



Annasaheb Dange College of Engineering and Technology
 Ashta - 416301, Dist. : Sangli, Maharashtra
 (An Empowered Autonomous Institute)



Curriculum Revision: Revision 02, with effect from the AY 2025- 26 to the students of UG Programme.

Department : Artificial Intelligence and Data Science
Programme : B.Tech.– AI&DS

Course Category	Acronym	I	II	III	IV	V	VI	VII	VIII	Total	% of Category
Basic Science Course	BS	7	8	0	0	0	0	0	0	15	9
Engineering Science Course	ES	9	9	0	0	0	0	0	0	18	10
Programme Core Course	PC	3	0	16	9	12	3	12	0	55	31
Programme Elective Course	PE	0	0	0	3	4	7	3	3	20	11
Open Elective (other than particular program)	OE	0	0	0	2	2	2	0	0	06	3
Multidisciplinary Minor	MDM	0	0	0	4	3	4	3	0	14	8
Vocational and Skill Enhancement Course	VSEC	0	2	2	0	0	1	1	0	06	3
Humanities Social Science and Management	HSSM	2	0	5	3	1	2	0	0	15	9
Indian Knowledge System	IKS	0	2	0	0	0	0	0	0		
Value Education Course(VAC)	VEC	0	0	0	0	0	0	0	0		
Research Methodology	RM	0	0	0	1	0	0	0	0	19	11
Experiential Learning (Internship, Project)	EL	0	0	0	1	1	0	4	12		
Community Engagement Activity / Field Project	CEA	0	0	0	0	0	2	0	0	02	1
Co-curricular & Extracurricular Activities	CCA	1	1	0	0	0	0	0	0	02	1
Self Study	SS	0	0	0	0	0	2	2	0	04	3
Total		22	22	23	23	22	23	25	15	176	100

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 Member Secretary -BoS

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ADCE

F.Y. B.Tech.–Artificial Intelligence and Data Science
[Level 4.5, UG Certificate] Semester -I

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	BS	T1	2ADBS101	Applied Mathematics – I	3	1	-	4	4	40	20	40	-	-
02	BS	T1	2ADBS102	Biology for Engineers	2	1	-	3	3	40	20	40	-	-
03	ES	L2	2ADES103	Engineering Graphics with CAD	1	-	2	1	2	-	-	-	50	-
04	ES	T1	2ADES104	Introduction to Emerging Technologies	2	-	-	2	2	40	20	40	-	-
05	ES	L1	2ADES105	Programming for Problem Solving using C	2	-	4	2	4	-	-	-	50	50
06	ES	L2	2ADES106	Design Thinking	-	-	2	-	1	-	-	-	50	-
07	HS	L2	2ADHS107	Professional Communication Skills	-	-	4	-	2	-	-	-	50	-
08	PC	T1	2ADPC108	Computer organization and architecture	3	-	-	3	3	40	20	40	-	-
09	CC	L2	3BSCCXXX	Liberal Learning Course-I	-	-	2	-	1	-	-	-	50	-
Total					13	2	14	15	22					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Minimum Passing Criteria			TA (Theory) : ≥8/20		MSE + ESE (Theory): ≥32/80			TA (Theory) / CIA (Lab) : ≥20/50			ESE (Lab) : ≥20/50			

CC Bouquet :

3BSCC121 - Introduction to Yoga and Mindfulness	3BSCC126 - Cultural Exploration & Heritage	3BSCC131- Introduction to Dance and Movement
3BSCC122 - Physical Fitness and Lifestyle Management	3BSCC127- Leadership and Team management	3BSCC132- Introduction to Music and Singing
3BSCC123 - Six-Sigma Happiness and Mind Mechanics	3BSCC128- Self Management and Purposeful Living	3BSCC133-Happiness and Well-Being
3BSCC124 - Creativity through Visual Arts	3BSCC129- Business Communication	3BSCC134- Financial Literacy & Investment Awareness
3BSCC125 - Community Engagement through NSS	3BSCC130- Mathematical Reasoning	3BSCC135-Cyber Awareness and Ethics

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F.Y. B.Tech.–Artificial Intelligence and Data Science

[Level 4.5, UG Certificate] Semester -II

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	BS	T1	2ADBS110	Applied Mathematics-II	3	1	-	4	4	40	20	40	-	-
02	BS	LIT2	2ADBS111	Engineering Physics and Chemistry	3	-	2	3	4	40	20	40	50	-
03	ES	LIT2	2ADES112	Basic Electrical and Electronics Engineering	2	-	2	2	3	40	20	40	50	-
04	ES	L1	2ADES113	Python Programming	2	-	2	2	3	-	-	-	50	50
05	ES	LIT2	2ADES114	Data Communication and Networking	2	-	2	2	3	40	20	40	50	-
06	IKS	T2	2ADHS115	Indian Knowledge system	2	-	-	2	2	-	50	-	-	-
07	VS	L2	2ADVS116	IDEA laboratory	1	-	2	1	2	-	-	-	50	-
08	CC	L2	3BSCCXXX	Liberal Learning Course-II	-	-	2	-	1	-	-	-	50	-
Total					15	1	12	16	22					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination

Minimum Passing Criteria	TA (Theory) : $\geq 8/20$	MSE + ESE(Theory): $\geq 32/80$	TA (Theory) / CIA (Lab) : $\geq 20/50$	ESE (Lab) : $\geq 20/50$
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CC Bouquet :

3BSCC121 - Introduction to Yoga and Mindfulness	3BSCC126 - Cultural Exploration & Heritage	3BSCC131- Introduction to Dance and Movement
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3BSCC123 - Six-Sigma Happiness and Mind Mechanics	3BSCC128- Self Management and Purposeful Living	3BSCC133-Happiness and Well-Being
3BSCC124 - Creativity through Visual Arts	3BSCC129- Business Communication	3BSCC134- Financial Literacy & Investment Awareness
3BSCC125 - Community Engagement through NSS	3BSCC130- Mathematical Reasoning	3BSCC135-Cyber Awareness and Ethics

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Exit after F.Y.B.Tech. – Artificial Intelligence and Data Science

Additional Credits to qualify for UG Certificate

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
1	VSEC	L	2ADVS118	Internship in Computer Hardware & Networking	-	-	-	10	10	-	-	-	100	-
Total					-	-	-	10	10					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Minimum Passing Criteria			TA (Theory) : ≥8/20		MSE + ESE(Theory): ≥32/80			TA (Theory) / CIA (Lab) : ≥20/50			ESE (Lab) : ≥20/50			


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S.Y. B. Tech. - Artificial Intelligence and Data Science
[Level 4.5, UG Diploma] Semester - III

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	PC	T1	2ADPC201	Statistical Analysis and Computing	3	1	-	4	4	40	20	40	-	-
02	PC	LIT1	2ADPC202	Data Structures and algorithms	3	-	2	3	4	40	20	40	50	50
03	PC	LIT2	2ADPC203	Operating Systems	3	-	2	3	4	40	20	40	50	-
04	PC	LIT1	2ADPC204	Foundation of AI with Ethics	3	-	2	3	4	40	20	40	50	50
05	VSEC	L2	2ADVS205	Object Oriented Programming using C++	-	-	2	-	1	-	-	-	50	-
06	VSEC	L2	2ADVS206	Data analysis using tools	-	-	2	-	1	-	-	-	50	-
07	HS	T2	2ADHS2XX	Foreign Language	2	-	-	2	2	-	50	-	-	-
08	HS	T2	2ADHS209	Psychology	1	-	-	1	1	-	50	-	-	-
09	HS	T2	2ADHS210	Universal Human Values	2	-	-	2	2	-	50	-	-	-
10	MA	T2	2ADCC211	Aptitude and Reasoning - I	2	-	-	2	-	-	50	-	-	-
Total					19	1	10	20	23					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Minimum Passing Criteria			TA (Theory): ≥ 8 / 20		MSE + ESE (Theory): ≥ 32 / 80			TA (Theory) / CIA (Lab): ≥ 20 / 50			ESE (Lab): ≥ 20/50			

Foreign Language Bouquet:

2ADHS207 - Foreign Language-German	2ADHS208- Foreign Language-Japanese
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S.Y. B. Tech. - Artificial Intelligence and Data Science
[Level 4.5, UG Diploma] Semester -IV

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	PC	T1	2ADPC212	Discrete Mathematics and Theory of Computations	2	1	-	3	3	40	20	40	-	-
02	PC	LIT1	2ADPC213	Database Management Systems	3	-	2	3	4	40	20	40	50	50
03	PE	T1	2ADPE21X	Professional Elective – I	3	-	-	3	3	40	20	40	-	-
04	MM	LIT2	2ADAI217	Multidisciplinary Minor - I	3	-	2	3	4	40	20	40	50	-
05	PC	L1	2ADPC218	Java Programming	1	-	2	1	2	-	-	-	50	50
06	OE	T1	3ILOE2XX	Open Elective – I	2	-	-	2	2	-	-	100	-	-
07	HS	T2	2ADHS219	Indian Constitution	1	-	-	1	1	-	50	-	-	-
08	HS	T2	2ADHS220	Environmental Studies	2	-	-	2	2	-	50	-	-	-
09	RM	L2	2ADRM221	Research Methodology	-	-	2	-	1	-	-	-	50	-
10	EL	L2	2ADEL222	Innovation and Product Development	-	-	2	-	1				50	
11	MA	T2	2ADCC223	Aptitude and Reasoning-II	2	-	-	2	-	-	50	-	-	-
Total					19	1	10	20	23					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Summer Internship (in Industry, R&D organization, or Academic Institute) shall be undertaken after the IV Semester during the summer vacation. The evaluation of the internship will be conducted during the V Semester														
Minimum Passing Criteria			TA (Theory): ≥ 8 / 20		MSE + ESE (Theory): ≥ 32 / 80		TA (Theory) / CIA (Lab): ≥ 20 / 50		ESE (Lab): ≥ 20/50		ESE (Theory): ≥ 40 / 100			

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Exit Criteria after S. Y. B.Tech. – Artificial Intelligence and Data Science

(As per AICTE Guidelines)

Eligibility Criteria

- All conditions applicable to the Exit Option After First Year shall also apply. In addition, the following criteria must be met:
- Students will have the option to exit the Artificial Intelligence and Data Science Program after successfully completing the second year.
- To qualify this exit option students must complete Internship of minimum 8 weeks in Artificial Intelligence and Data Science related field, aimed at enhancing practical knowledge and industry exposure. Students must submit **internship** report in accordance with the schedule and guidelines provided.

Outcome:

- Upon exit, they will be awarded an **Undergraduate Diploma in Artificial Intelligence and Data Science**.


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T.Y. B. Tech. - Artificial Intelligence and Data Science
[Level 4.5, UG B.Voc.] Semester - V

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	PC	LIT2	2ADPC301	Design and Analysis of Algorithms	3	-	2	3	4	40	20	40	50	-
02	PC	LIT1	2ADPC302	Machine Learning	3	-	2	3	4	40	20	40	50	50
03	PC	LIT1	2ADPC303	Data Exploration and Visualization	3	-	2	3	4	40	20	40	50	50
04	PE	LIT2	2ADPE30X	Professional Elective – II	3	-	2	3	4	40	20	40	50	-
05	MM	T1	2ADAI307	Multidisciplinary Minor - II	3	-	-	3	3	40	20	40	-	-
06	OE	T1	3ILOE3XX	Open Elective – II	2	-	-	2	2	-	-	100	-	-
07	HS	L2	2ADHS308	Entrepreneurship	-	-	2	-	1	-	-	-	50	-
08	EL	L2	2ADEL309	Summer Internship	-	-	-	-	1	-	-	-	50	-
09	MA	T2	2ADCC310	Aptitude and Reasoning - III	2		-	2	-	-	50	-	-	-
Total					19	-	10	19	23					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Minimum Passing Criteria			TA (Theory): ≥ 8 / 20		MSE + ESE (Theory): ≥ 32 / 80		TA (Theory) / CIA (Lab): ≥ 20 / 50		ESE (Lab): ≥ 20/50		ESE (Theory): ≥ 40 / 100			

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T.Y. B. Tech. - Artificial Intelligence and Data Science
[Level 4.5, UG B.Voc.] Semester - VI

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	PC	LIT1	2ADPC311	Deep Learning	2	-	2	2	3	40	20	40	50	50
02	PE	LIT1	2ADPE31X	Professional Elective – III	3	-	2	3	4	40	20	40	50	50
03	PE	T1	2ADPE31X	Professional Elective – IV	3	-	-	3	3	40	20	40	-	-
04	MM	LIT2	2ADMM318	Multidisciplinary Minor – III	3	-	2	3	4	40	20	40	50	-
05	HS	T2	2ADHS319	Project Management and Finance	2	-	-	2	2	-	50	-	-	-
06	OE	T1	3ILOE3XX	Open Elective – III	2	-	-	2	2	-	-	100	-	-
07	VSEC	L2	2ADVS320	R Programming	-	-	2	-	1		-	-	50	-
08	CEA	L2	2ADCE321	Mini Project	-	-	4	-	2	-	-	-	50	-
09	SS	T2	2ADSS322	Self-Study Course-I	-	-	-	2	2	-	-	100	-	-
10	MA	T2	2ADCC323	Aptitude and Reasoning-IV	2	-	-	2	-	-	50	-	-	-
Total					17	-	12	19	23					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination, CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Minimum Passing Criteria			TA (Theory): ≥ 8 / 20		MSE + ESE (Theory): ≥ 32 / 80		TA (Theory) / CIA (Lab): ≥ 20 / 50		ESE (Lab): ≥ 20/50		ESE (Theory): ≥ 40 / 100			

Ashga
Member Secretary-BoS

Adan
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Bomathi
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Exit Criteria after T.Y.B.Tech. – Artificial Intelligence and Data Science

(As per AICTE Guidelines)

Eligibility Criteria:

- Completion of all core courses in the first three years of the engineering curriculum.
- Demonstration of both theoretical understanding and practical application through:
 - Industry-Relevant Practical Training: Including internships or apprenticeships.
 - Advanced Skill-Based Course: Aligning with current industry needs.
 - Internship/Apprenticeship: At least 8 weeks in a relevant engineering field.
 - Community Engagement Project: Real-world problem-solving with societal benefit.
 - Capstone Project (Optional): Integration and application of learning outcomes across three years.

Outcome:

Students will be awarded a **B. Voc. Degree in Artificial Intelligence and Data Science**, signifying a strong foundation in engineering concepts, technical proficiency, and vocational readiness.


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Final Year B. Tech.- Artificial Intelligence and Data Science
[Level 4.5, UG B.Tech] Semester - VII

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	PC	LIT1	2ADPC401	High Performance Computing	3	-	2	3	4	40	20	40	50	50
02	PC	LIT1	2ADPC402	Generative AI	3	-	2	3	4	40	20	40	50	50
03	PC	LIT2	2ADPC403	Cloud Computing	3	-	2	3	4	40	20	40	50	-
04	PE	T1	2ADPE40X	Professional Elective - V	3	-	-	3	3	40	20	40	-	-
05	MM	T1	2ADMM407	Multidisciplinary Minor – IV	3	-	-	3	3	40	20	40	-	-
06	VSEC	L2	2ADVS408	Web and App Development	-	-	2	-	1	-	-	-	50	-
07	EL	L1	2ADEL409	Project	-	-	8	-	4	-	-	-	50	50
08	SS	T2	2ADSS410	Self-Study Course-II	-	-	-	2	2	-	-	100	-	-
Total					15	-	16	17	25					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Minimum Passing Criteria			TA (Theory): ≥ 8 / 20		MSE + ESE (Theory): ≥ 32 / 80			TA (Theory) / CIA (Lab): ≥ 20 / 50		ESE (Lab): ≥ 20/50		ESE (Theory): ≥ 40 / 100		

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Final Year B. Tech.- Artificial Intelligence and Data Science
[Level 4.5, UG B.Tech] Semester - VIII

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	PE	T1	2ADPE41X	Professional Elective – VI	3	-	-	3	3	40	20	40	-	-
02	EL	L2	2ADEL414	Internship	-	-	-	-	12	-	-	-	50	-
Total					3	-	-	3	15					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Minimum Passing Criteria			TA (Theory): ≥ 8 / 20		MSE + ESE (Theory): ≥ 32 / 80			TA (Theory) / CIA (Lab): ≥ 20 / 50			ESE (Lab): ≥ 20/50			

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Professional Electives/ Honor's Track (20 Credits)

Track Name	Professional Elective-I (3-0-0)	Professional Elective-II (3-0-2)	Professional Elective-III (3-0-2)	Professional Elective-IV (3-0-0)	Professional Elective-V (3-0-0)	Professional Elective-VI (3-0-0)
Class	S.Y.B.Tech	T.Y.B.Tech	T.Y.B.Tech	T.Y.B.Tech	B.Tech	B.Tech
Semester	IV	V	VI	VI	VII	VIII
Artificial Intelligence and Learning Systems	2ADPE214 Responsible Artificial Intelligence	2ADPE304 Genetic Algorithms and Optimization Techniques	2ADPE312 Natural Language Processing	2ADPE315 Computer Vision	2ADPE404 Agentic AI & Autonomous Systems	2ADPE411 DevOps and ML Ops Engineering
Data Science and Engineering	2ADPE215 Data Analytics	2ADPE305 Advanced Database	2ADPE313 Data warehouse & Data mining	2ADPE316 Big Data Analytics	2ADPE405 Quantum Computing and Analytics	2ADPE412 DevOps and ML Ops Engineering
AI for Sustainable Development	2ADPE216 AI for Sustainable Development	2ADPE306 IoT for Smart and Sustainable Systems	2ADPE314 Intelligent Precision Agriculture	2ADPE317 Sustainable Data Science and Green AI	2ADPE406 AI for Health care	2ADPE413 Sustainable Smart Cities Analytics

- Students may choose Professional Elective courses from a single track or across multiple tracks, based on their academic interests and career aspirations.
- Only one Professional Elective course may be selected from a given column in a semester. Additional courses from the same column may be taken in subsequent semesters, but not concurrently.
- Students opting for the Honors Degree shall complete all Honors courses from a single track, which shall be different from the track chosen for their Professional Elective courses.


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Multidisciplinary Minor (14 Credits)

Minor Stream : Artificial Intelligence (AI)

Sr. No.	Course Category	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
									Theory			Laboratory	
									MSE	TE	ESE	ISE	ESE
01	MM	2ADAI217	Foundation of AI	3	-	2	3	4	40	20	40	50	-
02	MM	2ADAI307	Python for Data Science	3	-	-	3	3	40	20	40	-	-
03	MM	2ADAI318	Machine Learning	3	-	2	3	4	40	20	40	50	-
04	MM	2ADAI407	Deep Learning	3	-	-	3	3	40	20	40	-	-
Total				12	-	4	12	14					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment ESE-End-Semester Examination													
Minimum Passing Criteria		TA (Theory) : ≥8/20		MSE + ESE(Theory): ≥32/80		TA (Theory) / CIA (Lab) : ≥20/50			ESE (Lab) : ≥20/50				


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Ashta - 416301, Dist. : Sangli, Maharashtra
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ADCE

Bridge Course for DSY - Lateral Entry Students

Sr. No.	Semester	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
											Theory			Laboratory	
											MSE	TA	ESE	CIA	ESE
1	III	BS	T1	2ADBS102	Biology for Engineers	2	1	-	3	3	-	-	100	-	-
2	IV	ES	T1	2ADES104	Introduction to Emerging Technologies	2	-	-	2	2	-	-	100	-	-
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination															
Minimum Passing Criteria													ESE : $\geq 40/100$		

*Note: All Direct Second Year students admitted to the B.Tech. Artificial Intelligence and Data Science programme shall compulsorily undergo the prescribed bridge courses. Students admitted from diploma programmes other than the parent discipline shall additionally complete bridge courses as prescribed by the designated committee.

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ADCE

Bridge Course – Change in Curriculum Revision (R1 to R2)

Sr. No.	Semester	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
											Theory			Laboratory	
											MSE	TA	ESE	CIA	ESE
01	I	ES	T1	2ADES104	Introduction to Emerging Technologies	2	-	-	2	2	-	-	100	-	-
02	I	PC	T1	2ADPC108	Computer Organization and Architecture	3	-	-	3	3	-	-	100	-	-
03	II	ES	L1	2ADES113	Python Programming	2	-	2	2	3	-	-	-	50	50
04	II	VS	L2	2ADVS116	IDEA Laboratory	1	-	2	1	2	-	-	-	50	-
Total						8	1	4	8	10					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination															
Minimum Passing Criteria						ESE (Theory): ≥ 40/100		CIA(Lab): ≥ 20 / 50				ESE (Lab): ≥ 20/50			

- Students shall complete the prescribed Semester I Bridge Courses during Semester III (Odd Semester) and the prescribed Semester II Bridge Courses during Semester IV (Even Semester).

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Annasaheb Dange College of Engineering and Technology, Ashta

Department of Artificial Intelligence and Data Science



AD CET

Structure and Curriculum Contents

B. Tech (Second Year)

Revision -2

SEM – III to SEM – IV

(Academic Year 2026-2027)



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S.Y. B. Tech. - Artificial Intelligence and Data Science
[Level 4.5, UG Diploma] Semester - III

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	PC	T1	2ADPC201	Statistical Analysis and Computing	3	1	-	4	4	40	20	40	-	-
02	PC	LIT1	2ADPC202	Data Structures and algorithms	3	-	2	3	4	40	20	40	50	50
03	PC	LIT2	2ADPC203	Operating Systems	3	-	2	3	4	40	20	40	50	-
04	PC	LIT1	2ADPC204	Foundation of AI with Ethics	3	-	2	3	4	40	20	40	50	50
05	VSEC	L2	2ADVS205	Object Oriented Programming using C++	-	-	2	-	1	-	-	-	50	-
06	VSEC	L2	2ADVS206	Data analysis using tools	-	-	2	-	1	-	-	-	50	-
07	HS	T2	2ADHS2XX	Foreign Language	2	-	-	2	2	-	50	-	-	-
08	HS	T2	2ADHS209	Psychology	1	-	-	1	1	-	50	-	-	-
09	HS	T2	2ADHS210	Universal Human Values	2	-	-	2	2	-	50	-	-	-
10	MA	T2	2ADCC211	Aptitude and Reasoning - I	2	-	-	2	-	-	50	-	-	-
Total					19	1	10	20	23					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Minimum Passing Criteria			TA (Theory): ≥ 8 / 20		MSE + ESE (Theory): ≥ 32 / 80			TA (Theory) / CIA (Lab): ≥ 20 / 50			ESE (Lab): ≥ 20/50			

Foreign Language Bouquet:

2ADHS207 - Foreign Language-German	2ADHS208- Foreign Language-Japanese
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S.Y. B. Tech. - Artificial Intelligence and Data Science
[Level 4.5, UG Diploma] Semester -IV

Sr. No.	Course Category	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Marks)				
										Theory			Laboratory	
										MSE	TA	ESE	CIA	ESE
01	PC	T1	2ADPC212	Discrete Mathematics and Theory of Computations	2	1	-	3	3	40	20	40	-	-
02	PC	LIT1	2ADPC213	Database Management Systems	3	-	2	3	4	40	20	40	50	50
03	PE	T1	2ADPE21X	Professional Elective – I	3	-	-	3	3	40	20	40	-	-
04	MM	LIT2	2ADAI217	Multidisciplinary Minor - I	3	-	2	3	4	40	20	40	50	-
05	PC	L1	2ADPC218	Java Programming	1	-	2	1	2	-	-	-	50	50
06	OE	T1	3ILOE2XX	Open Elective – I	2	-	-	2	2	-	-	100	-	-
07	HS	T2	2ADHS219	Indian Constitution	1	-	-	1	1	-	50	-	-	-
08	HS	T2	2ADHS220	Environmental Studies	2	-	-	2	2	-	50	-	-	-
09	RM	L2	2ADRM221	Research Methodology	-	-	2	-	1	-	-	-	50	-
10	EL	L2	2ADEL222	Innovation and Product Development	-	-	2	-	1				50	
11	MA	T2	2ADCC223	Aptitude and Reasoning-II	2	-	-	2	-	-	50	-	-	-
Total					19	1	10	20	23					
Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, MSE - Mid-Semester Examination. CIA-Continuous Internal Assessment, TA - Teachers Assessment, ESE-End-Semester Examination														
Summer Internship (in Industry, R&D organization, or Academic Institute) shall be undertaken after the IV Semester during the summer vacation. The evaluation of the internship will be conducted during the V Semester														
Minimum Passing Criteria			TA (Theory): ≥ 8 / 20		MSE + ESE (Theory): ≥ 32 / 80		TA (Theory) / CIA (Lab): ≥ 20 / 50		ESE (Lab): ≥ 20/50		ESE (Theory): ≥ 40 / 100			

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Exit Criteria after S. Y. B.Tech. – Artificial Intelligence and Data Science

(As per AICTE Guidelines)

Eligibility Criteria

- All conditions applicable to the Exit Option After First Year shall also apply. In addition, the following criteria must be met:
- Students will have the option to exit the Artificial Intelligence and Data Science Program after successfully completing the second year.
- To qualify this exit option students must complete Internship of minimum 8 weeks in Artificial Intelligence and Data Science related field, aimed at enhancing practical knowledge and industry exposure. Students must submit **internship** report in accordance with the schedule and guidelines provided.

Outcome:

- Upon exit, they will be awarded an **Undergraduate Diploma in Artificial Intelligence and Data Science**.


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Course Information:															
Class, Semester		S.Y. B.Tech, Semester - III					Category	PC							
Course Code, Course Title		2ADPC201, Statistical Analysis and Computing					Type	T1							
Prerequisites		2ADBS110													
Teaching Scheme (per week)		Lecture		Tutorial		Practical		Self-Study		Credits					
		3		1		-		4		4					
Examination Scheme (Marks)		Theory		MSE		TE		ESE		Practical		CIA		ESE	
				40		20		40				-		-	
Course Outcomes (COs):															
Upon successful completion of this course, the student will be able to:															
CO1		Solve real-world engineering problems by applying concepts of random variables and probability distributions, with appropriate interpretation of probabilistic results.													
CO2		Evaluate real-world engineering problems by applying appropriate hypothesis testing techniques, with accurate statistical analysis and interpretation of results.													
CO3		Determine optimal strategies for real-world decision-making problems using game theory principles and solution methods, with appropriate justification of results.													
CO4		Compute solutions to engineering and mathematical problems using fuzzy sets and fuzzy numbers, with accurate interpretation of results.													
CO5		Determine solutions to engineering problems by applying differential and vector calculus concepts, with accurate computation and interpretation of results.													
Syllabus:															
Module		Contents										Lecture Hours			
I		Univariate and Bivariate Random Variables: Basics of probability, Random variable, Types of random variables, Probability mass function, probability density function, Expectation, mean and variance of a random variable. Two-dimensional random variable, Joint Probability mass function, Marginal Probability mass function and conditional Probability function, Joint probability density function, Marginal probability density function, Independent random variable, Applied analysis of real datasets to study relationships between variable										7			
II		Probability Distributions: Discrete Probability Distribution: Binomial Distribution, Poisson Distribution, Hypergeometric Distribution. Continuous Probability Distribution: Exponential Distribution, Uniform Distribution, Normal Distribution										8			
III		Testing of Hypothesis : Introduction to Population and Sample, Parameters and Statistics, Concept of Hypothesis Testing, Advanced sampling methods for statistical inference Large Sample Tests: Tests for means: Tests for single population mean, Tests for equality of two population means. Small Sample Tests: t-tests, Chi-Square Test, Tests for single population variance, Test for goodness of fit of given probability distribution., Model validation and variable significance techniques										8			
IV		Game Theory Introduction, Two-Person Zero Sum Game, Maximin-Minimax Principle, Algebraic Method and Arithmetic Method, Dominance Principle, Sub-Game Method, Graphical Method										7			

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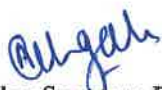
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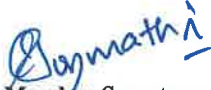
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V	Fuzzy Sets and Fuzzy Numbers. Basic concepts of Fuzzy Sets, Crisp Set and Fuzzy Set, Membership Functions, alpha and strong alpha cut of fuzzy sets and properties, Basic operations on fuzzy sets, Fuzzy Numbers, Fuzzy Cardinality.	7
VI	Differential and Vector Calculus Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem (without proof), applications and geometrical interpretations, vector functions, vector differential operator (∇ , del), gradient of scalar functions, directional derivative, divergence of vector fields, curl of vector fields, solenoidal vector fields, irrotational vector fields	8
Total Lecture Hours		45
List of Tutorials with CO Mapping		
S. No	Title / Topic of the Experiment	CO Mapped
1.	Expectation and Variance of Random Variables	1
2.	Joint, Marginal, and Conditional Probabilities	1
3.	Discrete Probability Distributions: Binomial, Poisson, Hypergeometric	1
4.	Continuous Probability Distributions: Exponential, Uniform, Normal	1
5.	Large Sample Tests for Means	2
6.	Small Sample Tests: t-Test, Chi-Square, Variance	2
7.	Two-Person Zero-Sum Games	3
8.	Graphical and Algebraic Methods	3
9.	Fuzzy Sets and Membership Functions	4
10.	Operations and Fuzzy Numbers	4
11.	Mean Value Theorems and Applications	5
12.	Gradient, Divergence, and Curl of Vector Fields	5
Total Tutorial Hours		15
Text Books		
1. Dr. B. S. Grewal, Higher Engineering Mathematics, 44 Edition, Khanna Publication, 2017		
2. Kanti Swarup, P. K. Gupta & Man Mohan, Operations Research, Sultan Chand & Sons, 20th Edition, 2022		
3. George J. Klir& Bo Yuan, Fuzzy Sets & Fuzzy Logic Theory and Applications, Pearson Education, 2nd Edition, 2015.		
4. H. K. Das, Advanced Engineering Mathematics, 22th Edition, S. Chand, 2018.		
5. B. V. Ramana, Higher Engineering Mathematics, 6th Edition, Tata McGraw Hill Publ., 2010		
References:		
1. S. C. Gupta & V. K. Kapoor, Fundamentals of Mathematical Statistics, Khanna Publishers, 12th Edition, 2020		
2. J.K. Sharma, Operation Research, Laxmi Publications, 6th Edition 2016		
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Publishers, 9th Edition, 2013		
Online Learning Resources		
Probability and Statistics	https://www.youtube.com/playlist?list=PLvuGwBYgypHZdTELi81ZStK_ScUk6Jqut	
Fuzzy Sets and Fuzzy Numbers.	https://www.youtube.com/playlist?list=PLbRMhDVUMngeASctgzkLElpgFNZmWwqRI	
Vector Calculus	https://www.youtube.com/playlist?list=PLbRMhDVUMngfIrZCNOvPZwHUUlpP66vQW	
Game Theory	https://www.youtube.com/playlist?list=PLOzRYVm0a65fY-Vh8Caiv3wAYmDd7SnrN	


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Course Information:								
Class, Semester	SY. B.Tech, Semester – III					Category	PC	
Course Code, Course Title	2ADPC202, Data structures and algorithms					Type	LIT1	
Prerequisites	2ADES105							
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self Study	Credits			
	3	-	2	3	4			
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE	
		40	20	40		50	50	
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Explain the fundamental concepts of data structures, algorithms, and their time and space complexity for given computational problems using complexity measures, accurately.							
CO2	Implement linear data structures by performing insertion, deletion, searching, and traversal operations for given problem statements using appropriate programming techniques, efficiently.							
CO3	Demonstrate the representation and traversal techniques of non-linear data structures for given problem scenarios using appropriate traversal methods, accurately.							
CO4	Analyze sorting and searching algorithms for given computational problems and datasets using time and space complexity, appropriately.							
Syllabus:								
Module	Contents						Lecture Hours	
I	Introduction to Data Structures: Data, Data Object, Data types, Abstract Data Types (ADT), Data structures, Classification of Data Structure: primitive and non-primitive, Static and Dynamic, Direct and Indirect recursion, analysis of recursive functions e.g. Towers of Hanoi Introduction to Algorithms: Definition and Characteristics of an algorithm, Algorithm Specification, Introduction to algorithm design strategies Performance Analysis- Time and space complexity, Asymptotic notations, Best, Average and worst cases. Finding complexity using step count method, Analysis of programming Constructs-Linear, Quadratic, Cubic, Logarithmic, Case Study: Online Examination Result Processing System						8	
II	Linear Data Structures: Linked List Introduction to Static and Dynamic Memory Allocation, Linked List: Introduction, of Linked Lists, Realization of linked list using dynamic memory management, operations, Types of Linked List: singly linked, linear and Circular Linked Lists, Doubly Linked List, Primitive Operations on Linked List-Create, Traverse, Search, Insert, Delete, Sort, Case study: A music player application uses a doubly linked list to store songs in a playlist. Users can navigate forward and backward through the playlist. Each song node contains data about the song and references to both the previous and next songs.						8	
III	Linear Data Structures: Stack and Queue Stacks as ADT, operations, representation using static and dynamic structures, applications of stack Queue as ADT, operations, representation using static and dynamic structures, circular queue, priority queue, double ended queue. Case study: 1. Stack: Undo/Redo Feature in Text Editors. 2 Queue: In a network router, a queue is used to buffer packets for transmission. The packets arrive in order and are transmitted in the same order, ensuring smooth data flow through the network. In a real-time system, a deque could be used to handle urgent tasks at both ends of the queue						7	

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IV	Non Linear Data Structures: Tree Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Threaded binary tree, Binary search trees, Conversion of General Trees To Binary Trees, Applications Of Trees Some balanced tree mechanism, eg. AVL trees, 2-3 trees, Height Balanced, Weight Balance, Red Black Trees Case study: 1 Student Record Management System using BST 2 Organization Structure of college	7
V	Non Linear Data Structures: Graphs Basic concept of graph theory, storage representation: adjacency matrix, adjacency list, adjacency multi-lists, graph traversal techniques- BFS and DFS. Graph-Matrix Representation Of Graphs, Elementary Graph operations,(Breadth First Search, Depth First Search) Case study :GPS/ navigation system that models a city map as weighted graph	7
VI	Searching and Sorting Techniques Linear search, binary search, Internal and External Sorts, bubble sort, selection sort, insertion sort, merge sort, quick sort, radix sort, heap sort. Hashing – Definition, hash functions, overflow, collision, Collision resolution techniques, Open addressing, Chaining. Case Study: Library Book Management and Retrieval System	8
Total Lecture Hours		45
S.No	Title / Topic of the Experiment	CO Mapped
1	Write a program to perform operations based on array, function, pointer, structures	1
2	Write a program to perform Implement Singly Linked List to perform following operations: Create, Insert, Delete, Display, Search, Reverse	2
3	Implement Doubly Linked List to perform following operations: Create, Insert, Delete, Display, Search	2
4	Implement Circular Linked List to perform following operations: Create, Insert, Delete, Display, Search, Reverse	2
5	Write a program to implement Stack ADT – Static and Dynamic	2
6	Write a program to implement Queue ADT – Static and Dynamic	2
7	Write a program to implement Binary Search Tree (BST) with insertion and deletion	3
8	Write a program to implement Graph using adjacency list and traversal	3
9	Write a program to implement Searching – Linear, Binary and Hashing algorithm	4
10	Write a program to perform Sorting using Bubble, Selection, Insertion sorting techniques	4
11	Write a program to perform Sorting – Merge and Quick	4
12	Micro project - Design and develop real-life application using data structure	1-4
Total Practical Sessions	15	Total Practical Hours
		30
Text Books		
1. Reema Thareja, "Data Structures Using C", 2nd Edition, Oxford University Press, 2019, ISBN 978-0-19-948285-0.		
2. R. Gillberg, B. Forouzn —Data Structures: A Pseudo code approach with C, Cenage Learning, ISBN: 9788131503140.		
3. Seymour Lipschutz, "Data Structures Using C (Schaum's Outline Series)", 1st Edition, McGraw-Hill Education, 1998, ISBN 978-0070378688.		
References:		
1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson, 1997, ISBN 0-201-36121-3.		
2. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, "Data Structures Using C", 2nd Edition, Pearson, 2006, ISBN 978-8177581144. Hill,2007		
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, 2009, ISBN 978-0262033848.		
4. Adam Drozdek, "Data Structures and Algorithms in C", 2nd Edition, Cengage Learning, 2012, ISBN 978-0534491827.5		
Online Learning Resources		

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Online Learning Resources

1. NPTEL, "Introduction to Data Structures", By Dr Gurpreet Singh Lehal Link:

https://onlinecourses.swayam2.ac.in/cec25_hs62/preview

2. NPTEL, "Data Structures" By Dr. M. Deivamani

Link: https://onlinecourses.swayam2.ac.in/cec25_ma15/preview

Experiments that may be performed through virtual labs:

S.No	Experiment Name	Experiments Links
1.	Linked List Experiment	IIIT Hyderabad – List of Data Structure Experiments https://ds1-iiith.vlabs.ac.in/exp/linked-list/overview.html? Virtual Laboratory : https://ds1-iiith.vlabs.ac.in/data-structures-1/ https://ds2-iiith.vlabs.ac.in/data-structures-2/ http://cse01-iiith.vlabs.ac.in/


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Course Information:															
Class, Semester		SY. B.Tech, Semester – III					Category	PC							
Course Code, Course Title		2ADPC203, Operating Systems					Type	LIT2							
Prerequisites		2ADPC108													
Teaching Scheme (per week)		Lecture		Tutorial		Practical		Self Study		Credits					
		3		-		2		3		4					
Examination Scheme (Marks)		Theory		MSE		TA		ESE		Practical		CIA		ESE	
				40		20		40				50		-	
Course Outcomes (COs) :															
Upon successful completion of this course, the student will be able to:															
CO1		Explain operating system concepts, inter-process communication, and multithreading using operating system principles, accurately.													
CO2		Apply process scheduling and synchronization techniques for process management using appropriate algorithms and mechanisms, effectively.													
CO3		Analyze deadlock, memory management, and virtual memory techniques using appropriate operating system strategies, efficiently.													
CO4		Analyze file systems, page replacement, disk scheduling, and I/O subsystem techniques using appropriate operating system algorithms, appropriately.													
Syllabus:															
Module		Contents										Lecture Hours			
I		Overview Introduction to Operating Systems, Operating System functions, Computer System organization, Operating System Architecture, Operating System Structure, Operating System operations, Types of Operating Systems, Operating System Services, User - Operating System interface, System calls, Types of system Calls, System programs, Kernel, Types of kernel.										7			
II		Process Management Process concept: Operations on processes, Inter-process communication, Multi-Threaded Models, Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms (First Come First Serve (FCFS), Shortest Job First (SJF), Shortest Remaining Time First (SRTF), Priority Scheduling, Round Robin (RR))										8			
III		Process Synchronization Background, the critical section problem, Peterson’s solution, synchronization hardware, semaphores, classic problems of Synchronization										7			
IV		Deadlock System model, deadlock characterization, methods for handling Deadlocks (deadlock preventions, deadlock avoidance, deadlock detection, deadlock recovery)										7			
V		Memory Management: Memory management strategies: Background; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Swapping Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.										8			

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VI	Storage Management & I/O Subsystem File System: File concept, access methods, directory and disk structure, file-system mounting, file sharing, protection, Overview of I/O system, I/O hardware, Application I/O interface, Kernel I/O subsystem. Case study: UNIX/Linux file system and I/O subsystem		8
	Total Lecture Hours		45
S.No	Title / Topic of the Experiment		CO Mapped
1	Installation of Linux/Windows Operating Systems		1
2	Study and demonstration of basics of Linux/UNIX commands.		1
3	Program to implement Inter-Process Communication (IPC) using Pipes / Message Queues.		1
4	Program based on CPU Scheduling Algorithms.		2
5	Program to simulate producer-consumer problem using semaphores.		2
6	Program to demonstrate critical section and mutual exclusion.		2
7	Program based on Bankers algorithm for Deadlock Avoidance.		3
8	Program to convert Resource Allocation Graph (RAG) into Wait-For Graph (WFG) and detect deadlock using Wait-For Graph.		3
9	Program to simulate Paging technique of memory management.		3
10	Program based on Page Replacement Policies.		4
11	Program based on various I/O System calls of UNIX operating System.		4
12	Implementation of Disk Scheduling using FCFS, SCAN and C-SCAN algorithm		4
Total Practical Sessions		15	Total Practical Hours
			30
Text Books			
1. Silberschatz, Galvin, Operating System Concepts, 8th Edition, John Wiley, 2009			
2. Dhananjay Dhamdhere, Operating Systems: A Concept-Based Approach, McGraw-Hill Education, 16 February 2008			
References:			
1. Charles Crowley, Operating System A Design Oriented Approach, McGraw Hill Education, July 2017			
2. Achyut S.Godbole, Operating System with Case Studies in Unix, Netware and Windows NT,5th, Tata McGraw Hill,2007			
3. William Stallings, Operating Systems Internals and Design Principles,8 th , Pearson Education International,2014			
4. Mark G. Sobell, A practical Guide to Unix system V,2 nd , Benjamin cummings Pub.,2005			
Online Learning Resources			
1. NPTEL Course on Real Time Operating System ,by Prof. Rajib Mall, https://onlinecourses.nptel.ac.in/noc26_cs47/preview			
Experiments that may be performed through virtual labs:			
S.No	Experiment Name	Experiments Links	
1.	To Implement File Allocation Strategies	https://erpjietuniverse.in/virtual_lab/Operating_system/labs/exp9/index.html	

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Course Information:							
Class, Semester	SY. B.Tech, Semester - III					Category	PC
Course Code, Course Title	2ADPC204 , Foundations of AI with Ethics					Type	LIT1
Prerequisites	2ADES104						
Teaching Scheme (per week)	Lecture 3	Tutorial -	Practical 2	Self Study 3	Credits 4		
Examination Scheme (Marks)	Theory	MSE 40	TE 20	ESE 40	Practical	CIA 50	ESE 50
Course Outcomes (COs) :							
Upon successful completion of this course, the student will be able to:							
CO1	Explain the fundamentals of Artificial Intelligence, intelligent agents, and search techniques for given AI problem scenarios using AI concepts, intelligent agent models, and search algorithms, accurately.						
CO2	Solve AI problems for given problem scenarios using AI problem-solving methods, intelligent agents, and probabilistic reasoning techniques, effectively.						
CO3	Solve knowledge-based AI problems for given knowledge representation scenarios using first-order logic, unification, forward chaining, backward chaining, and resolution techniques, accurately.						
CO4	Evaluate AI planning solutions and responsible AI applications for given real-world AI scenarios using AI planning techniques and ethical principles, appropriately.						
Syllabus:							
Module	Contents					Lecture Hours	
I	AI Introduction Introduction – Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to AI problems.					8	
II	Problem Solving Methods Search Strategies- Uninformed - Informed - Heuristics & Meta Heuristics Algorithms Local Search Algorithms and Optimization Problems – Constraint Satisfaction Problems - Optimal Decisions in Games					7	
III	Software Agent Systems Introduction to Logical Agents, Uncertainty-Probability -Inference-Independence and Bayes' Rule- Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Multi Agent systems					8	
IV	Knowledge Representation First order logic, Syntax and semantics for first order logic, Knowledge engineering in first order logic, Inference in First order logic, prepositional versus first order logic– Unification and Lifting – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation					7	
V	Planning Classical Planning- algorithms for Classical Planning- Heuristics for planning- hierarchical planning- non deterministic domains- time, schedule and resources – analysis					8	
VI	Ethics Introduction to Ethics in AI – Privacy - Degrees of Privacy - Modern Privacy Risks - Algorithmic Fairness, Anonymity and Data Validity, Case Studies / Applications: Targeted Ads, Algorithms and Race, Self Driving Cars, Autonomous Weapons					7	
Total Lecture Hours						45	

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List of Experiments with CO Mapping			
S.No	Title / Topic of the Experiment		CO Mapped
1	Implement Search Strategies 8 Puzzle Problem		1
2.	Implement Search Strategies 8 Queens problem		2
3	Implement Crypt arithmetic.		2
4	Implement A* Algorithms		2
5	Implement Minimax Algorithm for game playing		2
6	Solve constraint satisfaction problems		2
7	Implement propositional model checking algorithms		3
8	Implement forward chaining, backward chaining		3
9	Implement resolution strategies		3
10	Micro Project		4
Total Practical Sessions		15	Total Practical Hours
			30
Text Books			
1. Artificial Intelligence –A Modern approach, Stuart J. Russell, Peter Norwig, Pearson Education 3rd 2016			
2. Artificial Intelligence Elaine Rich And Kevin Knight Tata McGraw Hill Publishing Company, New Delhi, 2014			
References:			
1. Prolog: Programming for Artificial Intelligence, I. Bratko Addison-Wesley Educational Publishers Inc. Fourth edition 2015			
2. The Quest for Artificial Intelligence Nils J. Nilsson Cambridge University Press 6th 2013			
3. Artificial Intelligence: Foundations of Computational Agents David L. Poole and Alan K. Mackworth Cambridge University Press 2012			
4. Multi Agent Systems Gerhard Weiss MIT Press Second Edition 2013			
Online Learning Resources			
1. https://onlinecourses.nptel.ac.in/noc25_cs88/preview			
2. https://nptel.ac.in/courses/112103280			
3. https://onlinecourses.nptel.ac.in/noc21_ge20/preview			

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Course Information:								
Class, Semester		SY. B.Tech , Semester - III				Category	VSEC	
Course Code, Course Title		2ADVS205, Object Oriented Programming using C++				Type	L2	
Prerequisites		2ADES105						
Teaching Scheme (per week)		Lecture	Tutorial		Practical	Self Study	Credits	
		-	-		2	-	1	
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			--	--	--		50	--
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1		Explain object-oriented programming concepts, including classes, objects, member functions, constructors, and function overloading, for modular software applications using object-oriented programming principles, accurately.						
CO2		Apply object-oriented design principles, including constructors, destructors, operator overloading, and encapsulation, for efficient and reusable software solutions using appropriate programming techniques, effectively.						
CO3		Demonstrate object-oriented programming principles, including friend functions, inheritance, and polymorphism, for flexible and maintainable software applications using object-oriented programming concepts, accurately.						
CO4		Develop software applications using file handling and exception handling techniques for efficient data management and runtime error handling, effectively.						
List of Experiments with CO Mapping								
S.No		Title / Topic of the Experiment					CO Mapped	
1		Write a C++ program to create a class Student with data members (roll no, name, marks) and member functions to read and display student details.					1	
2		Write a C++ program to demonstrate function overloading for the following prototypes. • add(int a, int b) • add(double a, double b)					1	
3		Write a C++ program to implement default arguments and returning value by reference using a class Calculator.					1	
4		Write a Program to Generate Fibonacci Series use Constructor to Initialize the Data Members.					2	
5		Write a C++ program that illustrates the order of execution of constructors and destructors when new class is derived from more than one base class.					2	
6		Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading					2	
7		Write a Program to Demonstrate Friend Function and Friend Class.					3	
8		Write C++ programs that illustrate how the following forms of inheritance are supported: a) Single inheritance b) Multiple inheritance c) Multi level inheritance d) Hierarchical inheritance					3	
9		Write a Program to Invoking Derived Class Member Through Base Class Pointer					3	
10		Write a C++ program to create a text file, check file created or not, if created it will write some text into the file and then read the text from the file.					4	
11		Write a C++ program to write and read time in/from binary file using fstream					4	

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12	Write a function which throws a division by zero exception and catch it in catch block. Write a C++ program to demonstrate usage of try, catch and throw to handle exception.	4
Total Practical Sessions		15
Total Practical Hours		30
Text Books		
1. E. Balagurusamy, Object Oriented Programming with C++, McGraw-Hill Publication, 6th Edition, 2013.		
2. Dr. B. B. Meshram, Object Oriented Paradigms with C++ Beginners Guide for C and C++, SPD Publication, 1st Edition, 2016.		
3. Rajesh R. Shukla, Object-Oriented Programming in C++, Wiley India Publication, 1st Edition, 2008.		
References:		
1. Robert Lafore, Object Oriented Programming in C++, Sams Publishing, 4th Edition, 2001		
2. Bjarne Stroustrup, The C++ Programming Language, Addison-Wesley Publication, 4th Edition, 2013.		
3. P. J. Deitel, H. M. Deitel, C++ How to Program, PHI Publication, 9th Edition, 2012.		
4. John Hubbard, Programming with C++, Schaum's Outlines, McGraw-Hill Publication, 2nd Edition, 2000.		
5. Nicolai M. Josuttis, Object-Oriented Programming in C++, Wiley Publication, 1st Edition, 2002.		
Online Learning Resources		
1. http://www.spoken-tutorial.org/ NMEICT Project of Govt. Of India.		
Experiments that may be performed through virtual labs:		
S.No	Experiment Name	Experiments Links
1.	Understand subtype polymorphism in C++/Java	https://oop-amrt.vlabs.ac.in/exp/subtype-polymorphism/
2	Implement association relationship between classes using C++	https://oop-amrt.vlabs.ac.in/exp/association-relationship/


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Course Information:					
Class, Semester	SY. B.Tech, Semester - III			Category	VSEC
Course Code, Course Title	2ADVS206, Data Analysis using tools			Type	L2
Prerequisites	-				
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self-Study	Credits
	-	-	2	-	1
Examination Scheme (Marks)	Theory	MSE	TE	ESE	Practical
		-	-	-	CIA 50
					ESE -
Course Outcomes (COs) :					
Upon successful completion of this course, the student will be able to:					
CO1	Explain the Preprocessing of datasets by applying appropriate data preparation techniques using business intelligence software tools, ensuring data quality and readiness for analysis.				
CO2	Analyze datasets using suitable analytical methods and software tools to derive accurate, meaningful, and interpretable insights.				
CO3	Develop visualizations, reports, and dashboards to communicate analytical findings for informed and evidence-based decision-making.				
CO4	Implement data-driven solutions for real-world applications using appropriate data analysis tools and techniques, meeting specified problem requirements and validating the results.				
List of Experiments with CO Mapping					
S.No	Title / Topic of the Experiment				CO Mapped
1	Study of Data Analysis and Business Intelligence Tools (Excel, Cognos, Power BI) and comparison of their features.				1
2	Perform Data Cleaning Operations in Excel: Removing duplicates, handling missing values, correcting inconsistencies.				1
3	Implement Text Functions in Excel (LEFT, RIGHT, MID, LEN, TRIM) for data preprocessing.				1
4	Apply Data Validation, Error Handling, and Date-Time Functions for business datasets.				1
5	Perform Data Sorting, Filtering, and Conditional Formatting for sales and customer datasets.				2
6	Implement Logical Functions (IF, AND, OR, Nested IF) for business decision-making scenarios.				2
7	Perform Data Lookup Operations using VLOOKUP, HLOOKUP, INDEX-MATCH, and XLOOKUP.				2
8	Create and Analyze Pivot Tables and Pivot Charts for business performance analysis.				2
9	Perform What-if Analysis using Goal Seek and Scenario Manager for financial forecasting.				2
10	Design Interactive Dashboards in Excel using charts, slicers, and KPI indicators.				3
11	Create Advanced Data Visualizations: Histogram, Scatter Plot, Sparklines, and Combo Charts.				3
12	Develop a Business Performance Dashboard using Excel for sales, finance, or student performance data.				3
13	Create Data Modules and Reports using IBM Cognos Analytics from multiple data sources.				3
14	Design Interactive Dashboards in Cognos using filters, drill-down, and drill-through features.				4

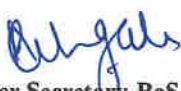

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15	Micro Project: Business Intelligence Solution Development (Sales Analysis / Financial Analysis / Student Performance Analysis) using Excel and Cognos/Power BI.	5
Total Practical Sessions		15
Total Practical Hours		30
Text Books		
1. Wayne Winston, Microsoft Excel Data Analysis and Business Modeling, Microsoft Press, 2016.		
2. Conrad Carlberg, Statistical Analysis with Excel, Pearson Education, 2018.		
3. IBM Corporation, IBM Cognos Analytics User Guide, IBM Documentation, Latest Edition.		
Reference Books		
1. Bill Jelen, Excel 2021 Inside Out, Microsoft Press, 2021.		
2. Stephen Few, Show Me the Numbers: Designing Tables and Graphs to Enlighten, Analytics Press, 2012.		
Online Learning Resources		
1. IBM Cognos & Excel Course: https://www.coursera.org/learn/data-visualization-dashboards-excel-cognos		
2. Microsoft Excel Support: https://support.microsoft.com/excel		
3. IBM Cognos Official: https://www.ibm.com/products/cognos-analytics		


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Course Information:								
Class, Semester		S.Y. B.Tech, Semester III					Category	HS
Course Code, Course Title		2ADHS207, Foreign Language - German					Type	T2
Prerequisites		-						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self-Study	Credits		
		2	-	-	2	2		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			-	50	-		-	-
Course Outcomes(COs):								
Upon successful completion of this course, the student will be able to:								
CO1	Explain basic German vocabulary, grammar, pronunciation, and common expressions used in everyday communication.							
CO2	Apply basic German language skills to communicate in familiar situations through listening, speaking, reading, and writing activities.							
CO3	Apply appropriate German vocabulary, sentence structures, and grammar to engage in simple conversations and respond to routine personal and social situations.							
CO4	Prepare simple written texts such as emails, messages, and short paragraphs in German using appropriate vocabulary and grammatical structures.							
Syllabus:								
Module	Contents							Lecture Hours
	PRE TERM SECTION							
1	Introduction to German Language • Introduction to German language and culture • German alphabets • Pronunciation and phonetics • Greetings and farewells • Classroom expressions • Basic vocabulary							10
2	Self-Introduction and Basic Communication • Personal pronouns • Verbs Haben and Sein • Verb conjugation • Introducing oneself and others • Numbers (0–1000) • Days of the week • Basic sentence structure • W-Fragen (Question Words)							10
3	Countries, Languages and Daily Communication • Countries and nationalities • Languages • Asking and answering simple questions • Yes/No questions • Articles (Definite and Indefinite) • Simple conversations							10
	IN TERM SECTION							
4	Friends, Family and Hobbies • Talking about friends and colleagues • Family members • Hobbies and interests							

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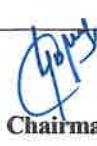


	• Daily routine • Possessive articles • Describing people	10
5	Time, Dates and Appointments • Days, months and seasons • Telling time • Dates and birthdays • Making appointments • Invitations • Apologizing • Modal verbs	10
6	Work and Workplace Communication • Occupations and professions • Workplace vocabulary • Talking about studies and work • Telephone conversations • Job advertisements • Expressing opinions about jobs	10
7	City, Transport and Directions • Places in a city • Means of transport • Asking for and giving directions • Enquiring information • Imperative forms • Negation • Definite and indefinite articles	10
SELF-STUDY SECTION		
8	Food, Shopping and Restaurants • Food and beverages • Shopping conversations • Ordering food • Paying bills • Akkusativ case • Verbs with Akkusativ • Restaurant communication	10
9	Home, Communication and Writing Skills • Describing home and surroundings • Understanding advertisements • Likes and dislikes • Letters and emails • Understanding texts • Dativ case • Dativ prepositions • Wechselpräpositionen	10
10	Social Life, Past Events and Fashion • Planning activities with friends • Event information and radio announcements • Separable verbs • Personal pronouns • Präteritum of Haben and Sein • Perfekt tense and Partizip II • Conjunctions (und, oder, aber) • Clothes and fashion • Demonstrative and interrogative articles • Verbs with Dativ	10
Total Lecture Hours		100


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Text Books:

1. Netzwerk neu A1 Kursbuch Goyal publishers & Distributors Pvt. Ltd. First Indian reprint 2020 Reprinted 2023
2. Netzwerk neu A1 Übungsbuch Goyal publishers & Distributors Pvt. Ltd. First Indian reprint 2020 Reprinted 2023

References:

1. Fit fürs Goethe -Zertifikat A1 Start Deutsch 1 Hübner


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Course Information:							
Class, Semester		S.Y. B.Tech, Semester III				Category	HS
Course Code, Course Title		2ADHS208, Foreign Language - Japanese				Type	T2
Prerequisites		-					
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self-Study	Credits	
		2	-	-	2	2	
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA ESE
			-	50	-		-
Course Outcomes(COs):							
Upon successful completion of this course, the student will be able to:							
CO1	Explain basic Japanese vocabulary, grammar, pronunciation, and common expressions used in everyday communication.						
CO2	Apply basic Japanese language skills to communicate in familiar situations through listening, speaking, reading, and writing activities.						
CO3	Apply appropriate Japanese vocabulary, sentence structures, and grammar to engage in simple conversations and respond to routine personal and social situations.						
CO4	Apply appropriate Japanese vocabulary and grammatical structures to compose simple written texts such as emails, messages, and short paragraphs.						
Syllabus:							
Module	Contents						Lecture Hours
MODULE 1 - PRE-TERM							
I	Introduction to Japanese Language and Culture - Overview of Japanese language and culture - Japanese writing systems: Hiragana, Katakana, Kanji - Basic pronunciation and phonetics - Greetings according to time of day - Classroom and workplace expressions - Asking for repetition and clarification - Basic etiquette and manners						10
II	Self-Introduction and Personal Information - Introducing oneself and others - Name, nationality, occupation, and residence - Family members - Languages spoken - Basic sentence patterns - Introduction to Hiragana writing practice						10
III	Hiragana and Katakana Mastery - Complete Hiragana characters - Complete Katakana characters - Reading and writing practice - Simple words and phrases - Listening and pronunciation exercises - Everyday vocabulary development						10

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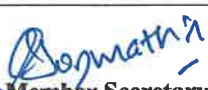
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IV	Food and Dining - Food and beverage vocabulary - Expressing likes and dislikes - Reading simple menus - Ordering food and drinks - Restaurant conversations - Japanese dining etiquette	10
V	Home, Family and Surroundings - Describing houses and rooms - Household objects and furniture - Family relationships - Location expressions - Counting objects and people - Describing surroundings	10
VI	Daily Life and Time Expressions - Telling time - Days, dates, and months - Daily routines - Operating hours and schedules - Borrowing and lending items - Making simple appointments	10
VII	Hobbies, Interests and Social Interaction - Hobbies and leisure activities - Sports, movies, music, manga, and anime - Inviting friends - Accepting and declining invitations - Expressing preferences and interests - Social conversations	10
MODULE 3 - SELF STUDY SECTION		
VIII	Transportation and Navigation - Public transportation vocabulary - Trains, buses, stations, and landmarks - Asking for directions - Giving simple directions - Understanding signs and notices - Travel-related conversations	10
IX	Shopping and Everyday Transactions - Shopping vocabulary - Asking for products and prices - Quantities and measurements - Locating items in stores - Purchasing goods - Customer-service interactions	10
X	Holidays, Experiences and Future Plans - Talking about past weekend activities - Introduction to simple past tense - Expressing wishes and desires - Travel plans and future intentions - Introduction to frequently used Kanji - Course review and consolidation - Speaking role-plays and presentations	10


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	• Speaking role-plays and presentations • Reading and writing assessment	
Total Lecture Hours		100
Text Books		
1. Irodori: Japanese for life in Japan (A1), The Japan Foundation, 2020		
Reference Books		
1. Marugoto Starter (A1) Katsudoo + Rikai (2 Books set) https://amzn.in/d/07fApBbW		
2. Genki: An Integrated Course in Elementary Japanese Vol. 1 [3rd Edition] https://amzn.in/d/0gXGM2Ef		
3. Minna no Nihongo 1-1&1-2 Main Textbook elementary +Translation & Grammatical with downloadable CDs. https://amzn.in/d/0dyQ9ips		


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Course Information:							
Class, Semester	S.Y. B.Tech, Semester III		Category	HS			
Course Code, Course Title	2ADHS209, Psychology		Type	T2			
Prerequisites	-						
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self-Study	Credits		
	1	-	-	1	1		
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE
		-	50	-		-	-
Course Outcomes(COs):							
Upon successful completion of this course, the student will be able to:							
CO1	Explain the fundamental concepts of decision making, emotional intelligence, emotional regulation, and procrastination in everyday personal, academic, and professional contexts.						
CO2	Differentiate between effective and ineffective thinking patterns, emotional responses, decision-making approaches, and behavioural strategies using psychological principles.						
CO3	Apply appropriate psychological principles and decision-making strategies to improve self-management, interpersonal effectiveness, and productivity in real-life situations.						
CO4	Evaluate the influence of cognitive biases, emotions, attention, and behavioural habits on decision making and personal effectiveness, and select appropriate corrective strategies.						
Syllabus:							
Module	Contents						Lecture Hours
I	Decision Making - Decision Making in Everyday Life - Why Smart People Make Poor Decisions - How Our Brain Makes Decisions (System 1 & System 2) - Cognitive Biases in Real Life - Decision-Making Frameworks - Thinking Tools						5
II	Understanding Emotional Intelligence - Understanding emotions and importance - EI vs IQ and 5 Domains of EI - Emotional Intelligence and Personality						3
III	Emotional Regulation & Interpersonal Skills - Impulse control (self-regulation) - Handling criticism (self-management) - Empathy and altruism (social awareness) - Assertiveness (relationship management)						3
IV	Procrastination - Introduction and definition of procrastination - Why do we procrastinate - Time management myths - Techniques to beat procrastination						4
Total Lecture Hours							15
Reference Books:							
1. "Thinking, Fast and Slow", Daniel Kahneman, Penguin Books, 2011							
2. Emotional Intelligence: Why It Can Matter More Than IQ", Daniel Goleman, Bantam Books, 1995							


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3. "Atomic Habits: An Easy & Proven Way to Build Good Habits & Break Bad Ones", James Clear, Avery, 2018
4. "Deep Work: Rules for Focused Success in a Distracted World", Cal Newport, Grand Central Publishing, 2016
5. "The Power of Habit: Why We Do What We Do in Life and Business", Charles Duhigg, Random House, 2012
6. "Nudge: Improving Decisions About Health, Wealth, and Happiness", Richard H. Thaler & Cass R. Sunstein, Penguin Books, 2008
7. "The 7 Habits of Highly Effective People", Stephen R. Covey, Free Press, 1989
NPTEL and Online Resources
1. https://www.youtube.com/watch?v=O2y1QGCIzMw
2. https://www.youtube.com/watch?v=33d61cpRfog
3. https://www.youtube.com/watch?v=b6FpfGIENPo
4. https://www.youtube.com/watch?v=YLhGgef7SvA
5. https://www.youtube.com/watch?v=TOFjyi0tg5w


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Course Information:								
Class, Semester		S.Y. B.Tech, Semester III				Category	HS	
Course Code, Course Title		2ADHS210, Universal Human Values				Type	T2	
Prerequisites		-						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self-Study	Credits		
		2	--	-	2	2		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			-	50	-		-	-
Course Outcomes(COs):								
Upon successful completion of this course, the student will be able to:								
CO1	Explain the concept, significance, and need of Universal Human Values and their role in achieving harmony in personal, social, and professional life.							
CO2	Apply the principles of harmony, social responsibility, and environmental sustainability in day-to-day life and professional situations.							
CO3	Classify ethical issues in engineering, society, and emerging technologies using ethical principles and professional guidelines.							
CO4	Demonstrate value-based behaviour and ethical decision-making for personal growth and professional practice through self-reflection and case-based situations.							
Syllabus:								
Module	Contents						Lecture Hours	
I	Evolution and Need of Universal Human Values: Meaning and concept of Universal Human Values, Historical evolution of value systems, Impact of Industrial Revolution on society and lifestyle, Consequences of World War II and global conflicts, Emergence of global value frameworks, Role of United Nations and UNESCO, Introduction of UHV in Indian education system by AICTE, Present-day challenges: stress, lack of purpose, environmental issues						05	
II	Understanding the Human Being: Human being as a combination of self and body, Distinction between self (consciousness) and body (physical entity), Needs of self vs needs of body, Happiness vs physical pleasure, Harmony in the self (thoughts, feelings, actions), Self-exploration and self-awareness						05	
III	Harmony in Relationships: Meaning and importance of relationships, Values in relationships (Trust, Respect, Affection, Care, Guidance, Reverence, Love), Mutual fulfillment in relationships, Role of family in value development, Interpersonal conflicts and resolution, Relationship in professional environment						05	
IV	Harmony in Society and Nature: Individual → Family → Society → Nation → World, Concept of undivided society, Social harmony and responsibility, Coexistence in nature, Human-nature relationship, Environmental degradation and its causes, Sustainable living and resource utilization, Local and global environmental issues						05	
V	Universal Human Values in Engineering and Technology: Professional ethics in engineering, Role of engineers in society, Guidelines by IEEE, Ethical issues in modern technology, Role of institutions like OpenAI, Core Framework to Assess Values: Self-Reflection Model, Value-Action Gap Model, Emotional Intelligence (EQ) Framework (The Nine Values (Bhavas) Assessment Model)						05	

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VI	Application of UHV in Personal and Professional Life: Self-reflection and personal development, Value-based decision making, Goal setting with values, Fulfilling Basic Human Aspirations Application of UHV in career and workplace, Development of holistic and responsible lifestyle, Core Framework to Assess Values: Emotional Intelligence (EQ) Framework, (Human-AI Value Alignment) Ikigai Model	05
Total Lecture Hours		30
Text Books		
1. Human Values and Professional Ethics: R. R. Gaur, R. Sangal, G. P. Bagaria, Excel Books, New Delhi, 2010		
2. Engineering Ethics: Charles E. Harris Jr., Michael S. Pritchard, Michael J. Rabins, Cengage Learning, 2013		
3. Understanding Human Being, Nature and Existence Comprehensively: UHV Team, UHV, 2022.		
4. Life 3.0, Max Tegmark, Knopf, 2017		
References:		
1. AICTE Universal Human Values Course Material, 2017 onwards		
2. IEEE Code of Ethics		
3. Engineering Ethics: Charles E. Harris Jr., Michael S. Pritchard, Michael J. Rabins, Cengage Learning, 2013		
Online Learning Resources		
1. TED Talks on ethics, happiness, human behaviour		
2. NPTEL Courses on UHV and Engineering Ethics		
3. MIT: AI Ethics lectures (Open Courseware)		


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Course Information:							
Class, Semester		S.Y. B.Tech, Semester III				Category	MA
Course Code, Course Title		2ADCC211, Aptitude and Reasoning- I				Type	T2
Prerequisites		-					
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self-Study	Credits	
		2	--	-	2	-	
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA
			-	50	-		-
Course Outcomes(COs):							
Upon successful completion of this course, the student will be able to:							
CO1	Apply quantitative aptitude concepts such as HCF & LCM, Vedic Mathematics, Ages, Percentage, Profit & Loss to solve numerical and real-time problem-solving tasks efficiently.						
CO2	Analyze and solve logical reasoning problems based on Number Series, Alphabet Series, Coding-Decoding, Cubes & Dice by applying systematic analytical approaches.						
CO3	Develop professional and career readiness skills through SWOT Analysis, understanding of Engineering Ecosystem, effective email writing, and essay writing techniques.						
CO4	Demonstrate logical thinking, decision-making ability, and personality development skills to enhance employability and professional effectiveness.						
Syllabus:							
Module	Contents						Lecture Hours
I	HCF & LCM Vedic Math						4
II	Number Series, Alphabet Series (Quant) Percentage						4
III	Profit & Loss Coding-Decoding						4
IV	Cubes & Dice SWOT Analysis						4
V	Introduction to Engineering Ecosystem Ages						4
VI	Email writing, Essay writing Logical Thinking Basics						4
Total Lecture Hours						24	
Text Books							
1. R.S. Agarwal ,S Chand ,Quantitative Aptitude,2019							
2. R.S. Agarwal ,S Chand ,Verbal & Non-verbal Reasoning,2010							
3. P.C. Wren ,S Chand,Wren & Martin (Verbal, Grammar) ,2017							
Reference Books							
1. Face Wiley ,APTIPEDIA (Quantitative, Logical, Verbal Aptitude) ,2017							
2. P.A. Anand ,Maestro ,Quantitative Aptitude,Wiley 2015							
3. Arun Sharma ,Meenakshi Upadhyay (Verbal Ability), McGraw Hill, 2020							


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Course Information:									
Class, Semester		SY. B.Tech, Semester – IV					Category	PC	
Course Code, Course Title		2ADPC212, Discrete Mathematics and Theory of Computation					Type	T1	
Prerequisites		2ADBS110							
Teaching Scheme (per week)		Lecture 2	Tutorial 1		Practical -		Self Study 3	Credits 3	
Examination Scheme (Marks)		Theory	MSE 40	TA 20	ESE 40	Practical	CIA -	ESE -	
Course Outcomes (COs) :									
Upon successful completion of this course, the student will be able to:									
CO1	Apply the concepts of discrete structures for mathematical and computational problems using appropriate mathematical techniques and representations, accurately.								
CO2	Apply the principles of abstract algebraic structures for theoretical computing problems using algebraic properties and operations, correctly.								
CO3	Use formal language techniques for language recognition problems using finite automata, regular expressions, and grammars, correctly.								
CO4	Analyze computational problems using appropriate models of computation and formal computational methods, accurately.								
Syllabus:									
Module	Contents							Lecture Hours	
I	Logic and Set theory: Logic- Proposition and Predicate Logic, Theory of Inference for Statement Calculus, Predicate Calculus, Proof of Techniques, Induction Set Theory: Basic concepts of set theory, operations on sets, ordered pairs, Cartesian Product, relation, properties of binary relations, matrix and graph representation, partition and covering of set.							6	
II	Relations and Functions: Relations and their Properties, n-ary relations and their applications, Representing relations, Closures of relations, Partial orderings, Partitions, Hasse diagram. Functions- Surjective, Injective and Bijective functions, Identity function, Partial function, Invertible function, Constant function, Inverse functions and Compositions of functions, The Pigeonhole Principle.							5	
III	Algebraic Systems: The structure of algebra, Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism and Normal Subgroups							4	
IV	Mathematical Induction, Regular Languages & Finite Automata : Regular expressions and corresponding regular languages, Finite automata-definition and representation, Minimization of DFA, Non-deterministic F.A.,NFA with epsilon to DFA conversion, Equivalence of FA's ..							5	
V	Grammar and Languages: Types of Languages, Derivation and ambiguity in CFL, Simplification of CFG, Conversion of CFG to CNF, Conversion of CFG to GNF, Pumping Lemma							5	
VI	Push Down Automata and Turing Machines PDA Definition, Deterministic PDA & types of acceptance, Equivalence of CFG's & PDA's.TM- Models of computation, definition of Turing Machine as Language acceptors, combining Turing Machines							5	
Total Lecture Hours							30		

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List of Tutorials with CO Mapping		
S. No	Title / Topic of the Experiment	CO Mapped
1	Logic and Propositional Calculus	1
2	Predicate Logic, Proof Techniques and Set Theory	1
3	Relations and Functions	1
4	Algebraic Structures	2
5	Regular Expressions and Finite Automata	3
6	DFA Minimization and NFA to DFA Conversion	3
7	Context-Free Grammar (CFG)	3
8	Pushdown Automata (PDA)	4
9	Turing Machines	4
10	Comprehensive Problem Solving	4
Total Tutorial Hours		15
Text Books		
1.	J. P. Tremblay & R. Manohar, Discrete Mathematical Structures with application to Computer Science, Tata MGH International, 2007	
2.	John C. Martin, Introduction to Languages & Theory of Computations, Tata McGraw-Hill Edition, 3 rd , 2007	
3.	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Edition, 3 rd , 2006	
References:		
1.	Kenneth H. Rosen (AT&T Bell Labs), Discrete Mathematics and its Applications, Tata McGraw-Hill, 7 th 2012	
2.	Michael Sipser, Introduction to Theory of Computations, Cengage Learning, 3 rd , 2012	
3.	Kavi Mahesh, Theory of Computation – A Problem Solving Approach, Wiley India, 1 st , 2005	
Online Learning Resources		
1.	https://www.youtube.com/watch?v=WW7Y00b4QHs&list=PLEAYkSg4uSQ2Wfc_l4QEZUSRdx2ZcFziQ	



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Course Information:								
Class, Semester		SY. B.Tech, Semester - IV				Category	PC	
Course Code, Course Title		2ADPC213, Database Management Systems				Type	LIT1	
Prerequisites		2ADPC202						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self Study	Credits		
		3	-	2	3	4		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		50	50
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Explain database system concepts and architecture for effective data management with conceptual accuracy and appropriate technical understanding.							
CO2	Develop structured database solutions for real-world applications using appropriate database design and management techniques with correctness, efficiency, and compliance with database requirements.							
CO3	Analyze database performance and operations for effective optimization and improved database efficiency with accurate interpretation of performance factors.							
CO4	Evaluate database reliability and security mechanisms for ensuring integrity, availability, and data protection with justified decisions and adherence to database standards.							
Syllabus:								
Module	Contents						Lecture Hours	
I	Database Fundamentals & ER -Relational Model: Database Management Systems (DBMS), Database System Applications, Characteristics of the Database Approach, Advantages of DBMS, Disadvantages of DBMS, Database Architecture, File System vs DBMS, What is Data Independence, purpose of database system, Types of dataset, Entity-Relationship model, entities, attributes, relationships, constraints, ER diagrams, weak entities, mapping ER to relational model, E-R Diagrams, introduction to database design principles. Relational Model, Relational Model Concepts, Introduction to RDBMS : Working, Features and Difference, Introduction to vector database						8	
II	Relational Algebra & SQL: Relational algebra operations (selection, projection, join, division), introduction to SQL, DDL, DML, DCL, Embedded SQL, constraints: Concept of keys: primary, candidate, foreign, Set operations aggregate functions, nested queries, Subqueries, views, triggers, SQL join operations: Inner Join, Left Join, Right Join, Full Join, PL-SQL: Introduction, Basic Syntax, Data Types, Variables, Operators, Loops, Cursors, Procedures Funtions, Exceptions						8	
III	Functional Dependency & Normalization: Importance of good schema, Motivation of Normalization forms Functional dependencies, Multi-valued Dependencies, Join Dependencies, Closure of Set FDs, attribute closure, types of dependencies, normalization: - 1NF, 2NF, 3NF, BCNF, decomposition, design of good relational schemas.						7	
IV	Storage, Indexing & Query Processing: Data Storage & its Types, File organization, indexing primary, secondary, B+ tree, hashing techniques, introduction to query processing, query optimization basics.						8	
V	Transaction Management: Transaction concepts, ACID properties, Storage Structure, concurrency control locking, timestamp, serializability: Testing Serializability, Conflict serializability, deadlocks						8	

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VI	Recovery: Recovery techniques log-based recovery, checkpoints, Recovery Concepts, NO-UNDO/REDO recovery based on Deferred update, Recovery techniques based on immediate update, Shadow paging, Database backup and recovery from catastrophic failures, Crash Recovery		6
	Total Lecture Hours 45		
List of Experiments with CO Mapping			
S. No	Title / Topic of the Experiment		CO Mapped
1	Drawing an E-R Diagram for any organization and converting the E-R diagram into Relational Tables.		1
2	Design and create a database schema using SQL DDL commands		2
3	Construct tables with appropriate constraint, such as PRIMARY KEY, FOREIGN KEY, UNIQUE, and NOT NULL to ensure data integrity.		2
4	Execute SQL DML commands for data manipulation SQL DCL commands for access control		3
5	Perform SQL join operations to retrieve combined data like different types of joins (INNER JOIN, LEFT JOIN, RIGHT JOIN, FULL JOIN) to integrate data from multiple tables.		3
6	Apply aggregate functions for data analysis using functions like MAX, MIN, AVG, and COUNT to derive meaningful insights.		2
7	Construct complex queries, nested queries and subqueries using SELECT, WHERE, and FROM clauses.		4
8	Design and normalize a database schema & normalize up to 3NF/BCNF		4
9	Study and Implementation of Functions and Stored Procedures		4
10	Create and utilize views for data abstraction and security to simplify query complexity and enhance data security.		4
11	Design and implement database triggers to automate actions based on events such as INSERT, UPDATE, and DELETE.		4
12	Micro project: Implement a real-world database application.		1-4
Total Practical Sessions		15	Total Practical Hours 30
Text Books			
1. Database System Concepts, Abraham- Silberschatz, Henry F. Korth, S. Sudarshan, Publisher: McGraw-Hill, Edition: 7th Edition , Year: 2020 / 2021			
2. Fundamentals of Database Systems-Ramez Elmasri, Shamkant B. Navathe, Publisher: Pearson Education, Edition: 7th Edition , Year: 2016 / 2017			
References:			
1. Database Systems: A Practical Approach to Design, Implementation and Management, Thomas M. Connolly, Carolyn E. Begg, Pearson Education, 3rd Edition (or latest available in library), 2016 / 2017			
2. SQL, PL/SQL: The Programming Language of Oracle, Ivan Bayross, BPB Publications, 5th Edition, Year: 2023			
Online Learning Resources			
1. Database Management System – IIT Kharagpur , https://nptel.ac.in/courses/106105175			
2. Introduction to Database Systems – IIT Madras , https://nptel.ac.in/courses/106106220			
Experiments that may be performed through virtual labs:			
S.No	Experiment Name		Experiments Links
1.	ER Modeling from Problem Statement		https://se-iitkgp.vlabs.ac.in/exp/e-r-modeling/procedure.html
2.	Implementation and Analysis of User Authentication Mechanisms in Database Systems		https://ds-amrt.vlabs.ac.in/exp/user-authentication-mechanisms/

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Course Information:							
Class, Semester	SY. B.Tech, Semester -IV		Category	PE			
Course Code, Course Title	2ADPE214, Responsible Artificial Intelligence		Type	T1			
Prerequisites	2ADPC204						
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self Study	Credits		
	3	-	-	3	3		
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE
		40	20	40		-	-
Course Outcomes (COs) :							
Upon successful completion of this course, the student will be able to:							
CO1	Describe the principles and lifecycle of Responsible AI for given AI systems, scenarios, and use cases with correct interpretation of ethical and Responsible AI principles and practices.						
CO2	Develop trustworthy AI systems for given AI applications and problem statements meeting fairness, explainability, privacy, security, and Responsible AI requirements.						
CO3	Analyze AI systems for given AI applications, ethical issues, and governance scenarios ensuring alignment with ethical, governance, and regulatory requirements for responsible and compliant AI deployment.						
CO4	Evaluate AI applications and case studies for given AI use cases and real-world scenarios with appropriate recommendations based on Responsible AI principles and evaluation frameworks.						
Syllabus:							
Module	Contents						Lecture Hours
I	Introduction to Responsible AI : What is Responsible AI ?, Need and importance in modern AI systems, AI risks and societal impact, Key principles: fairness, accountability, transparency, privacy, Overview of AI lifecycle and ethical checkpoints.						7
II	Bias, Fairness, and Explainability: Types of bias: data bias, algorithmic bias, Fairness metrics and evaluation, Bias mitigation techniques, Explainable AI (XAI) concepts, Tools: LIME, SHAP.						8
III	Privacy, Security, and Safety : Data privacy concepts (PII, anonymization), Privacy-preserving techniques: differential privacy, federated learning, AI security risks: adversarial attacks, Safe AI system design, Robustness in AI models						8
IV	AI Ethics and Governance: Ethical theories (utilitarianism, deontology), AI ethics principles by organizations like IEEE and OECD, AI governance frameworks, Responsible AI lifecycle management, Human-in-the-loop systems.						8
V	Legal and Regulatory Frameworks : Overview of global AI regulations, GDPR, EU AI Act, Indian perspective on AI governance, Compliance and accountability.						7
VI	Case Studies and Applications : AI failures (bias in hiring, facial recognition issues), Ethical issues in autonomous systems, AI in healthcare, finance, and surveillance, Case study discussions and analysis.						7
Total Lecture Hours							45
Text Books							
1. Artificial Intelligence: A Guide for Thinking Humans – Melanie Mitchell, Farrar, Straus and Giroux, 1st Edition 2019.							
2. Ethics of Artificial Intelligence – Nick Bostrom , Oxford University Press							


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Reference Books	
1.	Atlas of AI: Power, Politics, and the Planetary Costs of AI, Kate Crawford, Yale Univ. Press, 1st Edition 2021
2.	The Alignment Problem: Machine Learning and Human Values, Brian Christian, W. W. Norton & Company, 1st Edition, 2020.
3.	Human Compatible: Artificial Intelligence and the Problem of Control, Stuart Russell, Viking Press, 1st Edition 2019
Online Learning Resources	
1.	Google AI Responsible AI Practices
2.	Microsoft Responsible AI Guidelines
3.	UNESCO AI Ethics Recommendations


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Course Information:								
Class, Semester		SY. B.Tech, Semester -IV				Category	PE	
Course Code, Course Title		2ADPE215, Data Analytics				Type	T1	
Prerequisites		2ADPC202						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self Study	Credits		
		3	-	-	3	3		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		-	-
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1	Explain the concepts of data analytics, data analytics lifecycle, types of analytics, and the Python-based data analytics ecosystem using appropriate terminology with conceptual clarity.							
CO2	Implement preprocessing of datasets using appropriate data handling and transformation techniques with improved data quality for analysis.							
CO3	Analyze datasets by using appropriate exploratory data analysis techniques and suitable visualization methods to obtain meaningful insights.							
CO4	Implement predictive models using appropriate regression and classification techniques to evaluate model performance.							
CO5	Develop data analytics solutions using suitable analytics tools and techniques for real-world applications and informed decision-making.							
Syllabus:								
Module	Contents						Lecture Hours	
I	Introduction to Data Analytics Data, Information, Knowledge, Types of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive, Data Analytics Lifecycle, Data sources and types, Python ecosystem for Data Analytics, Jupyter Notebook / Google Colab, NumPy fundamentals						7	
II	Data Handling and Preprocessing Introduction to NumPy, Data Collection and Loading Data, Data Cleaning Techniques, Handling Missing Values, Handling Outliers, Data Transformation and Scaling, Data Encoding Techniques Data Integration and Data Reduction, Introduction to Pandas						8	
III	Exploratory Data Analysis and Visualization Data Exploration using Pandas, Descriptive Statistics, Data Visualization Concepts, Histograms Bar Charts and Pie Charts, Box Plots, Scatter Plots, Correlation Analysis, Introduction to Feature Engineering						8	
IV	Predictive Analytics Introduction to Predictive Modeling, Simple Linear Regression, Multiple Linear Regression, Logistic Regression, Model Training and Testing, Overfitting and Underfitting, Cross-Validation Basics, Model Evaluation Metrics: Accuracy, Precision, Recall, F1-Score, R ² Score						8	
V	Data Analytics Tools and Techniques Advanced Data Manipulation using Pandas, Data Aggregation and Grouping, Data Filtering and Sorting, Merging and Joining Datasets, Data Visualization using Matplotlib, Data Visualization using Seaborn, Dashboard Concepts, Introduction to Power BI/Tableau						8	
VI	Applications of Data Analytics Time Series Analysis Basics, Introduction to Recommendation Systems, Web, Analytics Business Analytics, Healthcare Analytics, Financial Analytics-Commerce Analytics, Mini Case Studies and Project						6	
Total Lecture Hours						45		

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Text Books	
1.	Allen B. Downey, Think Stats: Exploratory Data Analysis in Python, 2nd Edition, O'Reilly Media, 2014
2.	Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition, O'Reilly Media, 2017
3.	Brian Caffo, Statistical Inference for Data Science, Leanpub / Johns Hopkins University, 2016
References:	
1.	Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press, 5th Edition, 2014
2.	Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 1st Edition, 2020
3.	Field Cady, The Data Science Handbook, Wiley India, 1st, 2017
Online Learning Resources	
1.	https://www.youtube.com/@statquest/playlists
2.	https://www.youtube.com/@AlexTheAnalyst/videos


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Course Information:								
Class, Semester		SY. B.Tech, Semester - IV					Category	PE
Course Code, Course Title		2ADPE216, AI For Sustainable Development					Type	T1
Prerequisites		2ADHS208						
Teaching Scheme (per week)		Lecture	Tutorial		Practical	Self Study	Credits	
		3	-		-	3	3	
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			40	20	40		-	-
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1		Explain the fundamentals of AI and sustainability using AI concepts, sustainability principles, and Sustainable Development Goals (SDGs), accurately.						
CO2		Apply AI techniques and tools using appropriate datasets, software, and sustainability case studies for AI-based sustainability applications, effectively.						
CO3		Evaluate AI applications using ethical frameworks and real-world scenarios, appropriately.						
CO4		Analyze emerging trends in Sustainable AI using research literature and modern AI technologies, effectively.						
Syllabus:								
Module	Contents							Lecture Hours
I	Introduction to Sustainable AI Definition and Scope of Sustainable AI , Sustainability and AI, Key Trends in Sustainable AI, Sustainable Development Goals (SDGs), Ethical considerations in AI for society.							8
II	AI in Environmental Management Environmental Monitoring and Management, Geosciences and AI, Freshwater Management, Disaster Risk Reduction, Climate Change Assessments, Smart agriculture and precision farming, Renewable energy optimization, E-waste generation, Case studies of AI in environmental protection							8
III	AI Technologies and Tools Machine Learning fundamentals, Deep Learning and Neural Networks, Natural Language Processing (NLP), Computer Vision basics, Data collection, preprocessing, and visualization, AI tools and platforms (TensorFlow, Python libraries)							7
IV	AI for Social Sustainability Bias and fairness: Ensuring AI systems are fair. unbiased" and respectful of diversity, Job displacement: Mitigating the impact of AI-driven automation on employment and job markets., Social manipulation: Preventing AI-powered social manipulation and disinformation, Disaster prediction and management, Ethical AI and bias mitigation							7
V	Future Potential of AI in Scientific Research Advancements in AI Technologies, Quantum Computing, Data Quality and Management, IoT Enhancements, Ethical Frameworks for AI, AI and Public Trust, AI for Social Good, Future Challenges and Opportunities							7
VI	Research and Development Sustainable AI research: Encouraging research on sustainable AI development, deployment, and impact assessment. . AI for sustainability: Exploring AI applications that support sustainability. such as climate change mitigation and environmental monitoring. AI literacy and education: Promoting AI literacy, and education to ensure stakeholders understand AI's potential and limitations. Challenges in AI adoption for sustainability . Data privacy and security issues							8


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Text Books
1. Sætra, Henrik Skaug. "AI for the Sustainable Development Goals." CRC Press, February 2022.
2. Walker, Thomas, Stefan Wendt, Sherif Goubran, and Tyler Schwartz (Eds.). "Artificial Intelligence for Sustainability: Innovations in Business and Financial Services." Palgrave Macmillan Cham, DOI: https://doi.org/10.1007/978-3-031-49979-1
References:
1. Various academic papers and reports on Sustainable AI analyzing the intersection of artificial intelligence and sustainability, highlighting key challenges and opportunities from reputable sources such as IEEE, ACM, ScienceDirect, and governmental organizations.
2. The Quest for Artificial Intelligence Nils J. Nilsson Cambridge University Press 6th 2013
Online Learning Resources
1. https://onlinecourses.nptel.ac.in/noc25_cs88/preview

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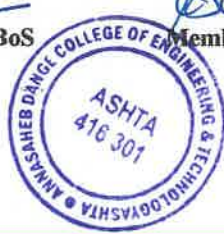
Course Information:							
Class, Semester	SY. B.Tech, Semester - IV					Category	MM
Course Code, Course Title	2ADAI217, Foundations of Artificial Intelligence					Type	LIT2
Prerequisites	2ADES104						
Teaching Scheme (per week)	Lecture	Tutorial	Practical		Self Study	Credits	
	3	-	2		3	4	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE
		40	20	40		50	-
Course Outcomes (COs) :							
Upon successful completion of this course, the student will be able to:							
CO1	Explain the fundamentals of Artificial Intelligence and search techniques by using AI concepts, search algorithms, and illustrative examples with correct interpretation of AI principles.						
CO2	Solve AI problems by applying AI search methods, intelligent agents, and probabilistic reasoning with appropriate selection of AI techniques and reasoning methods.						
CO3	Solve knowledge-based AI problems by applying knowledge representation and logical reasoning using propositional and first-order logic with accurate logical inference.						
CO4	Evaluate real-world AI solutions by analyzing AI planning methods and AI applications with appropriate planning strategies and justified decision-making.						
Syllabus:							
Module	Contents						Lecture Hours
I	Introduction to Artificial Intelligence Definition and Scope of Artificial Intelligence, Evolution and Future Trends of AI, AI Paradigms and Interdisciplinary Nature, Intelligent Agents: Definition, Types, and Characteristics, Agent-Environment Interaction, Problem Formulation and Problem-Solving Approach in AI						7
II	Problem Solving and Search Techniques State Space Representation, Search Strategies:, Uninformed Search (BFS, DFS, Uniform Cost Search), Informed Search (Greedy Best First, A* Search), Heuristic Functions and Design Issues, Local Search Algorithms and Optimization Problems, Constraint Satisfaction Problems (CSP): Formulation and Backtracking.						8
III	Intelligent and Software Agent Systems Introduction to Logical Agents, Knowledge-Based Agents, Reasoning under Uncertainty Probability Theory and Basic Inference, Independence and Bayes' Rule, Architecture of Intelligent Agents, Multi-Agent Systems: Communication, Coordination, Negotiation and Bargaining among Agents						8
IV	Knowledge Representation and Reasoning Knowledge Representation Concepts, Propositional Logic: Syntax and Semantics, First, Order Logic (FOL): Syntax, Semantics, and Knowledge Engineering, Inference in First Order Logic, Unification and Lifting, Forward Chaining and Backward Chaining Resolution Principle, Comparison of Propositional Logic and First Order Logic						8
V	Planning and Decision Making Introduction to AI Planning, Classical Planning Problems, Algorithms for Classical Planning, Heuristic Planning Techniques, Hierarchical Planning, Planning in Non-Deterministic Domains, Time, Scheduling, and Resource-Constrained Planning, Analysis of Planning Systems						7

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VI	Applications of Artificial Intelligence Overview of AI Applications, Language Models and AI Assistants, Information Retrieval and Search Engines. Information Extraction Systems, Fundamentals of Natural Language Processing, Machine Translation Techniques, Basics of Speech Recognition Introduction to Robotics and Intelligent Robots		7
Total Lecture Hours			45
List of Experiments with CO Mapping			
S.No	Title / Topic of the Experiment		CO Mapped
1	Implement basic search strategies – 8-Puzzle, 8-Queens problem.		1
2.	Implement Crypt arithmetic		2
3	Implement A* algorithms		2
4	Implement memory bounded A* algorithms		2
5	Implement Minimax algorithm for game playing (Alpha-Beta pruning)		2
6	Solve constraint satisfaction problems		2
7	Implement propositional model checking algorithms		3
8	Implement forward chaining, backward chaining		3
9	Implement resolution strategies		3
10	Build naive Bayes models		2
11	Implement Bayesian networks and perform inferences		2
12	Implement AI Planning for a Robot Navigation Problem		4
Total Practical Sessions	15	Total Practical Hours	30
Text Books			
1. Artificial Intelligence –A Modern approach, Stuart J. Russell, Peter Norwig, Pearson Education 3rd 2016			
2. Artificial Intelligence Elaine Rich And Kevin Knight Tata McGraw Hill Publishing Company,New Delhi, 2014			
References:			
1. Prolog: Programming for Artificial Intelligence,I. Bratko Addison-Wesley Educational Publishers Inc. Fourth edition 2015			
2. The Quest for Artificial Intelligence Nils J. Nilsson Cambridge University Press 6th 2013			
3. Artificial Intelligence: Foundations of Computational Agents David L. Poole and Alan K. Mackworth Cambridge University Press 2012			
4. Multi Agent Systems Gerhard Weiss MIT Press Second Edition 2013			
Online Learning Resources			
1. https://onlinecourses.nptel.ac.in/noc25_cs88/preview			


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Course Information:								
Class, Semester		SY. B.Tech, Semester – IV					Category	PC
Course Code, Course Title		2ADPC218, Java Programming					Type	L1
Prerequisites		2ADVS205						
Teaching Scheme (per week)		Lecture	Tutorial		Practical	Self Study	Credits	
		1	-		2	1	2	
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			-	-	-		50	50
Course Outcomes (COs) :								
Upon successful completion of this course, the student will be able to:								
CO1		Explain object-oriented programming concepts including classes, objects, inheritance, interfaces, packages, abstraction, encapsulation, and polymorphism using Java programming principles, accurately.						
CO2		Apply exception handling and file handling techniques for developing reliable and error-free Java applications using appropriate programming constructs, effectively.						
CO3		Develop graphical user interface (GUI) applications and implement multithreading and networking concepts using appropriate Java libraries and programming techniques, efficiently.						
CO4		Develop integrated Java applications using the Collections Framework, database connectivity (JDBC), and appropriate programming techniques to solve real-world problems, effectively.						
Syllabus:								
Module		Contents						Lecture Hours
I		Fundamental Programming in Java Object-Oriented Programming Concepts, JVM, JIT Compiler, Byte Code,, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Arrays- Jagged Array. Objects and Classes: Declaring Classes, Declaring Member Variables, Defining Methods, Constructor, Creating and using objects, Access Modifiers, Static Fields and Methods, this keyword.						3
II		Inheritance, Interface and Packaging Inheritance, Interface and Packaging Inheritance: Definition, Types of Inheritance, Polymorphism, Overriding and Hiding Methods, Super keyword, Final Classes and Methods, Abstract Classes and Methods, casting, finalization and garbage collection. Interfaces: Defining an Interface, Implementing an Interface Packages: Class importing, creating a Package, Naming a Package, Using Package Members.						2
III		Exception and I/O Streams Exception: Definition, Dealing with Errors, The Classification of Exceptions, Declaring Checked Exceptions, Throw an Exception, Creating Exception Classes, Catching Exceptions, finally clause,I/O Streams: Byte Stream – InputStream, OutputStream, FileInputStream, FileOutputStream, Character Streams.						2
IV		Graphical User Interfaces using Swing: Introduction to the Swing, Swing features, Swing Top Level Containers-Creating a Frame, Positioning a Frame, Displaying Information in a Panel, The Model-View-Controller Design Pattern, The JComponent Class – JLabel, JTextField, JButton etc. Layout Management: Border Layout, Flow Layout, Grid Layout Event Handling: Basics of Event Handling, The AWT Event Hierarchy, Key Events, Mouse Events						3

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V	Networking and Multithreading Multithreading: Processes and Threads, Runnable Interface and Thread Class, Defining and Starting a Thread, Thread States, Thread Properties, Networking: Overview of Networking, Networking Basics, Reading from and Writing to a URL Connection, Sockets, Reading from and Writing to a Socket.	3
VI	Collection and Database Programming Collections: Collection Interfaces, Concrete Collections- List, Queue, Set, Map, the Collections Framework. Database Programming: The Design of JDBC, The SQL, Basic JDBC Programming Concepts, Query Execution, Result Sets.	2
Total Lecture Hours		15

List of Experiments with CO Mapping

S.No	Title / Topic of the Experiment	CO Mapped
1	Implement a Java program to demonstrate the concept of Class and Object	1
2	Implement Java programs to demonstrate single, multilevel, and hierarchical inheritance	1
3	Implement multiple inheritance using Interface	1
4	Implement Java programs using Package and Sub-packages	2
5	Implement exception handling and user-defined exception in Java	2
6	Implement file read and write operations using Java I/O streams	2
7	Implement GUI-based application using Swing components	3
8	Implement GUI application using different Layout Managers	3
9	Implement multithreading using Thread class and Runnable interface	3
10	Implement client-server communication using Socket programming	4
11	Implement programs using Java Collections Framework	4
12	Implement Java application with Database Connectivity using JDBC	4
Total Practical Sessions		15
Total Practical Hours		30

Text Books

1. Cay Horstmann, Core Java- Volume I and II Fundamentals, 8th, Pearson ,2011.
2. Yashavant Kanetkar, Let Us Java ,3rd, BPB Publication ,2017.

References Books

1. Herbert Schildt, Java 2 Complete Reference, 9th, TMGH,2014.
2. Deitel Paul, JAVA HOW TO PROGRAM, Deitel Harvey,10th, PHI Learning ,2016.
3. Prentice Hall, Thinking in Java ,4th, Bruce Eckel ,2006.
4. Khaleed Mughal and Rolf W. Rasmussen, A Programmer's guide to JAVA SCJP Certification ,3rd, Addison Wesley,2008.

Online Learning Resources

1. NPTEL Course on Programming, Data Structures and Algorithms using Java, by Prof. Rajeev Kumar, IIT Kharagpur, <https://nptel.ac.in/courses/106105191>
2. Java Tutorials (Official Documentation), Oracle
<https://docs.oracle.com/javase/tutorial/>
3. Introduction to Java Programming, Geeks for Geeks
<https://www.geeksforgeeks.org/java/>
4. Java Programming Basics, Tutorials Point
<https://www.tutorialspoint.com/java/index.htm>

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5. Java Programming for Beginners, MIT Open Course Ware https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/		
Experiments that may be performed through virtual labs:		
S.No	Experiment Name	Experiments Links
1.	Introduction to Java Programming Language	https://java-iitd.vlabs.ac.in/exp/introduction-java/


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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Artificial Intelligence & Data Science						
	Course Information:						
Class, Semester	SY. B.Tech, Semester - IV			Category	HS		
Course Code, Course Title	2ADHS219, Indian Constitution			Type	T2		
Prerequisites	-						
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self Study	Credits		
	1	-	-	1	1		
Examination Scheme (Marks)	Theory	MSE	TA	ESE	Practical	CIA	ESE
		-	50	-		-	-
Course Outcomes (COs) :							
Upon successful completion of this course, the student will be able to:							
CO1	Describe the evolution and salient features of the Indian Constitution using the Government of India Acts of 1935 and 1947.						
CO2	Illustrate the philosophy of the Indian Constitution using the Preamble, Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy						
CO3	Explain the constitutional amendment process, principles of the Basic Structure, and emergency provisions under the Indian Constitution						
CO4	Summarize the structure and functioning of the Union and State Governments using the parliamentary and legislative systems.						
Syllabus:							
Module	Contents					Lecture Hours	
I	Constitution: Basic Structure & Making of Constitution Meaning of the constitution law and constitutionalism, Historical perspective of the constitution of India, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution, Meaning and importance of Constitution, Making of Indian Constitution – Sources, Salient features of Indian Constitution, Preamble.					04	
II	Fundamental Rights & Fundamental Duties Fundamental Rights – Features and characteristics, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles-Definition and Meaning, 42 nd Constitutional Amendment Act, List and Importance of Fundamental Duties.					06	
III	Amendments of Constitution and Emergency Provisions: Meaning and need of Constitutional Amendments, Procedure of Amendment under Article 368, Types of Amendments, Important Constitutional Amendments (42 nd , 44 th , 73 rd , 74 th , 86 th and 101 st Amendments), Basic Structure Doctrine. Emergency Provisions – Meaning and Objectives, National Emergency (Article 352), State Emergency/President's Rule (Article 356), Financial Emergency (Article 360), Effects of Emergency on Fundamental Rights and Centre-State Relations, Safeguards introduced by 44 th Constitutional Amendment.					03	
IV	Government of The Union and States: President of India – Election and Powers, Prime Minister of India - Election and Powers, Lok Sabha - Structure, Rajyasabha – Structure, Governor of State, Chief Minister and Council of Ministers in a state.					02	
Total Lecture Hours					15		
Text Books							
1. M. Laxmikanth, Indian Polity, 7th Edition, McGraw Hill Publications Delhi, 2023.							
2. P. M. Bakshi, The Constitution of India, 19th Edition, Lexis Nexis, 2023.							
3. Durga Das Basu, Introduction to the Constitution of India, 26th Edition, Lexis Nexis, 2022.							
4. M. Laxmikanth, Governance in India, 3rd Edition, McGraw Hill Publications Delhi, 2021.							

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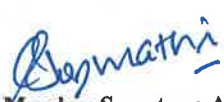
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5. J. N. Pandey, The Constitutional Law of India, 59th Edition, Allahabad: Central Law Agency, 2022.
References:
1. V. N. Shukla, Constitution of India, 14th Edition, EBC, 2022.
2. V. N. Tripathi, Constitution of India, 9th Edition, Premier Publishing Company, 2021.
3. M. V. Pylee, India's Constitution, 18th Edition, S. Chand Publications, New Delhi, 2020.
Online Learning Resources
1. https://legislative.gov.in/constitution-of-india/
2. nptel.ac.in/courses/129106003?utm


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Course Information:												
Class, Semester	SY. B.Tech, Semester - IV					Category		HS				
Course Code, Course Title	2ADHS220, Environmental Studies					Type		T2				
Prerequisites												
Teaching Scheme (per week)	Lecture		Tutorial		Practical		Self Study		Credits			
	2		-		-		2		2			
Examination Scheme (Marks)	Theory	MSE		TA		ESE		Practical	CIA		ESE	
		-		50		-			-		-	
Course Outcomes (COs) :												
Upon successful completion of this course, the student will be able to:												
CO1		Explain environmental systems, population dynamics, natural resources, and sustainability concepts.										
CO2		Explain the Sustainable Development Goals (SDGs) and their significance in engineering for sustainable development.										
CO3		Apply pollution concepts to identify sources, impacts, and suitable control measures for air, water, soil, and noise pollution.										
CO4		Apply principles of climate change mitigation and adaptation, renewable energy, waste management, and environmental governance to recommend sustainable engineering practices.										
Syllabus:												
Module		Contents									Lecture Hours	
I		Environmental Systems, Population, and Resource Use: Components of environment and earth systems, Population growth, urbanization, and industrial development, Natural resources: water, energy, land, minerals, Resource depletion, carrying capacity, and environmental stress, Human-environment interactions and sustainability challenges									5	
II		Sustainable Development Goals (SDGs) and Engineering Responsibility: Evolution of sustainable development concept, Overview of 17 Sustainable Development Goals and key targets, Interlinkages among SDGs (water-energy-food-climate nexus), SDGs relevant to engineering disciplines, Role of engineers in achieving SDGs									5	
III		Pollution Science and Environmental Quality: Air pollution: sources, types, impacts, and control overview, Water pollution: indicators, standards, reuse and recycling, Soil pollution: contamination sources and remediation concepts, Noise pollution: sources, measurement, impacts, and mitigation.									5	
IV		Climate Change – Science, Mitigation, and Adaptation: Greenhouse effect and climate change science, Evidence of climate change and observed impacts, Mitigation strategies: technology, energy transition, efficiency, Adaptation strategies: climate-resilient infrastructure and planning, Role of engineers in climate action.									5	
V		Renewable Energy and Sustainable Technologies: Overview of renewable energy technologies, Solar energy (PV and thermal systems), Wind energy systems, Hydropower, geothermal, ocean energy, Bioenergy and waste-to-energy, Comparative assessment of renewable technologies.									5	
VI		Waste Management, and Environmental Governance: Solid waste management and E-waste management, Life Cycle Assessment (LCA): concept and applications, Environmental policies and legislation (India and global overview), Environmental Impact Assessment (EIA), Ethics and professional responsibility of engineers									5	
Total Lecture Hours										30		

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Text Books:	
1.	Singh, J. S., Singh, S. P., Gupta, S. R., and Singh, R. Ecology, Environmental Science and Conservation. 2nd Edition. S. Chand Publishing, 2025.
2.	Bharucha, E. Environmental Studies for Undergraduate Courses. 4th Edition. Universities Press (India) Pvt. Ltd. 2025.
3.	Cunningham, W.P., & Cunningham, M.A., Environmental Science: A Global Concern, 15th Edition, McGraw-Hill Education, New Delhi, 2020.
4.	Rathoure, V.C., Fundamentals of Environmental Studies, 2nd Edition, Tata McGraw-Hill Education, New Delhi, 2019
5.	Singh, J.S., & Singh, S.P., Environmental Science: An Integrated Approach, 5th Edition, Jones & Bartlett Learning, 2019
6.	Kaushik, A., & Kaushik, C.P., Perspectives in Environmental Studies, 5th Edition, New Age International Publishers, New Delhi, 2018.
References:	
1.	Trivedi, R.K., & Goel, P.K., An Introduction to Environmental Biology, 1st Edition, University Book House, Jaipur, 2018.
2.	Odum, E.P., Fundamentals of Ecology, 5th Edition, Cengage Learning, 2017.
3.	Dash, M.C., Fundamentals of Ecology, 4th Edition, McGraw-Hill Education, New Delhi, 2016.
Online Learning Resources	
1.	https://www.youtube.com/watch?v=MtpxOdtS9KU&list=PL3qvHcrYGylu2egw2tipHWODV6elVC2Gg
2.	https://niti.gov.in/divisions/division/sustainable-development-goal


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Course Information:															
Class, Semester		SY. B.Tech, Semester - IV					Category	RM							
Course Code, Course Title		2ADRM221, Research Methodology					Type	L2							
Prerequisites		-													
Teaching Scheme (per week)		Lecture		Tutorial		Practical		Self Study		Credits					
		-		-		2		-		1					
Examination Scheme (Marks)		Theory		MSE		TA		ESE		Practical		CIA		ESE	
				-		-		-		50		-			
Course Outcomes (COs :															
Upon successful completion of this course, the student will be able to:															
CO1		Utilize fundamental concepts of research, research problems, literature sources, and research methodologies for engineering applications under given research scenarios.													
CO2		Apply appropriate research design, sampling techniques, and data collection methods to conduct systematic research studies under given problem statements.													
CO3		Analyze research data using qualitative, quantitative, statistical, and hypothesis testing techniques under given research scenarios.													
CO4		Develop a technical research article with ethical publication practices, appropriate referencing standards, and quality research guidelines.													
Syllabus:															
Module		Contents										Lecture Hours			
I		Research Fundamentals Meaning and objectives of research, Significance of research, Types of research, Research process, Criteria of Good Research, Importance of Research in Engineering										4			
II		Research Problem & Literature Review Meaning of Research Problem, Identification & Formulation of research Problem, Techniques for defining Research Problem, Literature Sources: Journals, Conferences, Patents, Use of Digital Libraries, Literature Review techniques and gap identification.										5			
III		Research Design & Methodology Need & Features of Good Research Design, Types of Research Design: Exploratory, Descriptive, Experimental, Sampling Techniques. Data Collection: Types of Data: Primary, Secondary, Methods of Data Collection: Survey, Questionnaire, Interview, Observation, Experimentation										6			
IV		Data Analysis & Testing of Hypothesis Types of data: Qualitative and Quantitative, Basic statistical tools: Mean, Median, Standard Deviation, Data representation: Tables, Graphs, Charts, Introduction to analysis tools, Interpretation of results, Hypothesis, Basic concepts concerning testing of hypothesis, Procedure for hypothesis testing, Flow diagram of hypothesis testing, Test of hypothesis, Hypothesis testing of Means, Hypothesis testing for differences between Means.										5			
V		Report Writing Introduction Technical Report Writing and tools (Latex), Significance of report writing, Steps in writing report, Types of reports, Layout and structure of reports, Documentation and Referencing Styles, Presentation Tools & Techniques: Zotero & Mendeley.										4			

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VI	Research Journals and Publication Ethics Research Journals, Types of Journals, Research Publication Process, Journal Indexing: Meaning and Importance of Journal Indexing, Benefits of Indexed Journals, Major Indexing Databases, (Scopus, Web of Science, Google Scholar, SCI, ESCI, and PubMed), Journal Metrics and Quality Indicators: Impact Factor, h-index, i10-index, CiteScore, SNIP and SJR, Types of Publications, Ethics in Research Publication: Plagiarism and Similarity Index (Turnitin Software), Copyright and Authorship, Duplicate Publication, Clone, Predatory, and Fake Journals, Researcher Profiles and Identifier (ORCID, Researcher ID)	6
Total Lecture Hours		30
Text Books		
1. Research Methodology–Methods and Techniques by C. R. Kothari, Second Edition, New Age International Publishers		
2. Dr. Santosh M Nejakar, Dr. Harish Bendigeri “Research Methodology and Intellectual Property Rights”, ISBN 978-93-5987-928-4, Edition: 2023-24		
Reference Books		
1. Research Methodology Concept and cases By Deepak Chawala and Neena Sondhi		
2. Research Methodology: Step by step guide for beginners, Ranjeet Kumar, 5 th Edition, SAGE Publications		
3. How to Write and Publish a Scientific Paper, Robert A. Day, Barbara Gastel, 8 th Edition: 8th Edition, Cambridge University Press		
NPTEL and Online Resources		
1. https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed28		
2. https://onlinecourses.swayam2.ac.in/e-learning/course/nou26_ge46		

Note: For the smooth and effective execution of this course, the department shall allocate 02 lecture hours in the respective timetables in place of practical hours as per the resolution passed in STT meeting.

ISE Activities

1. Conduct a literature review in the selected domain, identify the research gap, and submit a Literature Review Report.
2. Prepare and submit a Technical Article on the chosen topic based on the literature review.

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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Artificial Intelligence and Data Science					
Course Information:						
Class, Semester	SY. B.Tech, Semester - IV			Category	EL	
Course Code, Course Title	2ADEL222, Innovation and Product Development			Type	L2	
Prerequisites	-					
Teaching Scheme (per week)	Lecture	Tutorial	Practical	Self Study	Credits	
	-	-	2	-	1	
Examination Scheme (Marks)	Theory	MSE	TA	ESE	CIA	ESE
		-	-	-	50	-
Course Outcomes (COs :						
Upon successful completion of this course, the student will be able to:						
CO1	Identify innovative product ideas by observing real-world problems and user needs using creativity and design thinking tools.					
CO2	Apply design thinking techniques to generate and refine innovative solutions for identified engineering or societal problems based on user requirements.					
CO3	Construct functional prototypes and estimate preliminary production costs using appropriate materials, manufacturing methods, and engineering tools.					
CO4	Analyze prototype performance and production feasibility by interpreting testing results, cost data, and scalability requirements.					
CO5	Evaluate intellectual property opportunities, commercialization potential, and production planning based on technical feasibility, market requirements, and economic considerations.					
CO6	Develop a comprehensive entrepreneurial proposal integrating intellectual property protection, commercialization strategy, and production planning for an innovative product.					
Syllabus:						
The Innovation and Product Development course is designed to provide students with experiential learning in innovation, prototyping, product development, and commercialization. The course focuses on identifying real-world problems and transforming innovative ideas into functional prototypes/models/products through systematic design and development processes.						
Students will learn techniques for validating innovative concepts, assessing feasibility and utility, selecting suitable materials, along with a design-thinking approach and developing prototypes/models/products through iterative improvement and performance testing. The course also emphasizes expert reviews, prototype assessment, cost estimation, pricing strategies, and preliminary production planning for scalability.						
Further, students will gain exposure to Intellectual Property Rights (IPR), commercialization processes, and startup development, enabling them to prepare draft proposals for patenting, commercialization, or entrepreneurial ventures based on their innovative solutions.						


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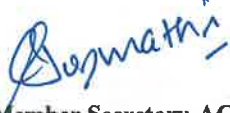

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INNOVATION AND PRODUCT DEVELOPMENT ACTIVITY PLAN

Sr. No	Innovation Prototype Course Activities	Planned Week
01	Introduction to Innovation and Prototyping	Week 1
02	Revising Design Thinking Approach	Week 2
03	Identifying Innovative Problems (Students & Faculty)	Week 3
04	Validating Innovation: Assessing Utility of a Proposed Concept	Week 4
05	Review No. 1 – by Guides - Innovativeness Assessment - (Final Idea Presentation)	Week 5
06	Planning and Designing the Prototype	Week 6
07	Choosing and Testing Materials for the Prototype	Week 7
08	Building the working Prototype / Model/ Product	Week 8
09	Improving working Prototype / Model/ Product	Week 9
10	Testing the Prototype / Model/ Product Performance	Week 10
11	Review No. 2 – by Expert Panel - Prototype/Model/Product Assessment along with poster	Week 11
12	Estimating Costs & Formulating a Pricing Strategy for Product	Week 12
13	Creating a Preliminary Production Plan for Scaling the Prototype	Week 13
14	Formulating IPR or Commercialization or Start up	Week 14
15	Review No. 3 – Submission of Draft Copy for IPR or Commercialization or Start up	Week 15


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 Established: 1999	Annasaheb Dange College of Engineering and Technology Ashta - 416301, Dist. : Sangli, Maharashtra (An Empowered Autonomous Institute) Department of Artificial Intelligence & Data Science							
Course Information:								
Class, Semester		S.Y. B.Tech, Semester IV				Category	MA	
Course Code, Course Title		2ADCC223, Aptitude and Reasoning-II				Type	T2	
Prerequisites		-						
Teaching Scheme (per week)		Lecture	Tutorial	Practical	Self-Study	Credits		
		2	-	-	2	-		
Examination Scheme (Marks)		Theory	MSE	TA	ESE	Practical	CIA	ESE
			-	50	-		-	-
Course Outcomes(COs):								
Upon successful completion of this course, the student will be able to:								
CO1		Apply quantitative aptitude concepts such as Partnership, Average, and Syllogism to solve numerical and logical problems effectively.						
CO2		Analyze and solve reasoning-based problems involving Seating Arrangements, Puzzles, and Direction Sense using systematic problem-solving approaches.						
CO3		Demonstrate professional communication and employability skills through presentation skills, grooming, body language, group discussions, and interview techniques for effective participation in hiring processes.						
CO4		Develop career readiness skills by preparing professional resumes, optimizing LinkedIn profiles, and applying networking strategies such as cold calling for internship and job opportunities.						
Syllabus:								
Module	Contents							Lecture Hours
I	Partnership Average							4
II	Seating Arrangements Puzzles							4
III	Syllogism Direction							4
IV	Presentation Skills Grooming & Body Language							4
V	Resume Writing LinkedIn Cold Calling							4
VI	Group Discussion Interview							4
Total Lecture Hours							24	
Text Books								
1. R.S. Agarwal ,S Chand ,Quantitative Aptitude ,2019								
2. R.S. Agarwal ,S Chand ,Verbal & Non-verbal Reasoning ,2010								
3. P.C. Wren , S Chand ,Wren & Martin (Verbal, Grammar) , 2017								
Reference Books								
1. Face ,Wiley ,APTIPEDIA (Quantitative, Logical, Verbal Aptitude), 2017								
2. P.A. Anand ,Maestro , Wiley (Quantitative Aptitude) ,2015								
3. Meenakshi Upadhyay ,Arun Sharma (Verbal Ability),McGraw Hill ,2020								

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