational & multicultural environment, embracing diversity, culturally sensitive and bonding to colleagues and stakeholders, sense of belongings and promotion of unity at work place	**02**
12.	Evaluation of Students for their Understanding of Various Concepts Discussed.	**02**

References –

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

Evaluation Scheme: ISE – 100% (Minimum Passing: 50%)
Evaluation Method: In every session student will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

Class: - **S.Y. B. Tech.**	Semester-**III/IV**
Course Code: **SH2695**	Course Name: **Innovation Tools and Methods for Entrepreneurs**

L	T	P	Credits
-	-	2	1

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

Course Leaning Outcomes:

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

1. Explain structured approach to define the problem with every possible detail, identify conflicts and solve them.
2. Apply User Journey Map to the selected problem to show user interaction at various stages.
3. Analyze the solutions provided by competitors for effectiveness and gaps if any.

Prerequisite:

- Creativity and Innovativeness, Problem identification, apply design thinking approach to develop working prototype, Structured approach to problem solving.

Minimum 12 sessions will be conducted from the following list.

Course Content		
Exp. No.	**Description**	**Hrs**
1.	**Systematic Innovation** Define the problem in depth with all details, Trend prediction, Modelling the problem to identify tradeoffs and contradictions	**02**
2.	**TRIZ** Theory of Inventive problem solving (TRIZ), HIT Matrix, Scamper, Algorithms of brain storming and innovation, Functional analysis.	**02**
3.	**Frugal and Disruptive Innovation** Biomimicry and frugal innovation for prototyping, Disruptive innovation.	**02**

4.	**User Journey Map** Map showing user interaction at every stage of product/service. Step-by step process of UJM creation.	**02**
5.	**Competitor analysis** Analysis of competitor and users for similar products, effectiveness of existing solutions and identifications of gaps.	**02**
6.	**Product/Software Design Specifications** Detailed specifications for better product design, detailed UI for software for clarity on user interaction, specify USPs of the product in comparison to the competitors.	**02**
7.	**Business Canvas** A. Definition of a Business Model B. The 9 Building Blocks: 1. Customer 2. Value Propositions 3. Channels, distribution, 4. Customer relationships 5. Revenue 6. Key Resources 7. Key Activities 8. Key Partnerships 9. Cost Structure	**02**
8.	**Design Thinking (Part I)** Customer Insights, Ideation, Visual Thinking.	**02**
9.	**Design Thinking (Part II):** A. Prototyping. B. Storytelling. C. Scenarios	**02**
10.	**Institutional arrangement for Entrepreneurship Development** Institutional arrangement for Entrepreneurship Development – DIC, ITCOT, SIDCO, NSIC, SISI, TIIC, SIDBI, Commercial Banks.	**02**
11.	**Project Report:** a) Economic Aspects b) Technical Aspects c) Financial Aspects d) Production Aspects e) Managerial Aspects	**02**
12.	**Investor Pitch Tool** a) Introduction b) Helpful Tips about preparation, pitching and content sharing c) Does and Don'ts d) Introduction e) Problem f) Solution/Product/Service g) Traction h) Market Opportunities/ Size	**02**

	i) Competition j) Go To Market Strategies k) Financials l) Team	
13.	**Revision -I**	**02**
14.	**Revision-II**	**02**

References –

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

Evaluation Scheme: ISE – 100% (Minimum Passing: 50%)
Evaluation Method: In every session student will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

Class: - **S.Y. B. Tech.**	Semester-**III/IV**	**L**	**T**	**P**	**Credits**
Course Code: **SH2595**	Course Name: **Personal Effectiveness and Body Language**	-	-	**2**	**1**

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

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

1. Develop skills to build self-esteem and positive attitude.
2. Develop interpersonal skills characterized by effective communication and conflict resolution.
3. Discover ways to overcome procrastination.
4. Demonstrate responsiveness towards stress and health issues.
5. Interpret the non-verbal behaviour of a person.

Prerequisite:

- Adequate knowledge of basic grammar of English language.
- Intermediate level vocabulary of English language.
- Communicate moderately using English language.

Minimum 12 sessions will be conducted from the following list.

Course Content		
Exp. No.	**Description**	**Hrs**
1.	**Self-awareness and Self Esteem** Meaning, Factors influencing self-esteem- environmental and social factors Developing self-esteem- strategies for building self-esteem.	**02**
2.	**Goal Setting** Long term and short-term goals, Steps in goal setting (SMART)- - identify strategies - consider possible blocks and ways to deal with them - outline the steps - set deadlines.	**02**
3.	**Self-Analysis**	**02**

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

References –

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

Evaluation Scheme: ISE – 100% (Minimum Passing: 50%)
Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

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Class: - **S.Y. B. Tech.**	Semester- **IV**
Course Code: **SH2645**	Course Name: **German Language - IV**

L	T	P	Credits
-	-	2	1

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

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Interpret the language if the next person is speaking slowly and clearly.
2. Make use of the language in routine life with the routing topics like family, shopping, work etc.
3. Demonstrate the language by self-introduction in German with simple sentences.

Prerequisite:
- Adequate knowledge of basic grammar of German language.
- Intermediate level vocabulary of German language.
- Communicate moderately using German language.

Course Content

Exp. No.	Description	Hrs
1.	Body parts and Krankheiten(diseases) and home remedies.	02
2.	Grammar- Imperative for du ,ihr, Sie.	02
3.	Health tips and conversation at clinic Modal verbs - dürfen&sollen.	02
4.	Professions related to health.	02
5.	Vocabulary of vacation and activities in vacation.	02
6.	Writing a postcard Grammar- Pronoun – man.	02
7.	Topic- Weather. Reading texts related to vacation and formation of "W" questions.	02
8.	Grammar revision for the entire book.	02
9.	Explaining the pattern of the exam and explanation of each skill's exam requirement.	02

10.	Practice for Skill "Writing" and "Speaking".	**02**
11.	Practice for skill "Reading" and "Listening".	**02**
12.	Solving exam set 1 Speaking practice	**02**
13.	Solving exam set 2 speaking practice	**02**

References –

- Studio D – A 1, CornelsenVerlag, Goyal Publishing House, New Delhi.
- Tangram aktuell A 1, Goyal Publishing House, New Delhi.
- Lagune A 1, Goyal Publishing House, New Delhi.
- Netzwerk A 1, Goyal Publishing House, New Delhi.

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

Evaluation Scheme: ISE – 100% (Minimum Passing: 50%)
Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.

K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Syllabus of Second Year B. Tech. CSE(AI&ML)
To be implemented for 2025-29 & 2026-30 Batch
Department of Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Class: - **S.Y. B. Tech.**	Semester- **IV**
Course Code: **SH2625**	Course Name: **Japanese Language - IV**

L	T	P	Credits
-	-	2	1

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

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

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

Prerequisite:

- Knowledge of basic grammar of Japanese Language.
- Communicate moderately using Japanese Language.

All the 15 lab sessions will be conducted to meet the needs of following content delivery.

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

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

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

References –

- Minna No Nihongo I (3A Corporation, Japan), Publications: Goyal publishers.
- Nihongo shouhou, Publication: JALTAP

Other reference material, practice papers & CDs for listening practice.
The extra notes will be provided to the students as per the requirement of the syllabus.

Evaluation Scheme: ISE – 100% (Minimum Passing: 50%)
Evaluation Method: In every session students will be assessed. Each assessment will be of minimum 10 marks. The best 10 performances of the student will be considered for ISE.