AISSMS
INSTITUTE OF INFORMATION TECHNOLOGY
(IOIT)
ADDING VALUE TO ENGINEERING
An Autonomous Institute Affiliated to Savitribai Phule Pune University
Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with "A+" Grade | NBA - 5 UG Programmes

ACADEMIC COURSE

STRUCTURED AND

DETAILED SYLLABUS

S. Y. BTECH

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

B.TECH. 4 YEAR UG COURSE

(Applicable for the batches admitted from 2022-2023)

AISSMS INSTITUTE OF
INFORMATION TECHNOLOGY
Kennedy Road, Near RTO,
Pune- 411-001, Maharashtra State, India
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BOS-ARTIFICIAL INTELLIGENCE
& DATA SCIENCES
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PUNE-1.

Vision Mission and PEOs of Departments

Vision of Department

To be well known for imparting quality education in the field of AI & DS.

Mission of Department

1. To Foster an environment to provide intelligent solutions applicable for multidisciplinary needs of industry & society.
2. To promote career development with ethical responsibility.

Program Educational Objectives (PEOs)

PEO1: Graduates will be able to analyze, formulate and function efficiently in a multi-disciplinary context to address industrial problems.

PEO2: Graduates will be able to work collaboratively with professionalism and ethical responsibilities to provide innovative industry solutions.

PEO3: Graduates will excel in their careers by adapting to new technologies.

Program Outcomes (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. **[Engineering knowledge]**
2. Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. **[Problem analysis]**
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. **[Design/development of solutions]**
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. **[Conduct investigations of complex problems]**
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. **[Modern tool usage]**
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. **[The engineer and society]**
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. **[Environment and sustainability]**
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. **[Ethics]**
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. **[Individual and team work]**
10. Communicate effectively on complex engineering activities with the engi...

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

instructions. **[Communication]**

11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. **[Project management and finance]**

12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. **[Life-long learning]**

Program Specific Outcomes (PSOs)

PSO1 Problem Solving and Programming Skills: Graduates will be able to apply programming skill to identify, modify and test algorithms that apply intelligence to make realistic decisions in problem solving.

PSO2 Professional Skills: Graduates will be able to collect, analyze, interpret and visualize data to solve problems in agriculture, automation, finance and medical domains.

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE
& DATA SCIENCES
AISSMS IOIT (AUTONOMOUS),
PUNE-1.

Program- Artificial Intelligence and Data Science
(Autonomous Curriculum Structure)

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical (Lab)/week	1 credit

B. Range of credits –

A range of credits from 160 to 176 for a student to be eligible to get Undergraduate degree in Engineering. A student will be eligible to get Undergraduate degree with Honors 20 credits and/or Minors 14 credits, if he/she completes additional credits.

C. Credit for Undergraduate Degree in Artificial Intelligence and Data Science

Sr. No.	Year	Semester	Credits
1	First Year	I	19
2		II	21
3	Second Year	III	22
4		IV	24
5	Third Year	V	23
6		VI	25
7	Final Year	VII	12
8		VIII	14
Total Credits			**160**

D. Structure of Undergraduate Engineering program

Sr. no.	Domains	Code	Credits	NEP Suggested
1	Basic Science courses	BSC	**19**	14-18
2	Engineering Science courses	ESC	**16**	12-16
3	Programme Core Courses	PCC	**59**	44-56
4	Programme Elective courses	PEC	**14**	20
5	Open Elective other than particular Programme	OEC	**06**	08
6	Vocational and Skill Enhancement Course	VSE	**08**	08
7	Humanities Social Science and Management	HSM	**12**	14
8	Experiential Learning Courses	ELC	**22**	22
9	Liberal Learning Courses	LLC	**04**	04
Total			**160**	**160-176**

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& DATA SCIENCES
AISSMS IOIT (AUTONOMOUS),
PUNE-1.

E. Domain wise credits Distribution

Sr. no.	Domain Code	Credits									
		Semesters								Total	NEP
		I	II	III	IV	V	VI	VII	VIII		
1	ADBSC	08	08	03	--	--	--	--	--	19	14-18
2	ADESC	09	07	--	--	--	--	--	--	16	16-12
3	ADPCC	--	--	13	16	13	13	04	--	59	44-56
4	ADPEC	--	--	--	--	04	04	06	--	14	20
5	ADOEC	--	--	03	--	03	--	--	--	06	08
6	ADVSE	01	01	--	03	--	03	--	--	08	08
7	ADHSM	--	--	03	03	03	03	--	--	12	14
8	ADELC	03	03	--	--	--	--	02	14	22	22
9	ADLLC	--	--	--	02	--	02	--	--	04	04
Total Credits		21	19	22	24	23	25	12	14	160	160-176
Exam Total		650	650	725	725	725	725	600	600	5400	
Total Working Hours per Week		30	28	26	28	28	31	18	26	215	

F. Honors Structure: Advance in Artificial Intelligence and Data Science

Sr. No.	Courses Name	Offered in semester	Credits
1	DevOps and Agile Software Development	5th	4
2	Continuous Integration and Continuous Delivery	6th	4
3	Application Containerization and Orchestration	7th	5
4	System Provisioning and Configuration Management	8th	5
Total			18

G. B. Tech (Honors with Research)

Sr No	Code	Courses Name	Hours per week			Credit	Examination Scheme					Total
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	
1	ADHDR708	Research Methodology	3	-	-	3	40#	60*	-	-	-	100
2	ADHDR709	Mathematical Modeling	3	-	-	3	40#	60*	-	-	-	100
3	ADHDR710	Dissertation Phase I	-	-	4	2	-	-	25		25	50
4	ADHDR804	Research Publication and Ethics	2	-	-	2	20#	30#	-	-	-	50
5	ADHDR805	Paper Publication	-	-	4	2	-	-	50	-	-	50
6	ADHDR806	Dissertation Phase II	-	-	12	6	-	-	100	-	50	150
Total			08	-	20	18	100	150	175	-	75	500

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

H. BSC/ESC Courses

Sr. No.	Course Code	Course Name	Sem	Hours per week			Credits	Examination scheme					Total
				Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	
1	ADBSC302	Discrete Mathematics and Statistics	III	03	--	--	03	40#	60*	--	--	--	100
Total				03	--	--	03	40#	60*	--	--	--	03

I. Major Courses

Sr. No.	Course Code	Course Name	Sem	Hours per week			Credits	Examination scheme					Total
				Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	
1	ADPCC303	Software Engineering	III	3	--	--	3	40#	60*	--	--	--	100
2	ADPCC304	Data Structure	III	3	--	--	3	40#	60**	--	--	--	100
3	ADPCC305	Object Oriented Programing	III	3	--	--	3	40#	60*	--	--	--	100
4	ADPCC307	Object Oriented Programming Laboratory	III	--	--	4	2	--	--	25	50	--	75
5	ADPCC308	Data Structure Laboratory	III	--	--	4	2	--	--	25	50	--	75
6	ADPCC402	Artificial Intelligence	IV	3	--	--	3	40#	60*	--	--	--	100
7	ADPCC403	Database Management Systems	IV	3	--	--	3	40#	60*	--	--	--	100
8	ADPCC404	Exploratory Data Analysis	IV	3	--	--	3	40#	60**	--	--	--	100
9	ADPCC405	Operating Systems	IV	3	--	--	3	40#	60*	--	--	--	100
10	ADPCC407	Database Management Systems Laboratory	IV	--	--	4	2	--	--	25	50	---	75
11	ADPCC408	Artificial Intelligence and Data Analysis Laboratory	IV	--	--	4	2	--	--	25	50	--	75
12	ADPCC502	Computer Network	V	3	--	--	3	40#	60*	--	--	--	100
13	ADPCC503	Machine Learning	V	3	--	--	3	40#	60*	--	--	--	100
14	ADPCC504	Web Technology	V	3	--	2	4	40#	60**	--	--	--	100
15	ADPEC505	Elective-I	V	3	--	--	3	40#	60*	--	--	--	100
16	ADPCC507	Machine Learning Laboratory	V	--	--	4	2	--	--	25	25	---	50
17	ADPCC508	Computer Network Laboratory	V	--	--	2	1	--	--	25	25	--	50
18	ADPEC509	EL-I Laboratory	V	--	--	2	1	--	--	25	25	--	50
19	ADPCC602	Deep learning	VI	3	--	--	3	40#	60*	--	--	--	100
20	ADPCC603	Cloud Computing	VI	3	--	--	3	40#	60*	--	--	--	100
21	ADPCC604	ML Ops	VI	3	--	2	4	40#	60**	--	--	--	100
22	ADPEC605	Elective-II	VI	3	--	--	3	40#	60*	--	--	--	100

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

		Laboratory											
25	ADPEC609	EL-II Laboratory	VI	--	--	2	1	--	--	--	25	--	25
26	ADPCC701	Soft Computing	VII	3	--	--	3	40#	60*	--	--	--	100
27	ADPEC702	Elective III	VII	2	--	--	2	40#	60*	--	--	--	100
28	ADPEC703	Elective IV	VII	2	--	--	2	40#	60*	--	--	--	100
29	ADPCC704	Soft Computing Laboratory	VII	--	--	2	1	--	--	25	25	--	50
30	ADPEC705	EL-III Laboratory	VII	--	--	2	1	--	--	25	25	--	50
31	ADPEC706	EL-IV Laboratory	VII	--	--	2	1	--	--	25	25	--	50
32	ADELC707	Project stage – I	VII	--	--	4	2	--	--	50	--	100	150
33	ADELC801	Internship/ 2 MOOCs	VIII	2	--	8	12	--	--	200@	--	100	300
34	ADELC802	Project Stage – II	VIII	--	--	12	2	--	--	200	--	100	300
Total				57	1	66	89	720	1080	750	450	300	3300

J. Minor Courses: Artificial Intelligence and Data Science

Sr. No.	Course Code	Course Name	Semester	Hours per week			Credits	Examination scheme					
				Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADMNR301	Python Programming for Data Science	III	3	--	--	3	--	75*	--	--	--	75
2	ADMNR302	Python Programming for Data Science Laboratory	III	-	--	2	1	---	--	25	--	--	25
3	ADMNR401	Artificial Intelligence	IV	3	--	--	3	--	75*	--	--	--	75
4	ADMNR402	Artificial Intelligence Laboratory	IV	-	--	2	1	---	--	25	--	--	25
5	ADMNR501	Machine Learning	IV	3	--	--	3	--	75*	--	--	--	75
6	ADMNR502	Machine Learning Laboratory	IV	-	--	2	1	---	--	25	--	--	25
7	ADMNR601	Deep Learning	VI	3	--	--	3	--	75*	--	--	--	75
8	ADMNR602	Deep Learning Laboratory	VI	-	--	2	1	---	--	25	--	--	25
Total				12	--	08	16	---	300	100	--	--	400

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

K. Open Elective Courses

Sr. No.	Course Code	Course Name	Sem	Hours per week			Credits	Examination scheme					
				Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADOEC306	Digital Forensics	III	3	--	--	3	40$	60$$	---	--	--	100
2	ADOEC506	User Interface and User Experience	V	3	--	--	3	40$	60$$	---	--	--	100
Total				6	--	--	6	80	120	---	--	---	200

L. Vocational and Skill Enhancement Courses

Sr. No.	Course Code	Course Name	Sem	Hours per week			Credits	Examination scheme					
				Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADVSE406	Data Analytics with Python	IV	1	--	4	3	--	--	50	50	--	100
2	ADVSE606	Applied Accelerated Artificial Intelligence	VI	1	--	4	3	--	--	50	50	--	100
Total				02	--	08	6	--	--	100	100	--	200

M. Humanities Social Science and Management Courses

Sr. No.	Course Code	Course Name	Sem	Hours per week			Credits	Examination scheme					
				Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADHSM301	Democracy Election & Constitution	III	2	--	--	2	--	--	50	--	--	50
2	ADHSM309	Audit course - Vedic Mathematics	III	1	--	--	1	--	--	25	--	--	25
3	ADHSM401	Project Management	IV	2	--	--	2	--		25	--	25	50
4	ADHSM409	Audit course Sustainable Development goals	IV	1	--	--	1	--	--	25	--	--	25
5	ADHSM501	Intellectual Property Rights	V	2	--	--	2	--	--	25	--	25	50
6	ADHSM510	Audit Course Foreign Language Level-I (German/ Japanese)	V	1	--	--	1	--	--	25	--	--	25
7	ADHSM601	Seminar and Technical Paper Writing	VI	1	--	2	2	--	--	50	--	---	50
8	ADHSM6010	Audit Course Foreign Language Level-II (German/ Japanese)	VI	1	--	--	1	--	--	25	--	--	25

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

N. Experiential Learning Courses

Sr. No.	Course Code	Course Name	Sem	Hours per week			Credits	Examination scheme					
				Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADELC707	Project stage – I	VII	--	--	4	2	--	--	50	--	100	150
2	ADELC801	Internship/ 2 MOOCs	VIII	2	--	20	12	--	--	200@	--	100	300
3	ADELC802	Project Stage-II	VIII	--	--	4	2	--	--	200	--	100	300
Total				2	---	28	16	--	--	450	--	300	750

O. Liberal Learning Courses

Sr. No.	Course Code	Course Name	Sem	Hours per week			Credits	Examination scheme					
				Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADLLC410	Lifelong Learning Skills-1	IV	--	--	--	1	--	--	--	--	--	--
2	ADLLC411	Lifelong Learning Skills-2	IV	--	--	--	1	--	--	--	--	--	--
3	ADLLC611	Lifelong Learning Skills-3	VI	--	--	--	1	--	--	--	--	--	--
4	ADLLC612	Lifelong Learning Skills-4	VI	--	--	--	1	--	--	--	--	--	--
Total				--	--	--	4	--	--	--	--	--	--

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BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

All the students are required to acquire 2 credits, one each from A. and B. which will have grades as below:

i. **Extracurricular Activities:**

Sr. No.	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Sports	Inter collegiate	Participation	P	Prize winner	C
		University	Participation	C	Prize winner	B
		Zonal	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O
2.	NSS/NCC	Camp	Attended	B		
		Camp + 5 Activities	Attended	B+		
		Camp + 10 Activities	Attended	A		
		Camp + 15 Activities	Attended	A+		
		Camp + 20 Activities	Attended	O		
3.	Cultural	Inter collegiate	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O
4.	Community Engagement	Certified by NGO/Authorities with report and geo-tagged photograph	1 Activity	B		
			2 Activities	B+		
			3 Activities	A		
			4 Activities	A+		
			5 Activities	O		

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

ii. **Co-curricular Activities:**

Sr. No	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Conference	National	Participation	B	Prize winner	A
		International	Participation	B+	Prize winner	A+
		International (Scopus indexing)	Participation	A+	Prize winner	O
2.	Journal Publication	Non-refereed but recognized and reputed journal/ periodical, having ISSN number.		B		
		Refereed Journal - As listed by UGC		A		
		Refereed Journals- As listed by Scopus		A+		
		Refereed Journals - As listed by SCI/ SCIE		O		
3.	Hackathon		Participation	A+	Prize winner	O
4.	Professional Body	National	Membership	P	3rd Prize	A
			Activities/participation	B	2nd Prize	A+
			5 participations	B+	1st Prize	O
5.	Internship	1 week	Completed	C		
		2 week	Completed	B		
		3 week	Completed	B+	Sponsored Project	A+
		4 week	Completed	A	Job through internship	O
6.	Entrepreneurship	Awareness camp	Attended	A	Product Developed	A+
					Own Startup	O
7.	Project/Technical events	Inter collegiate	Participation	P	Prize winner	C
		University	Participation	C	Prize winner	B
		Zonal	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O

Any activity other than listed above but having equal weight age should be considered for getting additional credit.

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS)
PUNE-1.

P. Exit Courses

Exit Course after First Year : One Year UG Certificate in Artificial Intelligence												
Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADEX101	Artificial Intelligence and Data Analysis Laboratory	--	--	4	2	--	--	50	--	--	50
2	ADEX102	Data Structure Laboratory	--	--	4	2	--	--	50	--	--	50
3	ADEX103	Internship	-	--	8	4	--	--	100	--	--	100
Total			-	--	16	8	-	-	200	--	--	200

Exit Course after Second Year : Two Years UG Diploma in Deep Learning												
Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADEX201	Machine Learning Laboratory	--	--	4	2	--	--	50	--	--	50
2	ADEX202	Deep Learning Laboratory	--	--	4	2	--	--	50	--	--	50
3	ADEX203	Internship	-	--	8	4	--	--	100	--	--	100
Total			-	--	16	8	-	-	200	--	--	200

Exit Course after Third Year : Three Years Bachelor's Degree in Vocation (B. Voc.) or B. Sc. in Artificial Intelligence												
Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADEX301	Soft Computing Laboratory	--	--	4	2	--	--	50	--	--	50
2	ADEX302	Project stage – I	--	--	4	2	--	--	50	--	--	50
3	ADEX303	Internship	-	--	8	4	--	--	100	--	--	100
Total			-	--	16	8	-	-	200	--	--	200

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

Artificial Intelligence and Data Science - Second Year (Semester –III)

Sr. No.	Course Code	Course Name	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADHSM301	Democracy, Election and Governance	2	--	--	2	--	--	50	--	---	50
2	ADBSC302	Discrete Mathematics and Statistics	3	--	--	3	40#	60*	---	--	--	100
3	ADPCC303	Software Engineering	3	--	--	3	40#	60*	--	--	--	100
4	ADPCC304	Data Structure	3	--	--	3	40#	60**	--	--	--	100
5	ADPCC305	Object Oriented Programing	3	--	--	3	40#	60*	--	--	--	100
6	ADOEC306	Digital Forensics	3	--	--	3	40$	60$$	---	--	--	100
7	ADPCC307	Object Oriented Programming Laboratory	--	--	4	2	--	--	25	50	--	75
8	ADPCC308	Data Structure Laboratory	--	--	4	2	--	--	25	50	--	75
9	ADHSM309	Audit course - Vedic Mathematics	1	--	--	1	--	--	25	--	--	25
Total			18	--	08	22	200	300	125	100	--	725

* **End Semester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation** based on Presentation/Group Discussion/Laboratory Work/Course Project/Home Assignment/Comprehensive Viva Voce/Blog Writing/Case Study/Survey/Multiple-Choice Question (MCQ) examination.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

$$ **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.

MOOC: Digital Forensics: https://onlinecourses.swayam2.ac.in/nou23_cs11/preview

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

Artificial Intelligence and Data Science - Second Year (Semester –IV)

Sr. No.	Course Code	Course Name	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADHSM401	Project Management	2	--	--	2	--		25	--	25	50
2	ADPCC402	Artificial Intelligence	3	--	--	3	40#	60*	--	--	--	100
3	ADPCC403	Database Management Systems	3	--	--	3	40#	60*	--	--	--	100
4	ADPCC404	Exploratory Data Analysis	3	--	--	3	40#	60**	--	--	--	100
5	ADPCC405	Operating Systems	3	--	--	3	40#	60*	--	--	--	100
6	ADVSE406	Data Analytics with Python	1	--	4	3	--	--	50	50	--	100
7	ADPCC407	Database Management Systems Laboratory	--	--	4	2	--	--	25	50	---	75
8	ADPCC408	Artificial Intelligence and Data Analysis Laboratory	--	--	4	2	--	--	25	50	--	75
9	ADHSM409	Audit course Sustainable Development goals	1	--	--	1	--	--	25	--	--	25
10	ADLLC410	Lifelong Learning Skills-1	--	--	--	1	--	--	--	--	--	--
11	ADLLC411	Lifelong Learning Skills-2	--	--	--	1	--	--	--	--	--	--
Total			16	--	12	24	160	240	150	150	25	725

* **End Semester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation** based on Presentation/Group Discussion/Laboratory Work/Course Project/Home Assignment/Comprehensive Viva Voce/Blog Writing/Case Study/Survey/Multiple-Choice Question (MCQ) examination.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

MOOC: Data Analytics with Python:

Data Analytics with Python - Course (nptel.ac.in)

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Artificial Intelligence and Data Science - Third Year (Semester –V)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADHSM501	Intellectual Property Rights	2	--	--	2	--	--	25	--	25	50
2	ADPCC502	Computer Networks	3	--	--	3	40#	60*	--	--	--	100
3	ADPCC503	Machine Learning	3	--	--	3	40#	60*	--	--	--	100
4	ADPCC504	Web Technology	3	--	2	4	40#	60**	--	--	--	100
5	ADPEC505	Elective-I	3	--	--	3	40#	60*	--	--	--	100
6	ADOEC506	User Interface and User Experience	3	--	--	3	40$	60$$	---	--	--	100
7	ADPCC507	Machine Learning Laboratory	--	--	4	2	--	--	25	25	---	50
8	ADPCC508	Computer Network Laboratory	--	--	2	1	--	--	25	25	--	50
9	ADPEC509	EL-I Laboratory	--	--	2	1	--	--	25	25	--	50
10	ADHSM510	Audit Course Foreign Language Level-I (German/ Japanese)	1	--	--	1	--	--	25	--	--	25
Total			18	0	10	23	200	300	125	75	25	725

* **End Semester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation** based on Presentation/Group Discussion/Laboratory Work/Course Project/Home Assignment/Comprehensive Viva Voce/Blog Writing/Case Study/Survey/Multiple-Choice Question (MCQ) examination.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

Elective-I

1. Design and Analysis of Algorithm
2. Data Analytics using Power BI and Tableau
3. Application Programming Interface

MOOC: User Interface and User Experience

https://www.coursera.org/specializations/ui-ux-design

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AISSMS IOIT (AUTONOMOUS), PUNE-1.

Artificial Intelligence and Data Science - Third Year (Semester –VI)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADHSM601	Seminar and Technical Paper Writing	1	--	2	2	--	--	50	--	---	50
2	ADPCC602	Deep learning	3	--	--	3	40#	60*	--	--	--	100
3	ADPCC603	Cloud Computing	3	--	--	3	40#	60*	--	--	--	100
4	ADPCC604	ML Ops	3	--	2	4	40#	60**	--	--	--	100
5	ADPEC605	Elective-II	3	--	--	3	40#	60*	--	--	--	100
6	ADVSE606	Applied Accelerated Artificial Intelligence	1	--	4	3	--	--	50	50	--	100
7	ADPCC607	Deep Learning Laboratory	--	--	2	1	--	--	25	25	---	50
8	ADPCC608	ML Ops Laboratory	--	--	4	2	--	--	25	50	--	75
9	ADPEC609	EL-II Laboratory	--	--	2	1	--	--	--	25	--	25
10	ADHSM6010	Audit Course Foreign Language Level-II (German/ Japanese)	1	--	--	1	--	--	25	--	--	25
11	ADLLC611	Lifelong Learning Skills-3	--	--	--	1	--	--	--	--	--	--
12	ADLLC612	Lifelong Learning Skills-4	--	--	--	1	--	--	--	--	--	--
Total			15	0	16	25	160	240	175	150	--	725
13	ADMC6012	Audit course-4	Entrepreneurship Development Program(Lecture of one hour per week)									

* **End Semester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation** based on Presentation/Group Discussion/Laboratory Work/Course Project/Home Assignment/Comprehensive Viva Voce/Blog Writing/Case Study/Survey/Multiple-Choice Question (MCQ) examination.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

$$ **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.

Elective-II

1. Natural Language Processing
2. High Performance Computing
3. Distributed Systems

MOOC: Applied Accelerated Artificial Intelligence:
Applied Accelerated Artificial Intelligence - Course (nptel.ac.in)

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AISSMS IOIT (AUTONOMOUS), PUNE-1.

Artificial Intelligence and Data Science - Final Year (Semester –VII)

Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADPCC701	Soft Computing	3	--	--	3	40#	60*	--	--	--	100
2	ADPEC702	Elective III	2	--	--	2	40#	60*	--	--	--	100
3	ADPEC703	Elective IV	2	--	--	2	40#	60*	--	--	--	100
4	ADPCC704	Soft Computing Laboratory	--	--	2	1	--	--	25	25	--	50
5	ADPEC705	EL-III Laboratory	--	--	2	1	--	--	25	25	--	50
6	ADPEC706	EL-IV Laboratory	--	--	2	1	--	--	25	25	--	50
7	ADELC707	Project stage – I	--	--	4	2	--	--	50	--	100	150
Total			8	0	10	12	120	180	125	75	100	600

* **End Semester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation** based on Presentation/Group Discussion/Laboratory Work/Course Project/Home Assignment/Comprehensive Viva Voce/Blog Writing/Case Study/Survey/Multiple-Choice Question (MCQ) examination.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

$$ **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.

Elective-III
1. Advance Imaging System
2. Cyber security
3. Edge Artificial Intelligence Computing

Elective-IV
1. Software Testing & Quality Assurance
2. Human Computer Interaction
3. Artificial Intelligence Internet of Things (AI-IoT)

MOOC: Principle of Optimization: https://nptel.ac.in/courses/112105235

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AISSMS IOIT (AUTONOMOUS), PUNE-1.

No.			Lecture	Tutorial	Practical		ISE	ESE	TW	PR	OR	Total
1	ADELC801	Internship/ 2 MOOCs/ Entrepreneurship/ Foreign University Certificate Course	2	--	20	12	--	--	200@	--	100	300
2	ADELC802	Project Stage-II	--	--	4	2	--	--	200	--	100	300
Total			6	0	24	14	--	--	400	0	200	600

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

$$ Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.

@ Marks obtained in two MOOCs will be converted on the scale of 200 marks.

Intelligent Process Automation	https://www.udemy.com/course/beginners-guide-to-cognitive-automation-anywhere/

Under ADPROJ802 Massive Open Online Courses (not less than 8 week) listed below:

Data Science: Productivity Tools	https://www.edx.org/course/data-science-productivity-tools?hs_analytics_source=referrals&utm_source=mooc.org&utm_medium=referral&utm_campaign=mooc.org-course-list
Principles, Statistical and Computational Tools for Reproducible Data Science	https://www.edx.org/course/principles-statistical-and-computational-tools-for?hs_analytics_source=referrals&utm_source=mooc.org&utm_medium=referral&utm_campaign=mooc.org-course-list
Emotional Intelligence	https://onlinecourses.nptel.ac.in/noc22_hs11/preview

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BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

Second Year Artificial Intelligence & Data Science (2022 Course) Democracy, Election and Governance			
Course Code	ADHSM301	**Credit**	02
Contact Hours	02 Hrs/weeks((L)	**Type of Course**	Lecture/Tutorial
Examination Scheme	TW: 25 marks OR: 25 marks	**Total Marks**	50

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term-work	Internal	25
2.	Oral	Internal	25

Course Objectives	
1	To introduce the students meaning of democracy and the role of the governance.
2	To help the understand the various approaches to the study of democracy and governance

Course Outcomes : Students will be able to	
301.1	Know the meaning of democracy and the role of the governance in life.
301.2	Understand the various approaches to the democracy and governance

Topics covered:

UNIT-I: DEMOCRACY-FOUNDATIONANDDIMENSIONS (5 hrs.)

a. Constitution of India
b. Evolution of Democracy-Different Models
c. Dimensions of Democracy-Social, Economic, and Political

UNIT-II: DECENTRALIZATION (5 hrs.)

a. Indian tradition of decentralization
b. History of panchayat Raj institution in the lost independence period
c. 73rdand74thamendments
d. Challenges of caste, gender, class, democracy and ethnicity

UNIT-III: GOVERNANCE (5 hrs.)

a. Meaning and concepts
b. Government and governance
c. Inclusion and exclusion

Text books

1. Banerjee- Dube, I. (2014). A history of modern India. Cambridge University Press.
2. Basu, D. D. (1982). Introduction to the Constitution of India. Prentice Hall of India.
3. Bhargava, R. (2008). Political theory: An introduction. Pearson Education India.
4. Bhargava,R.,Vanaik,A.(2010)UnderstandingContemporaryIndia:CriticalPerspective. New Delhi: Orient Blackswan.
5. Chandhoke.N.,Proyadardhi.P,(ed)(2009),'ContemporaryIndia:Economy,Society,Politics', Pearson India Education Services Pvt. Ltd, ISBN 978-81- 317-1929-9.

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AISSMS IOIT (AUTONOMOUS), PUNE-1.

6. Chandra, B. (1999). Essays on contemporary India. Har-Anand Publications.
7. Chaterjee, P. (1997). State and Politics in India.
8. Dasgupta.S.,(ed)(2011),'PoliticalSociology',DorlingKindersley(India)Pvt.Ltd .,Licens ees of Pearson Education in south Asia. ISBN: 978-317-6027- 7.
9. Deshpande,S.(2003).ContemporaryIndia:ASociologicalView,NewDelhi:Viki ngPublic ation.
10. Guha,R.(2007).India After Gandhi: The History of the

World's Largest.Democracy, HarperCollins Publishers, New York.
11. Guha, R. (2013). Gandhi before India. Penguin UK.
12. Jayal. N.G. (2001). Democracy in India. New Delhi: Oxford University Press.
13. Kohli,A.(1990).Democracyanddiscontent:India'sgrowingcrisisofgovernability .Cambri dge University Press.
14. Kohli,A.,Breman,J.,&Hawthorn,G.P.(Eds.).(2001).ThesuccessofIndia'sde mocracy (Vol. 6). Cambridge University Press.
15. Kothari,R.(1989).Stateagainstdemocracy:Insearchofhumanegovernance.ApexPr.
16. Kothari, R. (1970). Politics in India. New Delhi: Orient Blackswan.
17. Kothari, R. (1995). Caste in Indian politics. Orient Blackswan.
18. Sarkar,S.(2001).Indiandemocracy:thehistoricalinheritance.theSuccessofIndia' sDemoc racy, 23-46.

मराठी संदर्भ ग्रंथ:

१. राही श्रुती गणेश., आवटे श्रीरंजन, (२०१९), *'आपलं आयकार्ड'*, सुहास पळशीकर द युनिक अॅकॅडमी पब्लिकेशनप्रा.लि.,.

२. व्होरा राजेंद्र., पळशीकर, सुहास.(२०१४). *भारतीय लोकशाही अर्थ आणि व्यवहार.* पुणे : डायमंड प्रकाशन.

३. सुमंत, यशवंत.(२०१८). *प्रा. यशवंत सुमंत यांची तीन भाषणे.* पुणे : युनिक अॅकॅडमी पब्लिकेशन्स प्रा.लि

४. भोळे. भा.ल. (२०१५). *भारतीय गणराज्याचे शासन आणि राजकारण.* नागपूर: पिंपळापुरे बुक प्रकाशन

५. कसबे. रावसाहेब. (२०१०)डॉ. आंबेडकर आणि भारतीय राज्यघटना. पुणे: सुगावा प्रकाशन

Note: The assessment for the subject shall be based on presentation and reportsubmission.

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AISSMS IOIT (AUTONOMOUS), PUNE-1.

Second Year Artificial Intelligence & Data Science (2023 Course) Discrete Mathematics and Statistics			
Course Code:	ADBSC302	**Credit:**	03
Contact Hours:	03 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Basic Knowledge of Mathematics.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In Semester Evaluation	Internal	40#
2.	End Semester Evaluation	Internal	60*

Course Objectives	
1	To build knowledge of relations and functions.
2	To introduce the basic concepts of probability and random variables
3	To categorize types of probability distribution.
4	To learn statistical methods in various engineering applications.
5	To illustrate the knowledge of testing of hypothesis for small and large samples.
6	To explain the correlation.

Course Outcomes : Students will be able to	
302.1	Identify relations and operations on functions.
302.2	Understand the fundamentals of probability and random variables.
302.3	Analyze the behavior of various discrete and continuous probability distributions.
302.4	Implement sampling distribution.
302.5	Apply the concept of testing of hypothesis for small and large samples in real life problems.
302.6	Classify correlation.

Topics covered:

UNIT-I: RELATIONS & FUNCTIONS (7 Hrs)

Product Sets and Partitions, Relations, Properties of Relations, Equivalence Relations, Binary Relations, Operations on Relations, Representation of Relations, Closure of Relations and Warshalls Algorithm, Introduction of Function, Classification of Functions, Operation on Functions, Composite Functions, Inverse Function.

UNIT-II: PROBABILITY & RANDOM VARIABLES (7 Hrs)

Sample Space, Events, The Concept of Probability, The Axioms of Probability, Conditional Probability, Theorems on Conditional Probability, Independent Events, Bayes' Theorem, Random Variables, Discrete Random Variables, Continuous Random Variables, Joint Probability Distributions, Independent Random Variables, Distribution Function for Random Variable, Distribution Function for Discrete and Continuous Random Variable, Probability Density Functions, Cumulative Distribution Functions and Expected Values.

UNIT- III: PROBABILITY DISTRIBUTION (7 Hrs)

The Binomial Probability Distribution, Properties of Binomial Probability Distribution, Hypergeometric and Negative Binomial Distributions, The Poisson Probability Distribution, Normal Distribution, Properties of Normal Distribution, Continuous Uniform

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BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

Distribution, Applications of Normal Distribution, Gamma and Exponential Distributions, Chi-Squared Distribution, Beta Distribution, Lognormal Distribution.
UNIT- IV: SAMPLING AND ESTIMATION THEORY (8 Hrs) Population and Sample, Statistical Inference, Sampling with and without Replacement, Random Samples, Population Parameters, Sample Statistics, Sampling Distributions, Sample Mean, Sampling Distribution of Means, Sample Variances, Sampling Distribution of Variances, Unbiased Estimates and Efficient Estimates, Point Estimate and Interval Estimates, Confidence Interval Estimates of Population Parameters, Confidence Intervals for Variance of a Normal Distribution, Maximum Likelihood Estimates.
UNIT- V: TESTS OF HYPOTHESIS AND SIGNIFICANCE (7 Hrs) Statistical Hypothesis, Null and Alternate Hypothesis, Test of Hypothesis and Significance, Type I and Type II Errors, Level of Significance, Tests Involving the Normal Distribution, One-Tailed and Two-Tailed Tests, P Value. Special Tests of Significance for Large Samples and Small Samples (F, chi- square, z, t- test).
UNIT- VI: CORRELATION (6 Hrs) Correlation, The Linear Correlation Coefficient, Generalized Correlation Coefficient, Rank Correlation, Probability Interpretation of Correlation, Sampling Theory of Correlation, Correlation and Dependence.
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.) **Unit I:** Relations, Generating Functions. **Unit II:** Axiomatic Definition of Probability, Properties of Probability Function, Conditional Probability, Bayes' Theorem, Independence of Events; **Unit III:** Random Variables and their Distributions, Distribution Function, Probability Mass Function, Probability Density Function and their Properties, Distribution of Functions of a Random Variable, Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric, Discrete Uniform, Poisson, Continuous Uniform, Exponential, Gamma, Beta, Sampling Distributions: Central, Chi-Square, Central T, And Central F Distributions

Text Books:

1. "Discrete mathematical structures", B Kolman RC Busby, S Ross PHI Pvt. Ltd
2. "Probability and Statistics", Murray R. Spiegel, John Schiller and R. Alu Srinivasan, Tata McGraw-Hill Edition.
3. "Probability and Statistics for Engineering and the Sciences", Jay Devore, Eighth Edition

Reference Books:

1. "Discrete structures", Liu, Tata McGraw -Hill.
2. "Discrete Mathematical structures", Y N Singh, Wiley- India
3. "Introduction to Probability and Statistics for Engineers and Scientists", Sheldon M. Ross, Academic Press.
4. "Probability and Statistics for Engineers and Scientists", Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Ninth Edition
5. "Applied Statistics and Probability for Engineers", D. C. Montgomery and G.C. Runger, 5th edition, John Wiley & Sons

EBooks:

1. Discrete Mathematics (openmathbooks.org)
2. mth202.pdf (iitk.ac.in)
3. cs103x-notes.pdf (stanford.edu)

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PUNE-1.

MOOC Course:

1. Introduction to Probability and Statistics

   Introduction to Probability and Statistics - Course (nptel.ac.in)

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AISSMS IOIT (AUTONOMOUS),
PUNE-1.

Second Year Artificial Intelligence & Data Science (2023 Course) Software Engineering			
Course Code:	ADPCC303	Credit:	03
Contact Hours:	03 Hrs/weeks((L)	Type of Course:	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	Total Marks:	100

Pre-requisites: Basic knowledge of software.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In Semester Evaluation	Internal	40#
2.	End Semester Evaluation	Internal	60*

Course Objectives	
1	To discuss fundamental of Software Engineering.
2	To get familiar with analyzing Software requirement.
3	To learn Software Engineering Practices
4	To interpret software analysis model.
5	To categorize software design model.
6	To Paraphrase various phases of software testing.

Course Outcomes : Students will be able to	
303.1	Identify key element of software engineering.
303.2	Construct applicable solution using software Engineering approach.
303.3	To paraphrase Software engineering practices.
303.4	Reframe software analysis model.
303.5	Collaborating software design model.
303.6	Prioritize phases of Software development model.

Topics covered:

UNIT I: Introduction to Software Process Models (7hrs)
Introduction to Software Engineering, Software Myths, Software Engineering a Layered Technology, Software Process Framework, Software Process Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Process Model, Agile Development: Agility, SCRUM and KANBAN/Jira, Other Agile process models.

UNIT II: Requirements Analysis (7hrs)
Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management, Negotiation Requirements, Validation Requirement.

UNIT-III: Software Engineering Specification (6hrs)
Software Engineering Practice: Communication Practices, Planning Practices, Modeling Practices, Design Modeling Principles, Construction Practice, Testing Principles Deployment.

UNIT- IV: Software Analysis Model (7hrs)
Building analysis model: Requirement Analysis, Analysis Modeling Approaches, Data

CHAIRMAN
BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

Modeling concepts, Scenario based modeling, Flow oriented modeling, class based modeling, Behavioral Model.
UNIT- V: Software Design (7hrs) **Design process:** Design Concepts, Design Model, Design Heuristic Architectural styles, Architectural Design, Architectural Mapping using Data Flow, **Component level Design:** Designing Class based components, traditional Components. User Interface Design: Interface analysis, Interface Design.
UNIT- VI: Software Testing (7hrs) **Quality Management:** Quality concepts, Software quality assurance, Software quality factors, Statistical software Quality Assurance software Reliability. **Software testing:** fundamentals, White box testing, Black box testing, Validation testing, System testing, Debugging software maintenance maintainability, Maintenance tasks, Test GPT.

Text Books:

1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", McGraw-Hill, ISBN 0-07-337597-7.
2. Ian Sommerville, "Software Engineering", Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Rajib Mall, "Fundamentals of Software Engineering", PHI, ISBN-13:978-8120348981.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.

EBooks:

1. https://www.jobilize.com/web-assets/ebook/foundations-of-software-engineering-by-prof-kevin-amaratunga- mit.pdf
2. https://my.uopeople.edu/pluginfile.php/57436/mod_book/chapter/46513/CS4403.Conger.New. Software.Engineering.Ch01.Ch09.pdf

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AISSMS IOIT (AUTONOMOUS), PUNE-1.

Second Year Artificial Intelligence & Data Science (2023 Course) Data Structure			
Course Code:	ADPCC304	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60**	**Total Marks:**	100

Pre-requisites: Problem Solving and Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	Internal	60**

Course Objectives	
1	To understand the basics of data structures and algorithms.
2	To discover linear data structures – lists, stacks, and queues.
3	To learn different non- linear data structure and their implementation.
4	To identify various searching and sorting methods.
5	To study some advanced data structures such as hash and dictionary.
6	To analyze file management systems.

Course Outcomes : Students will be able to	
304.1	Outline concepts of data structure and algorithm.
304.2	Implement Linear data structures.
304.3	Understand non- linear data structure and principle.
304.4	Identify the various searching and sorting algorithms.
304.5	Analyze hash tables and dictionaries.
304.6	Apply various data structures in file organization.

Topics covered:

UNIT-I: DATA STRUCTURES AND ALGORITHM (7 hrs)

Basics of Data Structures, Data Structures Classification, Abstract Data Types (ADT), Operations on Array merging of two arrays, storage representation and their address calculation. Concept of algorithm, Algorithm design tools Pseudo-code and flowchart. Complexity of algorithm Space and Time complexity, Asymptotic notations Big-O, Theta and Omega.

UNIT-II: LINEAR DATA STRUCTURE (8 hrs)

Linked List: Concept, Types, Design, Operations, Implementation, complexity, and Application.

Stack: Concept, Design, Operations, Implementation, complexity, and Application.

Queue: Concept, Types, Design, Operations, Implementation, complexity, and Application.

Recursion: Concept, Variants of Recursion-Direct, Indirect, Tail and Tree, Use Of Stack in Backtracking.

UNIT-III :SEARCHING AND SORTING METHODS (7 hrs)

Searching: Sequential Search, Binary Search

Sorting: Insertion sort, Bubble Sort, Merge sort, Quick sort and Heap sort, Shell sort, sort

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BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

order, Radix sort, Index passes.

UNIT- IV: NON LINEAR DATA STRUCTURE (8 hrs)

Graph: Basic concepts, storage representation, Adjacency matrix, adjacency list. Traversals: Prims and Kruskal algorithms, Dikjstra's single source shortest path. Tree: Basic concepts, Representations, Traversals, Binary tree, Binary search tree, B+ Trees, Threaded Binary search tree- concepts, threading, insertion and deletion of nodes, AVL Trees.

UNIT-V:DICTIONARIES AND HASHING (6Hrs)

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hash: Hash Table, Hash Function, Collision Resolution Techniques in Hashing-Chaining, Open Addressing-Linear, Quadratic Probing and Double Hashing. Hash table overflow-open addressing and chaining.

UNIT- VI: FILE ORGANIZATION (6 hrs)

Files: concept, need, primitive operations. Sequential file organization- concept and primitive operations, Direct Access File: Concepts and Primitive operations, Indexed sequential file organization-concept, types of indices, structure of index sequential file.

Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)

Recursion, Arrays, stacks, queues, linked lists, binary heaps, graphs.

Unit1: Asymptotic worst case time and space complexity, Algorithm design techniques: greedy, dynamic programming, and divide-and-conquer.

Unit 2: Recursion. Arrays, stacks, queues, linked lists.

Unit 3: Searching, sorting.

Unit 4: Trees, binary search trees, shortest paths.

Unit 5: Hashing.

Text Books:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy" 5th edition, Careermonk Publications, ISBN-13 : 978-8193245279.
2. Robert Sedgewick and Kevin Wayne, "Algorithms" Addison-Wesley Professional; 4th edition (March 24, 2011), ISBN-13: 978-0321573513.
3. Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786.
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley Publication, ISBN: 978-1-118-29027-9.

Reference Books:

1. Adam Drozdek, "Data Structures and Algorithms in C++", Course Technology Ptr; 4th edition (27 August 2012), ISBN-13 : 978-1133608424
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein "Introduction to Algorithms", MIT Press, 1990 (first edition), ISBN: 978-0-262-04630-5.

EBooks:

1. https://www.cse.iitb.ac.in/~ranade/cs213/
2. Data Structures and Algorithms (iitpkd.ac.in)

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Second Year Artificial Intelligence & Data Science (2023 Course) Object Oriented Programming			
Course Code:	ADPCC305	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Problem Solving and Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	Internal	60*

Course Objectives	
1	To learn the object-oriented programming paradigm & fundamentals of object-oriented design.
2	To categories Class &object.
3	To illustrate Inheritance and Pointers
4	To build knowledge to demonstrate Polymorphism
5	To review Files handling & stream
6	To emphasize the importance of Exception Handling and Templates

Course Outcomes : Students will be able to	
305.1	Identify key element of Object oriented Programming.
305.2	Structuring class & object.
305.3	Implement Inheritance and Pointers
305.4	Identify virtual and pure virtual function and complex programming situations.
305.5	Elaborate upon file handling.
305.6	Generate awareness to handle error.

Topics covered:

UNIT-I: Fundamentals of Object Oriented Programming (7hrs)

Introduction to object-oriented programming, Need of object-oriented programming, Fundamentals of object-oriented programming: Namespaces, objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Benefits of OOP, C++ as object oriented programming language.

C++ programming Basics: character Set, Tokens, Keyword, Identifiers variable, Constant Data type, Operators, Expression, Typecasting, Control Structure, Arrays, Function, function prototype, accessing function and utility function String, Structure, Enumerations, Array of String, Array of Structure, Array of Function.

UNIT-II: Class & Object (7hrs)

Class, Object, class and data abstraction, Access specifies, separating interface from implementation.

Objects and Memory requirements, Static members: variable and functions, inline function, friend function, Constructors and destructor, Types of constructor.

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UNIT- III: Inheritance and Pointers (7hrs)

Inheritance- Base Class and derived Class, protected members, relationship between base Class and derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Public and Private Inheritance, Types of Inheritance, Ambiguity in Multiple Inheritance, Virtual Base Class, Abstract class, Friend Class, Nested Class.

Pointers: declaring and initializing pointers, indirection Operators, Memory Management: new and delete, Pointers to Objects, this pointer, Pointers Vs Arrays, accessing Arrays using pointers, Arrays of Pointers, Function pointers, Pointers to Pointers, Pointers to Derived classes, Passing pointers to functions, Return pointers from functions, Null pointer, void pointer.

UNIT- IV: Polymorphism (7hrs)

Polymorphism- Introduction to Polymorphism, Types of Polymorphism, Operator Overloading- concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable.

Function overloading,

Run Time Polymorphism- Pointers to Base class, virtual function and its significance in C++, pure virtual function and virtual table, virtual destructor, abstract base class.

UNIT- V: Files and Streams (7hrs)

Data hierarchy, Stream and files, Stream Classes, Stream Errors, Disk File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output.

UNIT- VI: Exception Handling and Templates (7hrs)

Exception Handling- Fundamentals, other error handling techniques, simple exception handling- Divide by Zero, Multiple catching, re-throwing an exception, exception specifications, user defined exceptions, processing unexpected exceptions, constructor, destructor and exception handling, exception and inheritance.

Templates- The Power of Templates, Function template, overloading Function templates, and class template, class template and Non type parameters, template and friends Generic Functions, The type name and export keywords.

Text Books:

1. E. Balagurusamy, "Object-Oriented Programming with C++", 7th edition, raw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
2. Herbert Schildt, "C++-The complete reference", Eighth Edition, McGraw Hill Professional, 2011, ISBN: 978-00-72226805

Reference Books:

1. Data Structures and Algorithm Analysis in C++ Hardcover, by Mark A. Weiss, Jun 2013, Publisher: PHI; 4 editions, ISBN-10: 013284737X ISBN-13: 978-0132847377.
2. Algorithms in C++: Fundamentals, Data Structures, Sorting, Searching, Parts 1-4, 3rd Edition (Paperback), Pearson India, ISBN-10 8131713059, 2009, ISBN-13 9788131713051.

EBooks:

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1. https://archive.mu.ac.in/myweb_test
2. https://mu.ac.in › uploads › 2021/03

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Second Year Artificial Intelligence & Data Science (2023 Course) Digital Forensics			
Course Code:	ADOEC306	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40$ ESE = 60$$	**Total Marks:**	100

Pre-requisites: Problem Solving and Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40$
2	End Semester Evaluation	Internal	60$$

Course Objectives	
1	To understand digital forensic basics
2	To understand computer investigations
3	To understand windows file system and technologies
4	To learn Linux file system organization.
5	To investigate the data
6	To discover various forensic tools

Course Outcomes : Students will be able to	
306.1	Illustrate the cyber-crime investigation procedures
306.2	Analyze methods of digital investigations
306.3	Apply the cyber-crime techniques to data acquisition and evidence collection
306.4	Analyzing the digital evidences and arriving at conclusions
306.5	Generate legal evidence and supporting investigation reports.

Topics covered:

UNIT-I: INTRODUCTION TO DIGITAL FORENSIC (7 Hrs)

Digital Forensic Concept, Type of digital devices -Computer forensics, Network Forensic and Mobile device forensic, Process of Digital Forensic, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

UNIT-II:UNDERSTANDING COMPUTER INVESTIGATIONS (7 Hrs)

Procedure for corporate High-Tech investigations, understanding data recovery workstation and software, conducting and investigations, Preparing for computer investigations, Understanding law enforcement agency investigations, Following the legal process, Understanding corporate investigations, Establishing company policies

UNIT- III: WINDOWS SYSTEM AND ARTIFACTS (6 Hrs)

Windows Systems and Artifacts: Introduction, Windows File Systems, File Allocation Table, New Technology File System, File System Summary, Registry, Event Logs, Prefetch Files, Shortcut Files, Windows Executable.

UNIT -IV : LINUX SYSTEMS AND ARTIFACTS (8 Hrs)

Linux File Systems: File System Layer, File Name Layer, Metadata Layer, Data Unit Layer, Journal Tools, Deleted Data, Linux Logical Volume Manager, Linux Boot Process and Services, System V, BSD, Linux System Organization and Artifacts, Partitioning, File system Hierarchy, Ownership and Permissions, File Attributes, Hidden Files, User

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Accounts, Home Directories, Shell History GNOME Windows Manager Artifacts, Logs, User Activity Logs, Syslog, Command Line Log Processing, Scheduling Tasks.

UNIT-V : IDENTIFICATION OF DATA (7 Hrs)

Identification of Data: Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices, *Reconstructing Past Events*: becoming a Digital Detective, Useable File Formats, Unusable File Formats, Converting Files, Investigating Network Intrusions and Cyber Crime, Network Forensics and Investigating logs, Investigating network Traffic, Investigating Web attacks ,Router Forensics. Cyber forensics tools and case studies on Cyber forensic tool.

UNIT- VI: ANALYZING EVENTS & FORENSIC TOOLS (6 Hrs)

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case. Evaluating Computer Forensics Tool Needs, Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools, Computer Forensics Software Tools, Command-Line Forensics Tools, UNIX/Linux Forensics Tools, Other GUI Forensics Tools, Computer Forensics Hardware Tools, Tool Comparisons, Forensic Workstations, Case Study on open source Digital forensic tools (SANS SIFT).

Text Books:

1. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 3 nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5
2. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.
3. Nina Godbole and Sunit Belapore; "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publications, 2011.

Reference Books:

1. Cory Altheide and Halan Carvey; "Digital Forensics with Open Source Tools", Syngress Publication.
2. LNJN National Institute of Criminology and Forensic Science, "A Forensic Guide for Crime Investigators – Standard Operating Procedures", LNJNNICFS, 2016.

EBooks:

1. https://onlinecourses.swayam2.ac.in/aic20_sp06/preview
2. https://onlinecourses.swayam2.ac.in/arp19_ap79/preview

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Second Year Artificial Intelligence & Data Science (2023 Course) Object Oriented Programming Laboratory			
Course Code:	ADPCC307	**Credit:**	2
Contact Hours:	4 Hrs/weeks((P)	**Type of Course:**	Practical
Examination Scheme:	TW: 25 PR:50	**Total:**	75

Pre-requisites: Problem Solving and Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	Term Work	Internal	25
2	Practical	External	50

Course Objectives	
1	To learn basics of object oriented programming.
2	To know constructor inheritance & overloading.
3	To review different type of file operation.
4	To illustrate exception handling & template.

Course Outcomes : Students will be able to	
307.1	Identify features of object oriented programming.
307.2	Identify constructor inheritance & overloading.
307.3	Categorize type of file operation.
307.4	Implement exception handling & template.

List of Experiment

	Group A
1	Write a C++ program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
2	Design a program to implement Array of pointers, pointer to functions, pointer to objects.
3	Create a class Student having data member student_name, Student_Roll, Student_Address, Student_banch. Construct default constructor, Parameterized constructor, and Copy Constructor.
4	Write a c++ program to implement Friend function.
	Group B
5	Write a C++ Program on. In a bank, different customer has saving account. Some customers may have taken loan from the bank. So the bank always maintains information about bank depositors and borrower. Customers having data member name, phone_no, depositor having data member account_no, balance and borrower having data member loan_no, alon_amount using multilevel inheritance
6	Program to calculate the total marks of student using the concept of virtual base class.
7	Program to perform the addition and subtraction of two complex numbers using the binary (+) and (-) operator
8	Write a Menu driven program to perform mathematical operation using Function Overloading.

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10	Write a C++ program to implement Pure Virtual Functions.
11	Write a program to handle divide by zero exception.
	Group C
12	Write a program to read the class object of student info such as name, age, gender, height and weight from the keyboard and to store them on a specified file using read() and write( ) functions. Again the same file is opened for reading and displaying the contents of the file on the screen.
13	Develop a program to implement class and function template for stack and queue
14	Design a program to demonstrate the concepts of catching and throwing of an exception.

Text Books:

5. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy" 5th edition, Career monk Publications, ISBN-13 : 978-8193245279.
6. Robert Sedgewick and Kevin Wayne, "Algorithms" Addison-Wesley Professional; 4th edition (March 24, 2011), ISBN-13: 978-0321573513.
7. Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786.
8. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley Publication, ISBN: 978-1-118-29027-9.

Reference Books:

1. Adam Drozdek, "Data Structures and Algorithms in C++", Course Technology Ptr; 4th edition (27 August 2012), ISBN-13 : 978-1133608424
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein "Introduction to Algorithms", MIT Press, 1990 (first edition), ISBN: 978-0-262-04630-5.

EBooks:

3. https://www.cse.iitb.ac.in/~ranade/cs213/
4. Data Structures and Algorithms (iitpkd.ac.in)

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Second Year Artificial Intelligence & Data Science (2023 Course) Data Structures Laboratory			
Course Code:	ADPCC308	**Credit:**	2
Contact Hours:	4 Hrs/weeks((P)	**Type of Course:**	Practical
Examination Scheme:	TW: 25 PR:50	**Total:**	75

Pre-requisites: Problem Solving and Programming

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	25
2	End Semester Evaluation	External	75

Course Objectives	
1	To understand basics of CUDA programming model and its use in data structure.
2	To understand the principles of hashing-based sorting algorithms, including Radix Sort, Dijkstra's Shortest Path using CUDA.
3	To develop an ability to work with programming languages such as CUDA, C++, or Python.
4	To implement and use different data structures such as arrays, linked lists, trees, stacks, queues.
5	To learn to design and implement efficient algorithms and data structures for specific problems and applications.
6	To Develop an ability to implement and use different algorithms such as sorting, searching algorithms.

Course Outcomes : Students will be able to	
308.1	Understand to different programming languages, tools, and environments.
308.2	Understand the basics of parallel computing and GPU architecture.
308.3	Understand the principles of hashing-based sorting algorithms, including Radix Sort, Dijkstra's Shortest Path using CUDA.
308.4	Analyze the performance of GPU-based sorting algorithms and comparing them to their CPU-based counterparts.
308.5	Apply and use different data structures such as arrays, linked lists, trees, stacks, queues for specific problems and applications.
308.6	Analyze algorithms and calculate their time and space complexity.

List of Experiment

Sr. No.	Name of the program
1.	Study of CUDA and CUDA in Data Structure Algorithm.
2.	Study of Hashing-based Sorting Algorithm using CUDA.
3.	Study of Radix Sort Algorithm using CUDA.
4.	Study of Dijkstra's Shortest Path Algorithm using CUDA.
5.	Write a C++ programs to implement list ADT to perform following operations a. Insert an element into a list. b. Delete an element from list c. Search for a key element in list count number of nodes in list

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6.	Write a C++ program that uses functions to perform the following operations onsingly linked list a. Creation b. Insertion. c. Deletion. d. Traversal.
7.	Write Python programs for the following: a. Uses Stack operations to convert infix expression into postfix expression. b. Uses Stack operations for evaluating the postfix expression.
8.	Write a C++ programs to implement recursive and non-recursive a. Linear search b. Binary search
9.	Write Python programs for implementing the following searching techniques. a. Sequential search b. Binary search
10.	Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Bubble sort b. Insertion sort **OR** Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Quick sort b. Merge sort
11.	Write a Python program to perform the following: a. Create a binary search tree. b. Traverse the above binary search tree recursively in pre order, post-orderand in-order. c. Count the number of nodes in the binary search tree.
12.	Write a C++ program to perform the following operations: a. Insert an element into a AVL tree. b. Delete an element from a AVL tree.Search for a key element in an AVL tree.
13.	Write a C++ program to implement all the functions of a dictionary (ADT).
14.	Department maintains a student information. The file contains roll number, name, division and address. Write a C++ program to create a sequential file to store and maintain student data. It should allow the user to add, delete information of student. Display information of particular employee. If record of student does not exist an appropriate message is displayed. If student record is found it should display the student details.

Text Books:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy" 5th edition, Careermonk Publications, ISBN-13 : 978-8193245279.
2. Robert Sedgewick and Kevin Wayne, "Algorithms" Addison-Wesley Professional; 4th edition (March 24, 2011), ISBN-13: 978-0321573513.
3. Horowitz, Sahani, Dinesh Mehata, "Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786.

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4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley Publication, ISBN: 978-1-118-29027-9.

Reference Books:

1. Adam Drozdek, "Data Structures and Algorithms in C++", Course Technology Ptr; 4th edition (27 August 2012), ISBN-13 : 978-1133608424
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein "Introduction to Algorithms", MIT Press, 1990 (first edition), ISBN: 978-0-262-04630-5.

EBooks:

1. https://www.cse.iitb.ac.in/~ranade/cs213/
2. Data Structures and Algorithms (iitpkd.ac.in)

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Audit course-3 Course Title: Vedic Mathematics			
ContactHours:	1Hrs./week(L)	TypeofCourse:	Lecture
Examination Scheme	In Sem Exam:	End Sem Exam:	Practical: -
Course Credit	01		

Sr. No.	Course assessment methods/tools	External/Internal	Marks
1.	Assignment	Internal	25
		Total	25

Course Objectives	
1	To meet the needs of ever growing industry with respect to language support.
2	To get introduced to Japanese society and culture through language.

Course Outcomes : Students will be able to	
309.1	Demonstrate basic communication skills.
309.2	Show the knowledge of Japanese script.
309.3	Apply skills to reading, writing and listening.
309.4	Develop interest to pursue professional Japanese Language course.

Pre-requisites:Vedic Sutras,Vedic Sub Sutras

CourseObjectives:

1	Todeveloptheunderstanding of *Techniques/Sutras to solve mathematical arithmetic's in easy and faster way and use these techniques to varies Competitive Examinations.*
2	*To Improve speed and efficiency to solve even the most complex Mathematical problems.*
3	*To remove the phobia about mathematics in the minds of Students.*
4	*To help students to have better command over mathematical concepts and boost up their self-confidence level towards the subject.*

CourseOutcomes:

Aftersuccessfully completingthe coursestudentswillbeableto

1	ApplyVedic Mathematics techniques to Perform quickly and accurately mathematical calculations like multiplication, division, squares, cubes,LCM,HCF.
2	Apply Vedic Mathematics techniques to solve Linear Equations, Quadratic Equations, Factorization of a Cubic Polynomial.
3	Apply Vedic Mathematics techniques to Perform calculations in Coordinate Geometry, Differentiation, Integration and Trigonometry without relying heavily on calculators or written methods.

Syllabus

Course:Vedic Mathematics

Module I:- Basic Level(4Hrs)

Introduction of Vedic Mathematics, Multiplication, Square, Cube, Divisibility Test , Highest Common Factor of Polynomials, Multiplication of Polynomials, Division of Polynomials.

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ModuleII: Intermediate Level(4Hrs)
Linear Equations, Quadratic Equations, Factorization of a Cubic Polynomial, Magic squares, Dates and Calendar.

ModuleIII:Advance Level (4Hrs)
Determinant, Coordinate Geometry, Differentiation, Integration, Trigonometry.

Textbooks

1. Advanced Vedic Mathematics, Rajesh Kumar Thakur.
2. Vedic Mathematics Made Easy , DhavalBathia
3. VEDIC MATHEMATICS ForStudents: LEVEL – 1 OF 5 SERIES, by Nava Vision

ReferenceBooks

1. Sri BharatikrishnaTirthaji,"Vedic Mathematics",Published by MotilalBanarsidass, 1965.ISBN 81-208-0163-6.
2. Williams K.R. "Discover Vedic Mathematics" Vedic Mathematics Research Group, 1984.ISBN 1-869932-01-3.
3. Wiliams K.R. and M.Gaskell "The Cosmic Calculator". MotilalBanarsidass ,2002.ISBN 81-208-1871-7.

Nicholas A.P., Williams,J. Pickles."Vertically and Crosswise". Inspiration books, 1984.ISBN 1-902517-03-2

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Semester IV

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Second Year Artificial Intelligence & Data Science (2023 Course) Project Management			
Course Code:	ADHSM401	**Credit:**	2
Contact Hours:	2 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	TW: 25 OR: 25	**Total Marks:**	50

Pre-requisites: Software Engineering

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	Term Work	Internal	25
2	Oral	External	25

Course Objectives	
1	To understand the process of software Project Management.
2	To identify the estimation of project and task scheduling
3	To recognize the risks involved.
4	To understand software configuration management process

Course Outcomes : Students will be able to	
401.1	Explain the process of software Project Management.
401.2	Illustrate project estimation and scheduling the task.
401.3	Interpret the risk involved in project.
401.4	Apply software configuration management process and reengineering.

Topics covered:

UNIT-I: Project Management: Process, Metrics (7hrs)

Project Management Concepts: The Management Spectrum, People, Product, Process, Project, The W5HH Principle, Metrics in the Process and Project Domains, Software Measurement : size & function oriented metrics (FP & LOC), Metrics for Project and Software Quality

UNIT-II: Project Estimation & Scheduling (8hrs)

Project Estimation: Observations on Estimation, Project Planning Process, Software Scope and feasibility, Resources: Human Resources, Reusable software, Environmental Resources. Software Project Estimation, Decomposition Techniques, Empirical Estimation Models: Structure, COCOMO I, COCOMO II, Estimation of Object-oriented Projects, Specialized Estimation

Project Scheduling: Basic Concepts, Defining a Task Set for the Software Project, Defining Task Network, and Scheduling with time-line charts, Tracking the schedule, tracking progress for an object oriented projects, scheduling for webapp projects.

UNIT- III: Project Risk Management (6hrs)

Risk Analysis & Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Risks Monitoring and Management, RMMM plan

UNIT- IV: Configuration Management, Maintenance & Reengineering (7hrs)

Software Configuration Management : The SCM repository, SCM process, Configuration management for WebApps, **Maintenance & Reengineering:** Software

Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering

Text Books:

1. Roger S. Pressman, "Software Engineering – A Practitioner"s Approach", McGraw-Hill, ISBN 0-07-337597-7.
2. Ian Sommerville, "Software Engineering", Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Rajib Mall, "Fundamentals of Software Engineering", PHI, ISBN-13:978-8120348981.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.

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Second Year Artificial Intelligence & Data Science (2023 Course) Artificial Intelligence			
Course Code:	ADBSC402	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Data Structures.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	Internal	60*

Course Objectives	
1	To understand the concepts of Artificial Intelligence and its applications
2	To learn the concepts of searching for AI problems
3	To understand Adversarial Search & Constraint Satisfaction Problems
4	To learn about Agents and Knowledge Representation
5	To use the concepts of Planning & Acting in the real world
6	To choose the Best Hypothesis from various observations

Course Outcomes : Students will be able to	
402.1	Explain the concepts of Artificial Intelligence and its applications
402.2	Apply various searching algorithms to solve real life problems
402.3	Illustrate Constraint Satisfaction Problems & Adversarial Search
402.4	Represent real world knowledge using first order or propositional logic
402.5	Apply the concepts of Planning & Acting in the real world
402.6	Evaluate the Best Hypothesis from various observations

Topics covered:

UNIT-I: Introduction & Problem-Solving (07 Hrs)

Introduction, Foundation, History and Application of AI, Intelligent Agents, Define Problems as a State Space Search, Solving Problems, Problem-Solving Agents, Searching for Solutions, **Strategies:** Greedy Strategy, Divide and Conquer Strategy; **Uninformed Search Strategies:** Breadth-First Search, Depth-First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, **Informed Search Strategies:** Greedy best-first search, A*, Heuristic Functions, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

UNIT-II: Adversarial Search & Constraint Satisfaction Problems (07 Hrs)

Adversarial Search: Games, Optimal Decisions in Games, Optimal Strategies, Minimax Algorithm, Optimal decisions in multiplayer games, Alpha-Beta Pruning, Stochastic Games, Partially Observable Games, **Constraint Satisfaction Problems (CSP):** Constraint Propagation: Inference in CSPs; Backtracking Search for CSPs: Variable and Value Ordering, Intelligent Backtracking; Local Search for CSPs.

UNIT-III: First-Order Logic & Knowledge (07 Hrs)

Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents

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AISSMS IOIT (AUTONOMOUS), PUNE-1.

Based on Propositional Logic; First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.
UNIT-IV: Knowledge Representation (07 Hrs) Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution; Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.
UNIT-V: Planning & Acting (07 Hrs) Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches, Time, Schedules and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning.
UNIT-VI: Learning from Observations (07 Hrs) Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Support Vector Machines, Ensemble Learning, A Logical Formulation of Learning, Knowledge in Learning, Explanation-Based Learning, Learning Using Relevance Information, Inductive Logic Programming.
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)

Text Books:

1. S. Russel, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2015.

Reference Books:

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, McGraw Hill, 2017.
2. Introduction to AI & Expert System: Dan W. Patterson, PHI.
3. Ivan Bratko: "Prolog Programming For Artificial Intelligence", 2nd Edition Addison Wesley

EBooks:

https://courses.csail.mit.edu/6.034f/ai3/rest.pdf

MOOC Course:

1. Introduction to Artificial Intelligence: https://onlinecourses.nptel.ac.in/noc22_cs56/preview - Course (nptel.ac.in)

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Second Year Artificial Intelligence & Data Science (2023 Course) Database Management Systems			
Course Code:	ADPCC403	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Basic Knowledge of Mathematics.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	Internal	60*

Course Objectives	
1	To learn the concepts of Database Management System using ER model
2	To know Database queries
3	To disseminate database design techniques and practice.
4	To emphasize the importance of transaction processing and concurrency control.
5	To build a knowledge to differentiate types of advance database
6	To learn knowledge of emerging database

Course Outcomes : Students will be able to	
403.1	Implement Database Management System using ER model.
403.2	Structuring database queries.
403.3	Elaborate database design techniques.
403.4	Understand transaction processing and concurrency control.
403.5	Identify types of advance database.
403.6	Categorizing emerging database.

Topics covered:

UNIT-I: INTRODUCTION TO DBMS AND DATA MODEL (6 hrs.)

Introduction and Purpose of Database System

Database Design: Entity, Attributes, Relationships, Constraints, Keys, Design Process.

Data models: Entity Relationship (ER), ER model, Mapping ER Model to Relational Mode, ER Diagram, Design issues. Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations, ER to Table Conversion.

UNIT-II: RELATIONAL ALGEBRA AND SQL/PLSQL (7 hrs.)

Relational Algebra: Select, Project, Union, Set difference, Joins, **SQL**-Characteristics and advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, Views, Indexes.

SQL DML Queries: SELECT Query and clauses, Index and Sequence in SQL

PLSQL : Concept of Stored Procedures, Functions, Cursors, Triggers.

UNIT-III: DATABASE DESIGN (7 hrs.)

Relational Model: Basic concepts, Attributes and Domains, CODD's Rules.

Functional Dependency, Purpose of Normalization, Data Redundancy and Update Anomalies, Functional Dependency Single Valued Dependencies. Single Valued

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Normalization: 1NF, 2NF, 3NF, BCNF. Decomposition: lossless join decomposition and dependency preservation, Multi valued Normalization (4NF), Join Dependencies and the Fifth Normal Form.

UNIT- IV: DATABASE PROCESSING AND TRANSACTION(7 hrs.)

Introduction to Query processing and query optimization, Basic concept of a Transaction, Transaction Management, ACID Properties of Transactions, Concept of Schedule, Serial and Concurrent Schedule, **Serializability**: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, **Concurrency Control**: Need, Locking based Protocol, Deadlocks-Prevention, Detection Techniques, **Recovery methods** : Shadow Paging and Log Based Recovery, Checkpoint.

UNIT- V: ADVANCE CONCEPTS OF DATABASES (7 hrs.)

NOSQL- MongoDB CRUD Operations, SQL VsNoSQL Databases

Database Architectures: Centralized and ClientServer Architectures, Database Connectivity using Python with SQL and NoSQL databases. Introduction to Parallel Databases, Architecture of Parallel Databases. Introduction to Distributed Databases, Distributed Transactions. 2PC, 3PC protocols, Introduction to Data Mining, clustering and Data Warehouse.

UNIT- VI: EMERGING DATABASE (6 hrs.)

Introduction to Big data, Handling large datasets using Map-Reduce and Hadoop. Introduction to Hbase data model and hbase region. Introduction to emerging database technologies- Cloud Databases, Mobile Databases, SQLite Database, XML Databases.

Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)(*if complete unit is applicable then write only "unit 1/2/.." or write the contents from that unit):*

Unit 1 - Data models.
Unit 2 - Relational Algebra
Unit 3 - Relational Model, 1NF, 2NF, 3NF, BCNF
Unit 4 - Serializability, Concurrency Control
Unit 5 - Transactions. 2PC, 3PC protocols
Unit 6 - Big data, Hadoop, Emerging database technologies

Text Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. Connally T., Begg C., "Database Systems", 4th Edition, Pearson Education, 2002, ISBN 8178088614
3. "MongoDB: The Definitive Guide" by Kristina Chodorow, O"Reilly Publications
4. Pramod J. Sadalage Martin Fowler," NoSQLDistilled",Addison Wesley, ISBN- 10:0321826620
5. "Principles of Distributed Database Systems", by M. Tamer Özsu, Patrick Valduriez, Springe

Reference Books:

1. S. K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
2. Data Mining: Concepts and Techniques, Jiawei Han, MichelineKamber, Jian Pei, Elsevier
3. Big Data: Understanding How Data Powers Big Business, Bill Schmarzo, Wiley 3. Hadoop: The Definitive Guide, Fourth Edition, Tom White, O'Reilly

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4. H Base: The Definitive Guide, Fourth Edition, Lars George, O"Reilly Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum, —Data Structures using C and C++‖, Pearson Education

EBooks:

1. DBMS Full Form: Database Management System - javaTpoint
2. Introduction to Database Management Systems (DBMS) | Udemy
3. Introduction to Database Systems - Course (nptel.ac.in)

MOOC Course:

Introduction to Database Systems: https://onlinecourses.nptel.ac.in/noc20_cs03/preview

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PUNE-1.

Second Year Artificial Intelligence & Data Science (2023 Course) Exploratory Data Analysis			
Course Code:	ADPCC404	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60**	**Total Marks:**	100

Pre-requisites:

1. Programming and Problem Solving
2. Discrete mathematics and statistics

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	Internal	60**

Course Objectives	
1	To learn the Data Processing and identify data outliers.
2	To be familiar with exploratory data analysis process and its types.
3	To explain multivariate analysis technique.
4	To define Data visualization
5	To recognize and use symbolic data analysis technique.
6	To learn basic inference techniques.

Course Outcomes : Students will be able to	
404.1	Understand concepts of data processing and apply statistical methods for data processing.
404.2	Classify multivariate exploratory data analysis.
404.3	Apply data analytic methods to solve data analytical problems.
404.4	Implement Data Analytics using Python programming.
404.5	Describe and demonstrate different symbolic data analysis methods.
404.6	Implement statistical technique on data problems.

Topics covered:

UNIT-I: DATA PROCESSING AND STATESTICS (06 Hrs)

Basics of Data and its processing -Record Keeping , Statistics and data science , measurement scales , properties of data, Visualization, cleaning the data Symbolic data analysis **Statistics-**Basic Statistical Measures, Variance and Standard Deviation, Visualizing Statistical Measures, Calculating Percentiles, Quartiles and Box Plots **Missing data handling methods**-Finding missing values, dealing with missing values. **Outliers-** What are Outliers, Using Z-scores to Find Outliers, Modified Z-score, Using IQR to Detect Outliers

UNIT-II: DATA ANALYSIS (7 Hrs)

Data format and types of EDA, Univariate non-graphical EDA -Categorical data, Characteristics of quantitative data, UNIVARIATE NON-GRAPHICAL EDA, Central

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tendency, spread, Skewness and kurtosis, **Univariate graphical EDA** –Histograms, Stem-and-leaf plots, Boxplots, Quantile-normal plots. **Bivariate Analysis**-correlation coefficient , scatter plots and heatmaps **Types of Bivariate Analysis**- Scatter Plots, Regression Analysis, Correlation Coefficients.
UNIT- III:MULTIVARIATE EDA (7 Hrs) **Multivariate non-graphical EDA-** Cross-tabulation, Correlation for categorical data, Univariate statistics by category, Correlation and covariance, Covariance and correlation matrices, **Multivariate graphical EDA**-Univariate graphs by category, Scatterplots **Multivariate analysis Techniques**-Dependence Method, Interdependence method. Discriminant analysis, conjoint analysis, canonical correlation analysis, structural equation modeling, and multidimensional scaling.
UNIT- IV DATA VISUALIZATION (7 Hrs) **Introduction**: Types of data visualization, Data Visualization Techniques, Tools used in Data Visualization, Challenges to Big data visualization, Visualizing Big Data, Analytical techniques used in Big data visualization. **Data Visualization using Python:** Line plot, Scatter plot, Histogram, Density plot, Box- plot Box and Whisker Plots, Line Charts, Maps, Candlestick Charts,Treemaps and Sunburst Charts ,Sparkline's and Facets.
UNIT- V SYMBOLIC DATA ANALYSIS (7 Hrs) **Symbolic Data**.-Symbolic and Classical Data. Categories, Symbolic Objects. Comparison of Symbolic and Classical Analysis. **Descriptive Statistics for symbolic data-**: One Variate, Two or More Variates. Multi-valued Variables. Interval-valued Variables. Multi-valued Modal variables. Modal Interval-valued Variables. Baseball Interval-valued Dataset. Measures of Dependence.
UNIT- VI: Clustering methods in symbolic data analysis (6 Hrs) **Types of symbolic data** -non-modal multi-valued data and interval data **Partitioning methods**: k-means methods, k-medoids method **Hierarchical methods**: monothetic or polythetic methods, **Agglomerative algorithms** multi-valued list observations, interval-valued observations, histogram-valued observations, and mixed-valued observations
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)(*if complete unit is applicable then write only "unit 1/2/.." or write the contents from that unit):* **Unit 3:***Multivariate EDA* **Unit 4:** Data Visualization

Text Books:

1.Data analytics Anil Maheshwari.
2.Probability and Statistics", Murray R. Spiegel, John Schillerand R. Alu Srinivasan, Tata McGraw-Hill Edition.
3.Data Analytics" ravindra gogineni
4."Exploratory Data Analysis" John Turky

Reference Books:

1.Experimental Design and Analysis Howard J. Seltman July 11, 2018
2.Symbolic Data Analysis: Conceptual Statistics and Data Mining
3.DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edition

EBooks:

1. STAT GR5702 Exploratory Data Analysis and Visualization (EDAV) Syllabus Spring 2018.pdf(columbia.edu)

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2. Exploratory Data Analysis with Pandas and Python 3.x | Udemy
3. Data Analytics with Python - Course (nptel.ac.in)
4. Agglomerative Hierarchical Clustering - Clustering Methodology for Symbolic Data - WileyOnline Library

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Second Year Artificial Intelligence & Data Science (2023 Course) Operating Systems			
Course Code:	ADPCC405	**Credit:**	3
Contact Hours:	3 Hrs/weeks((L)	**Type of Course:**	Lecture
Examination Scheme:	ISE = 40# ESE = 60*	**Total Marks:**	100

Pre-requisites: Programming and Problem Solving

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	In Semester Evaluation	Internal	40#
2	End Semester Evaluation	Internal	60*

Course Objectives	
1	To understand main Structure of Operating System and it's working.
2	To learn the operations performed by Operating System and various scheduling procedures of Operating System.
3	To understand the concept of Deadlocks and Concurrency.
4	To learn the different memory management techniques
5	To understand I/O management and File systems.
6	To learn with the basics of Linux system.

Course Outcomes : Students will be able to	
405.1	Illustrate concept and Structures of Operating systems.
405.2	Apply scheduling algorithms to solve a given problem.
405.3	Illustrate deadlock prevention, avoidance and recovery.
405.4	Describe memory management technique.
405.5	Illustrate I/O and file management policies.
405.6	Explain Linux and process management.

Topics covered:

UNIT-I: OPERATING SYSTEMS OVERVIEW AND STRUCTURE (07 hrs.)

Introduction, operating system operations, operating systems generations, Types of Management- process management, memory management, storage management, protection and security, Structures- Operating system services and systems calls, system programs, operating system structure, Types of OS- Batch, time sharing, multiprogramming,distributed, network and real-time systems.

UNIT-II: PROCESS MANAGEMENT (07 hrs.)

Process concept, Process Control Block(PCB), Process Operations, Processes Scheduling - first come first serve, Round-robin, shortest job first, priority based scheduling and Multilevel feedback queue scheduling. Threads - Multithreading models, Thread implementations – user level and kernel level threads and Thread Scheduling.

UNIT- III: CONCURRENCY AND DEADLOCK (07 hrs.)

Principles of Concurrency, Mutual Exclusion: Hardware approaches, Software approach, Operating System/Programming Language support: Semaphores, Mutex, and Monitors. Classical Problems of Synchronization- Readers-Writers problem, Producer Consumer problem, Dining Philosopher problem, Deadlock - Principles of deadlock, Deadlock

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Prevention, Deadlock Avoidance, Deadlock Detection and Deadlock Recovery.
UNIT- IV: MEMORY MANAGEMENT (07 hrs.) Memory Management requirements, Memory Partitioning - Fixed, Dynamic Partitioning, Buddy Systems. Placement Strategies- First Fit, Best Fit, and Worst Fit, Fragmentation, Swapping, Paging, Segmentation, Address translation, Virtual Memory - Concepts, VM with Paging, Page Table Structure and VM with Segmentation.
UNIT- V: I/O AND FILE SYSTEM (07 hrs.) Input/output Devices - Types, Organization of the I/O Function- Technique, DMA, OS design issues for I/O management, I/O Buffering, Disk Scheduling - FCFS, SCAN, C-SCAN, and SSTF. File systems – Concept, File system interface, File system structure, Access methods and protection.
UNIT- VI: CASE STUDY: LINUX (07 hrs.) **LINUX** Overview of Linux, - Goals, Interfaces to Linux, The Shell, Linux Utility Programs and Kernel Structure. GitHub/Gitlab - Version Control.
Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.) Unit 1 - System calls. Unit 2 - processes and threads, inter-process communication. Unit 3 - concurrency, and synchronization, Deadlock. Unit 4 - Memory management and virtual memory. Unit 5 - I/O scheduling.

Text Books:

1. "Operating System Concepts," Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, WILEY, ISBN978-1-118-06333-0, 9th Edition.
2. "Operating System: Internals and Design Principles", William Stallings, Prentice Hall, ISBN-10: 0-13-380591-3, ISBN-13: 978-0-13-380591-8, 8th Edition
3. "Modern Operating System", Andrew S. Tanenbaum & Herbert Bos, Pearson, ISBN-13: 9780133592221, 4th Edition.

Reference Books:

1. "Operating System in depth: Design and Programming", Thomas W. Doeppner, WILEY, ISBN: 978-0-471-68723-8

EBooks:

1. https://www.coursera.org/lecture/introduction-to-hardware-and-operating-systems/an-introduction-to-operating-systems-eQ46T
2. https://archive.nptel.ac.in/courses/106/105/106105214/
3. https://www.cse.iitb.ac.in/~mythili/os/

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BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
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Second Year Artificial Intelligence & Data Science (2023 Course) Database Management Systems Laboratory			
Course Code:	ADPCC407	**Credit:**	2
Contact Hours:	4 Hrs/weeks((P)	**Type of Course:**	Practical
Examination Scheme:	TW: 25 PR: 50	**Total Marks:**	75

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	Term Work	Internal	25
2	Practical	External	50

Course Objectives	
1	To understand basics of Database manipulation skills and implement a database schema for a given problem-domain.
2	To implement and use different PL/SQL Programming.
3	To explain designing of database, creating relational database, analysis of table design.
4	To study the concepts and techniques relating to MongoDB and its implementations.
5	To learn to design database connectivity for implementation of project.

Course Outcomes : Students will be able to	
302.1	Identify SQL DML/DDL/TCL commands using database languages.
302.2	Demonstrate different PL/SQL Programming including stored procedures, stored functions, cursors, packages.
302.3	Describe the database using queries to retrieve records.
302.4	Analyze solutions for database applications using Mongo DB Queries using aggregation and indexing.
302.5	Develop solutions using database concepts for real time requirements.

Sr. No	Name of the program [Group A] DBMS
1.	**SQL Queries: (DDL)** • Design and Develop SQL Data definition languages (DDL) commands of base tables and views. • DDL commands: CREATE , ALTER , DROP , RENAME , TRUNCATE • Write at least10 SQL queries for suitable database application using SQL DDL statements. Note: Instructor will design the queries which demonstrate the use of concepts DDL commands.

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AISSMS IOIT (AUTONOMOUS),
PUNE-1.

2.	**SQL Queries: (DML)** • Data manipulation language (DML) of base tables and views. • DML commands: INSERT , UPDATE , DELETE , SELECT • Write at least10 SQL queries for suitable database application using SQL DML statements. Note: Instructor will design the queries which demonstrate the use of concepts DML commands.
3.	**Perform the following: (TCL)** a. Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)
4.	For a given set of relation schemes, create tables and perform the following a. Simple Queries b. Simple Queries with Aggregate functions (group by and having clause), Queries involving- Date Functions, String c. Functions , Math Functions d. Join Queries- Inner Join, Outer Join e. Sub queries- With IN clause, With EXISTS clause.
5.	**PL/SQL Programming** i. Creating stored procedures, functions and packages ii. Error handling and Exception iii. Triggers and auditing triggers
6.	**Cursors(All types)** Write a PL/SQL block that will display the name, dept no, salary of fist highest paid employees. OR Write a PL/SQL block that will display the employee details along with salary using cursors.
7.	Write a Mongo DB query to display the fields restaurant_id, name, borough and cuisine for all the documents in the collection restaurant.
8.	Design and Develop Mongo DB Queries using aggregation and indexing with suitable example using Mongo DB.
	[Group B] Mini Project

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9.	**Database Connectivity :** Create a program to implement MySQL database connectivity with any front end language that allows To enter the employee details into a database. OR To create an application program that process a query which returns the grade result of a student after processing the marks table. 1.Develop an application with following details • Front End: Python/Java/PHP/Perl/Ruby/.NET/ or any other language • Backend : MongoDB/ MySQL/ Oracle / or any standard SQL / NoSQL database 2. Test and validate application using Manual/Automation testing. 3.Student should develop application in group of 2-3 students and submit the Project Report which will consist of documentation related to different phases of Software Development Life Cycle: • Title of the Project, Abstract, Introduction • Software Requirement Specification (SRS) • Conceptual Design using ER features, Relational Model in appropriate Normalize form. • Graphical User Interface, Source Code • Testing document • Conclusion.

Text Books:

6. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
7. Connally T., Begg C., "Database Systems", 4th Edition, Pearson Education, 2002, ISBN 8178088614
8. "MongoDB: The Definitive Guide" by Kristina Chodorow, O"Reilly Publications
9. Pramod J. Sadalage Martin Fowler," NoSQLDistilled",Addison Wesley, ISBN- 10:0321826620
10. "Principles of Distributed Database Systems", by M. Tamer Özsu, Patrick Valduriez, Springe

Reference Books:

5. S. K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
6. Data Mining: Concepts and Techniques, Jiawei Han, MichelineKamber, Jian Pei, Elsevier
7. Big Data: Understanding How Data Powers Big Business, Bill Schmarzo, Wiley 3. Hadoop: The Definitive Guide, Fourth Edition, Tom White, O"Reilly
8. H Base: The Definitive Guide, Fourth Edition, Lars George, O"Reilly Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum, —Data Structures using C and C++I, Pearson Education

EBooks:

4. DBMS Full Form: Database Management System - javaTpoint
5. Introduction to Database Management Systems (DBMS) | Udemy
6. Introduction to Database Systems - Course (nptel.ac.in)

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AISSMS IOIT (AUTONOMOUS), PUNE

Second Year Artificial Intelligence & Data Science (2023 Course) Artificial Intelligence and Data Analysis Laboratory			
Course Code:	ADPCC408	**Credit:**	2
Contact Hours:	4 Hrs/weeks((P)	**Type of Course:**	Practical
Examination Scheme:	TW:25 PR: 50	**Total Marks:**	75

Pre-requisites: Data Structures.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1	Term Work	Internal	25
2	Practical	External	50

Course Objectives	
1	To learn the concepts of searching for AI problems
2	To learn about scheduling algorithms
3	To use the concepts of tree
4	To learn about types of regression.
5	To summarize principles of Data Science for the analysis of real time problems
6	To develop approach for implementation of the key technologies in Data Analytics

Course Outcomes : Students will be able to	
302.1	Apply various searching algorithms to solve real life problems
302.2	Implement concepts of scheduling algorithms.
302.3	Illustrate working of tree execution.
302.4	Obligate linear regression.
302.5	Use and evaluate data analytics algorithms
302.6	Utilize data visualization techniques

List of Experiment:

Group A (At least Four) Using Python Or PROLOG	
1	Implementation of Depth First Search for Water Jug problem.
2	Implementation of Breadth First Search for Tic- Tac – Toe problem
3	Solve 9- puzzle problem using Best First Search.
4	Write a PROLOG program to solve N-Queens problem.
5	Implementation of Traveling Salesman problem.
6	Min max algorithm in game theory program using python.
7	Write program to implement N-Queens problem using python
8	Employee Scheduling algorithm using python.
Group B (At least 4)	

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BOS-ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE-1.

9	ly and implementation of Pandas Profiling, Sweetviz, Autoviz
10	**Data Wrangling, I** Perform the following operations using Python on any open source dataset (e.g., data.csv) 1. Import all the required Python Libraries. 2. Locate open source data from the web (e.g., https://www.kaggle.com). Provide a cleardescription of the data and its source (i.e., URL of the web site). 3. Load the Dataset into pandas dataframe. 4. Data Preprocessing: check for missing values in the data using pandas isnull(), describe() function to get some initial statistics. Provide variable descriptions. Types of variables etc. Check the dimensions of the data frame. 5. Data Formatting and Data Normalization: Summarize the types of variables by checking the data types (i.e., character, numeric, integer, factor, and logical) of the variables in the data set. If variables are not in the correct data type, apply proper type conversions. 6. Turn categorical variables into quantitative variables in Python. In addition to the codes and outputs, explain every operation that you do in the above steps and explaineverything that you do to import/read/scrape the data set.
11	Create an "Academic performance" dataset of students and perform the following operations usingPython. 1. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them. 2. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniquesto deal with them. 3. Apply data transformations on at least one of the variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and convert the distribution into a normal distribution. Reason and document your approach properly.
12	Perform the following operations on any open source dataset (e.g., data.csv) Provide summary statistics (mean, median, minimum, maximum, standard deviation) for a dataset (age, income etc.) with numeric variables grouped by one of the qualitative (categorical) variable. For example, if your categorical variable is age groups and quantitative variable is income, then provide summary statistics of income grouped by the age groups. Create a list that contains a numeric value for each

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BOS–ARTIFICIAL INTELLIGENCE & DATA SCIENCES
AISSMS IOIT (AUTONOMOUS), PUNE–1.

	response to the categorical variable. 2. Write a Python program to display some basic statistical details like percentile, mean, standard deviation etc. of the species of 'Iris-setosa', 'Iris-versicolor' and 'Iris-versicolor' of iris.csv dataset. Provide the codes with outputs and explain everything that you do in this step.
13	1. Use the inbuilt dataset 'titanic'. The dataset contains 891 rows and contains information about the passengers who boarded the unfortunate Titanic ship. Use the Seaborn library to see if we can find any patterns in the data. 2. Write a code to check how the price of the ticket (column name: 'fare') for each passenger is distributed by plotting a histogram.
14	Use the inbuilt dataset 'titanic' as used in the above problem. Plot a box plot for distribution ofage with respect to each gender along with the information about whether they survived ornot. (Column names : 'sex' and 'age') Write observations on the inference from the above statistics.
15	**10) Data Visualization III** Download the Iris flower dataset or any other dataset into a DataFrame.(e.g., https://archive.ics.uci.edu/ml/datasets/Iris). Scan the dataset and give the inference as: 1. List down the features and their types (e.g., numeric, nominal) available in the dataset. 2. Create a histogram for each feature in the dataset to illustrate the feature distributions. 3. Create a boxplot for each feature in the dataset. Compare distributions and identify outliers.
	Group C(Compulsory)
16	Implement interval scheduling algorithm using python
17	Airline scheduling algorithm.
18	Implement mini project on Predicting Stock Prices Using Pandas and Sckit –learn
19	Implement color detection using Pandas and Autoviz,Sweetviz

Text Books:

1. S. Russel, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2015.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1

Reference Books:

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, McGraw Hill, 2017.
2. Introduction to AI & Expert System: Dan W. Patterson, PHI.
3. Ivan Bratko: "Prolog Programming For Artificial Intelligence", 2nd Edition Addison Wesley
4. Experimental Design and Analysis Howard J. Seltman July 11, 2018
5. Symbolic Data Analysis: Conceptual Statistics and Data Mining

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6. DT Editorial Services, "Big Data, Black Book", DT Editorial Services,ISBN: 9789351197577, 2016 Edition

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Second Year Artificial Intelligence & Data Science (2023 Course)			
Lifelong Learning Skills-1			
Course Code:	ADHSMEC1	**Credit:**	1

All the students are required to acquire 1 credit, which will have grades as below:

Sr. No.	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Sports	Inter collegiate	Participation	P	Prize winner	C
		University	Participation	C	Prize winner	B
		Zonal	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O
2.	NSS/NCC	Camp	Attended	B		
		Camp + 5 Activities	Attended	B+		
		Camp + 10 Activities	Attended	A		
		Camp + 15 Activities	Attended	A+		
		Camp + 20 Activities	Attended	O		
3.	Cultural	Inter collegiate	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O
4.	Community Engagement	Certified by NGO/Authorities with report and geo-tagged photograph	1 Activity	B		
			2 Activities	B+		
			3 Activities	A		
			4 Activities	A+		
			5 Activities	O		

Any activity other than listed above but having equal weight age should be considered for getting additional credit.

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PUNE-1.

Second Year Artificial Intelligence & Data Science (2023 Course)			
Lifelong Learning Skills-1			
Course Code:	ADPCCCC1	**Credit:**	1

All the students are required to acquire 1 credit, which will have grades as below:

Sr. No	Activity	Level	Achievement	Grade	Achievement	Grade
1.	Conference	National	Participation	B	Prize winner	A
		International	Participation	B+	Prize winner	A+
		International (Scopus indexing)	Participation	A+	Prize winner	O
2.	Journal Publication	Non-refereed but recognized and reputed journal/ periodical, having ISSN number.		B		
		Refereed Journal - As listed by UGC		A		
		Refereed Journals- As listed by Scopus		A+		
		Refereed Journals - As listed by SCI/ SCIE		O		
3.	Hackathon		Participation	A+	Prize winner	O
4.	Professional Body	National	Membership	P	3rd Prize	A
			Activities/participation	B	2nd Prize	A+
			5 participations	B+	1st Prize	O
5.	Internship	1 week	Completed	C		
		2 week	Completed	B		
		3 week	Completed	B+	Sponsored Project	A+
		4 week	Completed	A	Job through internship	O
6.	Entrepreneurship	Awareness camp	Attended	A	Product Developed	A+
					Own Startup	O
7.	Project/Technical events	Inter collegiate	Participation	P	Prize winner	C
		University	Participation	C	Prize winner	B
		Zonal	Participation	B	Prize winner	B+
		State	Participation	B+	Prize winner	A
		National	Participation	A	Prize winner	A+
		International	Participation	A+	Prize winner	O

Any activity other than listed above but having equal weight age should be considered for getting additional credit.

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Audit Course 4

Course Title: Sustainable Development Goals

Contact Hours:	**1 Hrs./week**	Type of Course:	**Lecture**
Examination Scheme	**Home Assignment / MCQ 25 Marks**		
Course Credit	**01**		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	MCQ Exam	Internal	25
		Total	25

Prerequisites – Basic Concepts of Environmental Studies

Course Objectives

1	To discuss the sustainable development goals.
2	To explain framework of Seventeen Sustainable Development Goals.
3	To discuss structure and order of Sustainable Development Goals.
4	To study cases of Sustainable Development Goals.

Course Outcomes:

At the end of course students will be able to

1	Explain sustainable development goals.
2	Describe framework of Seventeen Sustainable Development Goals.
3	Discuss structure and order of Sustainable Development Goals.
4	Report case studies of Sustainable Development Goals.

Syllabus

Course: Sustainable Development Goals

Total Hours:12Hrs. (SESSIONS)

Sustainable Development Goals

Unit 1: Introduction to SDGs **(3 hrs)**

Sustainability, Sustainable development, Role of UN and the Need for SDGs, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs, Distinction between Development and Sustainable Development

Unit 2: Sustainable Development Goals **(5 hrs)**

Framework and Structuring of Seventeen SDGs

SDG 1: No Poverty

SDG 2: Zero Hunger

SDG 3: Good Health and Well-being

SDG 4: Quality Education

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SDG 5: Gender Equality
SDG 6: Clean Water and Sanitation
SDG 7: Affordable and Clean Energy
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation and Infrastructure
SDG 10: Reduced Inequality

SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production
SDG 13: Climate Action
SDG 14: Life Below Water
SDG 15: Life on Land
SDG 16: Peace and Justice Strong Institutions
SDG 17: Partnerships to achieve the Goal

Unit 3: SDG Structure and Order **(3 hrs)**

Interrelationships and Connections between Seventeen SDGs, SDG Structure and Order at Levels of People, Ecological and Spiritual , SDGs and Socio Ecological Systems: Economy; Society; Biosphere

Unit 4: Sustainable Development Goals- Case Studies **(2 hrs)**

Case Studies from around the World, Case studies from India

BOOKS

1. Hazra, Somnath., Bhukta, Anindya (2020) Sustainable Development Goals An Indian Perspective, Springer International Publishing, Switzerland
2. Ziai, Aram (2016) Development Discourse and Global History from colonialism to the sustainable development goals. Routledge, London & New York
3. OECD (2019), Sustainable Results in Development: Using the SDGs for Shared Results and Impact, OECD Publishing, Paris, https://doi.org/10.1787/368cf8b4-en.
4. Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. 2020. The Sustainable Development Goals and COVID-19. Sustainable Development Report 2020. Cambridge: Cambridge University Press.

Relevant websites, movies, and documentaries

https://www.un.org/sustainabledevelopment/

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PUNE-1.

Python Programming for Data Science			
Course Code:	ADMNR 301	Course Title:	Python Programming for Data Science
Contact Hours:	3 Hrs/week (L)	Type of Course:	Lecture
Examination Scheme		Paper (End Sem)	75 Marks

Pre-requisites:

1. Problem Solving & Programming

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	End Semester	External	75

Course Objectives	
1	To explain concepts of Python programming and its diverse applications.
2	To impart hands-on skills through intensive practical exercises, enabling students to solve real-world problems.
3	To introduce popular Python libraries, Numpy and Pandas, and their significance in data handling and analysis.
Course Outcomes : Students will be able to	
C301.1	Explain concept of Python programming.
C301.2	Implement program using Data Structures.
C301.3	Make use of loop structures to implement programs.
C301.4	Apply concept of functions to implement programs.

Topics covered:

Unit 01: Python Foundations **(7 Hrs)**
Introduction to Python, Why Python is best for Data Science, Variables and Data Types, Basic Operators, Flow Control with Conditionals (if-else), Introduction to Functions

Unit 02: Data Structures and String Manipulation **(7 Hrs)**
Lists and Tuples, Dictionaries, Strings and their Methods, Data Manipulation with .sort(), .pop(), and len(), Slicing Techniques

Unit 03: Advanced Programming Constructs (7 Hrs)
For and While Loops, Break, Continue statements, Advanced Functions and Error Handling, File Handling in Python, Regular Expressions

Unit 04: Functional Programming and Comprehensions (7 hrs)
Lambda Functions and their Applications, Map, Filter, and Reduce Functions, List and Dictionary Comprehensions, Introduction to Modules and Packages

Unit 05 : Data Analysis with Numpy and Pandas (7 Hrs)
Introduction to Numpy: Arrays and Matrices, Basic Operations in Numpy, Introduction to Pandas: DataFrames and Series, Data Cleaning and Manipulation in Pandas, Libraries used in Data Analysis, Data Analysis Techniques using Numpy and Pandas

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Syllabus contents required for competitive exams (GATE, UPSC, MPSC etc.)(*if complete unit is applicable then write only "unit 1/2/.." or write the contents from that unit):*

1.

2.

Text Books:

1. Introduction to linear algebra - by Gilbert Strang
2. Applied statistics and probability for engineers – by Douglas Montgomery
3. Mastering python for data science, Samir Madhavan

NPTEL: Python for Data Science

https://onlinecourses.nptel.ac.in/noc22_cs32/preview

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Python Programming for Data Science Laboratory			
Univ. Course No. College Course Code:	ADMNR 302	Course Title:	Python Programming for Data Science Lab
		Credit:	1
Contact Hours:	3 Hrs/week (L)	Type of Course:	Practical
Examination Scheme		Term Work 25 Marks	

Pre-requisites:

2. Problem Solving & Programming

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
2.	Term Work	External	25

Course Objectives	
1	To explain concepts of Python programming and its diverse applications.
2	To impart hands-on skills through intensive practical exercises, enabling students to solve real-world problems.
3	To introduce popular Python libraries, Numpy and Pandas, and their significance in data handling and analysis.
Course Outcomes : Students will be able to	
C301.1	Explain concept of Python programming.
C301.2	Implement program using Data Structures.
C301.3	Make use of loop structures to implement programs.
C301.4	Apply concept of functions to implement programs.
C301.5	Apply knowledge of data analysis.

List of Experiments:

Group A (At least Seven)	
1	Installation of Python, Setting Python environment and execute a simple "Hello World!" script.
2	Perform basic arithmetic operations and handle user input.
3	Implement Contact book: Use dictionaries to store and retrieve contact details, allowing users to add, view, and search for contacts.
4	Perform String operations like reversing, counting vowels, word replacement, etc.
5	Design a basic quiz game where users answer questions; use loops and conditionals to manage user experience.
6	Implement Simple log parser: Read a file and extract specific data from it, using string methods and possibly regular expressions.
7	Design Expense tracker: Allow users to input daily expenses, categorize them, and analyze (e.g., highest expense, total spent, etc.) using lambda and

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AISSMS IOIT (AUTONOMOUS), PUNE-1.

	filter functions.
8	Design Module explorer: Introduce of different Python modules, import and explore basic functionalities.
	Group B(At least Four)
9	Implement array and matrix operations in Numpy, including creation, manipulation and basic linear algebra.
10	Mini calculator project: Implement basic arithmetic operations through functions and provide a user interface for input and operation selection.
11	Implement Pandas data analysis project: Use a sample dataset, clean, process, and analyze the data, extracting meaningful insights using Pandas functionalities.
12	Implement on Missing Data in Pandas: Use functions for detecting, removing, and replacing null values in Pandas.
13	Implement Pandas data analysis project: Use Slicing, Indexing, Manipulating and Cleaning in Pandas
	Group C(Compulsory)
14	Implement Project for Predicting Weather
15	Implement Project for Predicting price of pre-owned cars
16	Implement Project to Classifying personal income.

Text Books:

1. Introduction to linear algebra - by Gilbert Strang
2. Applied statistics and probability for engineers – by Douglas Montgomery
3. Mastering python for data science, Samir Madhavan

NPTEL: Python for Data Science

https://onlinecourses.nptel.ac.in/noc22_cs32/preview

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Artificial Intelligence			
Univ. Course No. College Course Code:	ADBSC402	**Course Title:**	Artificial Intelligence
Contact Hours:	03 Hours/Week	**Type of Course:**	Theory
Examination Scheme		**End Sem.**	75*

Pre-requisites:

1. Advanced Data Structures

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	End Sem	External	75

Course Objectives

1	To understand the concepts of Artificial Intelligence and its applications
2	To learn the concepts of searching for AI problems
3	To understand Adversarial Search & Constraint Satisfaction Problems
4	To learn about Agents and Knowledge Representation
5	To use the concepts of Planning & Acting in the real world

Course Outcomes: Students will be able to

1	Explain the concepts of Artificial Intelligence and its applications
2	Apply various searching algorithms to solve real life problems
3	Illustrate Constraint Satisfaction Problems & Adversarial Search
4	Represent real world knowledge using first order or propositional logic
5	Apply the concepts of Planning & Acting in the real world

Topics covered:	
UNIT-I: Introduction & Problem-solving Introduction, Foundation, History and Application of AI, Intelligent Agents, Define Problems as a State Space Search, Solving Problems, Problem-Solving Agents, Searching for Solutions, **Strategies:** Greedy Strategy, Divide and Conquer Strategy; **Uninformed Search Strategies:** Breadth-First Search, Depth-First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, **Informed Search Strategies:** Greedy best-first search, A*, Heuristic Functions, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.	[07 Hrs]
UNIT-II: Adversarial Search & Constraint Satisfaction Problems **Adversarial Search:** Games, Optimal Decisions in Games, Optimal Strategies, Minimax Algorithm, Optimal decisions in multiplayer games, Alpha-Beta Pruning, Stochastic Games, Partially Observable Games, **Constraint Satisfaction Problems (CSP):** Constraint Propagation: Inference in CSPs; Backtracking Search for CSPs: Variable and Value Ordering, Intelligent Backtracking; Local Search for CSPs.	[07 Hrs]
UNIT-III: First-Order Logic & Knowledge Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic; First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.	[07 Hrs]

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UNIT-IV: Knowledge Representation [07 Hrs] Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution; Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.
UNIT-V: Planning & Acting [07 Hrs] Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches, Time, Schedules and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning.
Syllabus contents required for competitive exams (GATE) **Unit-I** 1. Breadth-First Search 2. Depth-First Search 3. Greedy Strategy 4. Divide & Conquer Strategy

Text Books:

2. S. Russel, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2015.

Reference Books:

4. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, McGraw Hill, 2017.
5. Introduction to AI & Expert System: Dan W. Patterson, PHI.
6. Ivan Bratko: "Prolog Programming For Artificial Intelligence", 2nd Edition Addison Wesley

NPTEL:

Introduction to Artificial Intelligence

References:

1. NIT, Trichy
2. NIT, Durgapur

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Second Year Artificial Intelligence and Data Science (2022 Course) Artificial Intelligence Laboratory			
Course Code:	ADPCC408	**Credit**	1
Contact Hours:	2 Hrs/week (P)	**Type of Course:**	Practical
Examination Scheme	TW - 25	Total Marks	25

Pre-requisites:

- Problem Solving And Programming.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	End Semester Examination	TW	25

Course Objectives	
1	To learn basics of object oriented programming.
2	To know constructor inheritance & overloading.
3	To review different type of file operation.
4	To illustrate exception handling & template.
Course Outcomes: Students will be able to	
307.1	identify features of object oriented programming.
307.2	identify constructor inheritance & overloading.
307.3	categorize type of file operation
307.4	implement exception handling & template.
Topics covered:	

List of Experiment:

Group A (At least four)	
1	Implementation of Depth First Search for Water Jug problem.
2	Implementation of Breadth First Search for Tic- Tac – Toe problem
3	Solve 9- puzzle problem using Best First Search.
4	Write a program to solve N-Queens problem using Greedy approach.
5	Implementation of Traveling Salesman problem.
6	Min max algorithm in game theory program using python.
7	Implement A star (A*) Algorithm for any game search problem.
8	Implement a solution for a Constraint Satisfaction Problem using Branch and Bound for n-queens problem.
Group B	

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7	Implement Alpha-Beta Tree search for any game search problem.
8	Implement Greedy search algorithm for Single-Source Shortest Path Problem
9	Employee Scheduling algorithm using python
10	Implement Greedy search algorithm for Minimum Spanning Tree
11	Implement Greedy search algorithm for Dijkstra's Minimal Spanning Tree Algorithm
	Group C(Compulsory)
12	Implement interval scheduling algorithm using python or C++
13	Implement decision Tree
14	Air line scheduling algorithm.

Text Books:

1.E.Balagurusamy, "Object-Oriented Programming with C++", 7th edition, raw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990

2. Herbert Schildt, "C++-The complete reference"‖, Eighth Edition, McGraw Hill Professional, 2011,
ISBN: 978-00-72226805

Reference Books:

3. Data Structures and Algorithm Analysis in C++ Hardcover, by Mark A. Weiss, Jun 2013, Publisher: PHI; 4 editions, ISBN-10: 013284737X ISBN-13: 978-0132847377.
4. Algorithms in C++: Fundamentals, Data Structures, Sorting, Searching, Parts 1-4, 3rd Edition (Paperback), Pearson India, ISBN-10 8131713059, 2009, ISBN-13 9788131713051.

References:

4. https://nptel.ac.in/content/syllabus_pdf/106105166.pdf
https://ece.unm.edu/featured-students/spotlight-images/ece1d-intro-to-io

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