Kolhapur Institute of Technology's College of Engineering (Autonomous), Kolhapur

Department of Computer Science and Engineering (AIML)

Curriculum and Syllabus

for

B. Tech. Computer Science and Engineering (AIML)

Scheme: 2024-25 (As Per NEP)

ABOUT THE DEPARTMENT

Welcome to the department of Computer science and engineering (Artificial Intelligence and Machine learning). The department is established in 2021-22. The adoption of artificial intelligence/ Machine Learning (AI/ML) is growing worldwide. Artificial Intelligence and Machine Learning has become one of the fastest-growing engineering streams due to the tremendous rise of computer intelligent systems and their integration into all aspects of our life. Whether it's a basic cell phone or a complex space shuttle, computing systems are present everywhere and play a very important role in all aspects of our life.
AI attempts to artificially instill intelligence in robots by simulating human intellect. Machine learning (ML) is an AI application that aims to give machines the ability to learn on their own. AI and machine learning are key drivers of digital transformation and have resulted in a slew of new career opportunities. Engineers who are well versed in these technologies are in high demand.

DEPARTMENT VISION

To emerge as a leading department in Technical Education and Research in Computer Science and Engineering, especially in the Artificial Intelligence and Machine Learning domain with focus to produce professionally competent and socially sensitive engineers capable of working in a global environment.

DEPARTMENT MISSION

M1	To impart necessary technical and professional skills in the field of Computer Science and Engineering with specialization of Artificial Intelligence and Machine Learning amongst students to make them competent enough from an employability, higher education & entrepreneurship point of view with commitment towards lifelong learning.
M2	To produce the socially sensitive engineers capable of working in a global IT environment who will be competent technocrats to meet current industrial challenges
M3	To establish effective institute-industry interaction where students will be adapting to current industrial tools and techniques.
M4	To enable the graduates to use modern tools, to design and develop Artificial Intelligence and Machine Learning enabled products and communicate effectively with professional ethics.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO1	Graduate will gain knowledge in core computer science and engineering fields such as networks, data management and application development.
PEO2	Graduate will gain knowledge in Artificial Intelligence, Machine Learning, Deep learning, and Computer vision.
PEO3	Graduate will demonstrate technical skills, competency in AI & ML and exhibit team management capability with proper communication in a job environment.
PEO4	Graduate will carry out research in the advanced areas of AI & ML and address the basic needs of the society.

PROGRAMME OUTCOMES (PO)	
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, basic science and in-depth technical competence in computer science and engineering discipline to meet the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review various computer science research literature, and analyze complex engineering problems using basic principles of mathematics, natural sciences, and engineering sciences to reach substantiated conclusions
PO3	**Design/development of Solutions:** Design software solutions for complex computer science and engineering problems and design system processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods in the field of computer science and engineering including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and software tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO6	**The engineer and society:** Apply reasoning obtained from the contextual knowledge of computer science to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice
PO7	**Environment and sustainability:** Understand the impact of the software solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the computer science and engineering practice
PO9	**Individual and team work:** Function effectively as an individual, and as a member or Leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex computer engineering activities with the engineering community and with society at large, such as being able to make effective presentations, write effective reports and design documentation.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the software 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.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of computer engineering and technological change.

PROGRAMME SPECIFIC OUTCOMES (PSO)	
PSO1	**Academic competence:** Apply the concepts of Mathematics, Data Structure, Database System, Operating System, Programming, Networking, and Intelligence System in core areas of Artificial Intelligence and Machine Learning to solve industry and societal problems.
PSO2	**Personal and Professional Competence:** Develop models in Data Science, Machine learning, Deep learning and Bigdata technologies, using acquired AI & ML knowledge and modern tools. Also apply the skills in Health Care, Education, Agriculture, Intelligent Transport, Environment, Smart System and in the multi-disciplinary area of Artificial Intelligence and Machine Learning.

MAPPING OF PEOS TO POS												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3		1		3			1				1
PEO2	1	2	3	1	2			3				3
PEO3	1		1					2	3		3	2
PEO4	1	1		3		3	1	2		1		2

MAPPING OF PEOS TO PSOS		
	PSO1	PSO2
PEO1	2	2
PEO2	-	3
PEO3	1	2
PEO4	2	3

As per NEP Guidelines

Proposed Scheme of Credit Distribution

	Year	FY		SY		TY		B. Tech.			
Sr. No.	Type of Course	I	II	III	IV	V	VI	VII	VIII	Actual	NEP Guidelines
1	BS: Basic Science	8	8							16	14-18
2	ES: Engineering Science	7	6							13	12-16
3	PC: Programme Core	3		16	15	10	11	11		66	44-56
4	PE: Programme Elective					3	3	3	6	15	20
5	MM: Multi Minor			2	3	3	3	3		14	14
6	OE: Open Elective					3	3	2		8	8
7	VS: Vocational and Skill Enhancement course	1	3		1	1				6	8
8	AE: Ability Enhancement		3			1				4	4
9	EM: Entrepreneurship /Economics/ Management courses (Mgt/Economics/Mkt/Finance)			2			2			4	4
10	IK: Indian Knowledge System	2								2	2
11	VE: Value Education			2	2					4	4
12	IL: Research Methodology (Project)							4		4	4
13	IL: Comm. Engg Project/Field Project (PBL/Seminar/Mini Project)					1	1			2	2
14	IL: Project								4	4	4
15	IL: Internship/OJT (PBL/Seminar/Mini Project/Virtual Internship/Physical)			1	1				6	8	12
16	CC: Co-curricular Courses		1		1		1		1	4	4
		20-22	20-22	20-22	20-22	20-22	20-22	20-22	20-22	174	
		21	21	23	23	22	2	23	17	174	

SEMESTER III													
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs/ Week**	**Credits**	**Evaluation Scheme (Components)**			
1	PC	UAMPC0301	Discrete Mathematics and Graph Theory	3	1	-	4	4	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	PC	UAMPC0302	Linear Algebra	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	PC	UAMPC0303	Advanced Data Structures	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4	PC	UAMPC0304	Database Management System	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5	VEC	UAMVE0305	Constitution of India	2	-	-	2	2	ISE	50	20	20
6	HSSM	UAMEM0306	Principles of AIML	2	-	-	2	2	ESE	50	20	20
7	PC	UAMPC0331	Advanced Data Structures Laboratory	-	-	2	2	1	ISE ESE (POE)	25 50	10 20	
8	PC	UAMPC0332	Database Management System Laboratory			2	2	1	ISE ESE (POE)	25 25	10 10	
9	PC	UAMPC0333	Software System Tools Laboratory			2	2	1	ISE	25	10	
10	OJT	UAMIL0371	Mini Project-I			2	2	1	ISE	50	20	
11	MM	UAMMM03**	MM-1	2			2	2	ESE	100	40	
						Total:	**27**	**23**	**Total Marks: 800** **Total Credit: 23**			

SEMESTER IV													
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs/ Week**	**Credits**	**Evaluation Scheme (Components)**				
1	PC	UAMPC0401	Computer Networks	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
2	PC	UAMPC0402	Automata Theory	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
3	PC	UAMPC0403	Design And Analysis of Algorithms	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
4	PC	UAMPC0404	Statistics and Probability	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
5	PC	UAMPC0405	Object Oriented Programming in Java	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
6	VEC	UAMVE0406	Environmental Studies	2	-	-	2	2	ISE	50	20		20
7	PC	UAMPC0431	Object Oriented Programming Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10		
8	PC	UAMPC0432	Data Analytics & Visualization Tools Laboratory	-	-	2	2	1	ISE	25	10		
9	OJT	UAMIL0471	Mini Project-II	-	-	2	2	1	ISE	25	10		
10	VSEC	UAMVS0433	AI DS Tools Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10		
11	CC	UAMCC0434	Co-curricular Activities-II	-	-	2	2	1	ISE	50	20		
12	MM	UAMMM04**	MM-2	3	-		3	3	ESE	100	40		
						Total:	**28**	**23**	**Total Marks: 850** **Total Credit: 23**				

SEMESTER V													
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs/ Week**	**Credits**	**Evaluation Scheme (Components)**			
1	PC	UAMPC0501	Machine Learning	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	PC	UAMPC0502	Computer Organization and Operating System	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	PC	UAMPC0503	Exploratory Data Analytics	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4	PE	UAMPE05**	Program Elective-I	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5	OE	UAMOE0521	Open Elective-I	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
6	HSSM	UAMAE0534	Business Communication and Value Science	-	-	2	2	1	ISE	50	20	20
7	PC	UAMPC0531	Machine Learning Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
8	PC	UAMPC0532	Advanced Java Programming Laboratory	-	-	2	2	1	ISE	25	10	
10	VSEC	UAMVS0533	Exploratory Data Analytics Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
11	CEP	UAMIL0571	Mini Project (Android)-III	-	-	2	2	1	ISE	25	10	
12	MM	UAMMM05**	MM-3	3	-	-	3	3	ESE	100	40	
						Total:	**27**	**22**	**Total Marks: 800** **Total Credit: 22**			

SEMESTER VI

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs/ Week	Credits	Evaluation Scheme (Components)			
1	PC	UAMPC0601	Deep Learning	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	PC	UAMPC0602	Natural Language Processing	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	PC	UAMPC0603	Image Processing & Computer Vision	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4	PE	UAMPE06**	Program Elective-II	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5	OE	UAMOE0621	Open Elective-II	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
6	HSSM	UAMEM0604	Software Engineering & Project Management	2	-	-	2	2	ESE	50	20	20
7	PC	UAMPC0631	Deep Learning Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
8	PC	UAMPC0632	Image Processing & Computer Vision Laboratory	-	-	2	2	1	ISE	25	10	
9	PC	UAMPC0633	Advanced Web Development Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
10	CEP	UAMIL0671	Mini Project -IV	-	-	2	2	1	ISE	25	10	
11	CC	UAMCC0634	Co-curricular Activities-III	-	-	2	2	1	ISE	50	20	
12	MM	UAMMM06**	MM-4	3	-	-	3	3	ESE	100	40	
			Total:				**29**	**24**	**Total Marks: 850** **Total Credit: 24**			

SEMESTER VII													
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs/ Week**	**Credits**	**Evaluation Scheme (Components)**				
1	PC	UAMPC0701	Cyber and Blockchain Security	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
2	PC	UAMPC0702	Generative and Agentic AI	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
3	PC	UAMPC0703	ML DevOps	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
4	PE	UAMPE07**	Program Elective-III	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
5	OE	UAMOE0721	Open Elective-III	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
6	PC	UAMPC0731	Generative and Agentic AI Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10		
7	PC	UAMPC0732	ML DevOps Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10		
8	RM	UAMIL0771	Project-I	-	-	2	2	4	ISE I ESE (OE)	50 50	40		
12	MM	UAMMM07**	MM-5	3	-	-	3	3	ESE	100	40		
			Total:				**23**	**23**	**Total Marks: 800** **Total Credit: 23**				

SEMESTER VIII												
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs/ Week**	**Credits**	**Evaluation Scheme (Components)**			
1	PE	UAMPE08**	Program Elective-IV	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	OE	UAMPE08**	Program Elective-V	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	RM	UAMIL0871	Project-II	-	-	8	8	4	ISE I ESE (OE)	50 50	40	
4	OJT	UAMIL0872	Internship	-	-	12	12	6	ISE I ISE II	75 75	75	
5	CC	UAMCC0831	Co-curricular Activities-IV	-	-	2	2	1	ISE	50	20	
			Total:				**28**	**17**	**Total Marks: 500** **Total Credit: 17**			

PC: Program Core							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMPC0301	Discrete Mathematics and Graph Theory	3	1	-	4	4
2	UAMPC0302	Linear Algebra	3	-	-	3	3
3	UAMPC0303	Advanced Data Structures	3	-	-	3	3
4	UAMPC0304	Database Management System	3	-	-	3	3
5	UAMPC0331	Advanced Data Structures Laboratory	-	-	2	2	1
6	UAMPC0332	Database Management System Laboratory	-	-	2	2	1
7	UAMPC0333	Software System Tools Laboratory	-	-	2	2	1
8	UAMPC0401	Computer Networks	2	-	-	2	2
9	UAMPC0402	Automata Theory	3	-	-	3	3
10	UAMPC0403	Design And Analysis of Algorithms	3	-	-	3	3
11	UAMPC0404	Statistics and Probability	3	-	-	3	3
12	UAMPC0405	Object Oriented Programming in Java	2	-	-	2	2
13	UAMPC0431	Object Oriented Programming Laboratory	-	-	2	2	1
14	UAMPC0432	Data Analytics & Visualization Tools Laboratory	-	-	2	2	1
15	UAMPC0501	Machine Learning	3	-	-	3	3
16	UAMPC0502	Computer Organization and Operating System	2	-	-	2	2
17	UAMPC0503	Exploratory Data Analytics	3	-	-	3	3
18	UAMPC0531	Machine Learning Laboratory	-	-	2	2	1
19	UAMPC0532	Advanced Java Programming Laboratory	-	-	2	2	1
20	UAMPC0601	Deep Learning	3	-	-	3	3
21	UAMPC0602	Natural Language Processing	2	-	-	2	2
22	UAMPC0603	Image processing & Computer Vision	3	-	-	3	3
23	UAMPC0631	Deep Learning Laboratory	-	-	2	2	1
24	UAMPC0632	Image processing & Computer Vision Laboratory	-	-	2	2	1
25	UAMPC0633	Advanced Web Development Laboratory	-	-	2	2	1
26	UAMPC0701	Information Security	3	-	-	3	3
27	UAMPC0702	Generative AI	3	-	-	3	3
28	UAMPC0703	Internet of Things & Cloud Computing	3	-	-	3	3
29	UAMPC0731	Advanced Deep Learning Laboratory	-	-	2	2	1
30	UAMPC0732	ML DevOps Laboratory	-	-	2	2	1
					Total:	**75**	**63**

PE: PROGRAM ELECTIVE– I							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMPE0511	Human Computer Interaction (UI/UX) (PE-I)	3	-	-	3	3
2	UAMPE0512	Intelligent Robot (PE-I)	3	-	-	3	3
3	UAMPE0513	Storage Area Networks (PE-I)	3	-	-	3	3

PE: PROGRAM ELECTIVE - II							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMPE0611	Business Intelligence (PE-II)	3	-	-	3	3
2	UAMPE0612	Introduction to Augmented Reality Virtual Reality (ARVR) (PE-II)	3	-	-	3	3
3	UAMPE0613	Robotics Process Automation (PE-II)	3	-	-	3	3

PE: PROGRAM ELECTIVE - III							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMPE0711	Data and Storytelling (PE-III)	3	-	-	3	3
2	UAMPE0712	Time Series Analysis (PE-III)	3	-	-	3	3
3	UAMPE0713	Big Data Analytics (PE-III)	3	-	-	3	3

PE: PROGRAM ELECTIVE - IV							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMPE0811	Ethics in AI (PE-IV)	3	-	-	3	3
2	UAMPE0812	Introduction to Quantum Computing (PE-IV)	3	-	-	3	3
3	UAMPE0813	Edge and Fog Computing (PE-IV)	3	-	-	3	3

PE: PROGRAM ELECTIVE - V							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMPE0814	AI in Healthcare (PE-V)	3	-	-	3	3
2	UAMPE0815	Reinforcement Learning (PE-V)	3	-	-	3	3

MM: Multi-Disciplinary Minor Courses - Biomedical Engineering (Basket 1)							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMMM0341	Basics of Biomedical Engineering (MM-I)	2	-	-	2	2
2	UAMMM0441	Biostatistics and Algorithms (MM-II)	3	-	-	3	3
3	UAMMM0541	Soft Computing (MM-III)	3	-	-	3	3
4	UAMMM0641	Medical Image Analysis (MM-IV)	3	-	-	3	3
5	UAMMM0741	AI based Medical Automation (MM-V)	3	-	-	3	3
					Total:	**14**	**14**

MM: Multi-Disciplinary Minor Courses - Finance Engineering (Basket 2)							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMMM0342	Fundamentals of Finance for Engineering (MM-I)	2	-	-	2	2
2	UAMMM0442	Blockchain Technologies and FinTech (MM-II)	3	-	-	3	3
3	UAMMM0542	Time Series Analysis (MM-III)	3	-	-	3	3
4	UAMMM0642	Machine Learning for Finance (MM-IV)	3	-	-	3	3
5	UAMMM0742	Deep Learning for Finance (MM-V)	3	-	-	3	3
					Total:	**14**	**14**

MM: Multi-Disciplinary Minor Courses - Embedded Systems (Basket 3)							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMMM0343	Digital Electronics (MM-I)	2	-	-	2	2
2	UAMMM0443	Microprocessor and Microcontrollers (MM-II)	3	-	-	3	3
3	UAMMM0543	Embedded Systems (MM-III)	3	-	-	3	3
4	UAMMN0643	IoT with Arduino and Raspberry Pi (MM-IV)	3	-	-	3	3
5	UAMMM0743	AI in Embedded Systems (MM-V)	3	-	-	3	3
					Total:	**14**	**14**

VS: Vocational and Skill Enhancement Course							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMVS0433	AI DS Tools Laboratory	-	-	2	2	1
2	UAMVS0533	Exploratory Data Analytics Laboratory	-	-	2	2	1

AE: Ability Enhancement Course							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMAE0534	Business Communication and Value Science	-	-	2	2	1

EM: Entrepreneurship /Economics/ Management courses							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMEM0306	Principles of AIML	2	-	-	2	2
2	UAMEM0604	Software Engineering & Project Management	2	-	-	2	2

VE: Value Education Course							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMVE0305	Constitution of India	2	-	-	2	2
2	UAMVE0406	Environmental Studies	2	-	-	2	2

IL: Research Methodology (Project)							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMIL0771	Project-I	-	-	2	2	4

IL: Community Engineering Project / Field Project (PBL/Seminar/Mini-Project)							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMIL0571	Mini Project (Android)-III	-	-	2	2	1
2	UAMIL0671	Mini Project -IV	-	-	2	2	1

IL: PROJECT							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMIL0871	Project-II	-	-	2	2	4

IL: INTERNSHIP/ON JOB TRAINING							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMIL0371	Mini Project-I	-	-	2	2	1
2	UAMIL0471	Mini Project-II	-	-	2	2	1
3	UAMIL0872	Internship	-	-	12	12	6

CC: CO-CURRICULAR COURSES							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMCC0434	Co-curricular Activities-II	-	-	2	2	1
2	UAMCC0634	Co-curricular Activities-III	-	-	2	2	1
3	UAMCC0831	Co-curricular Activities-IV			2	2	1

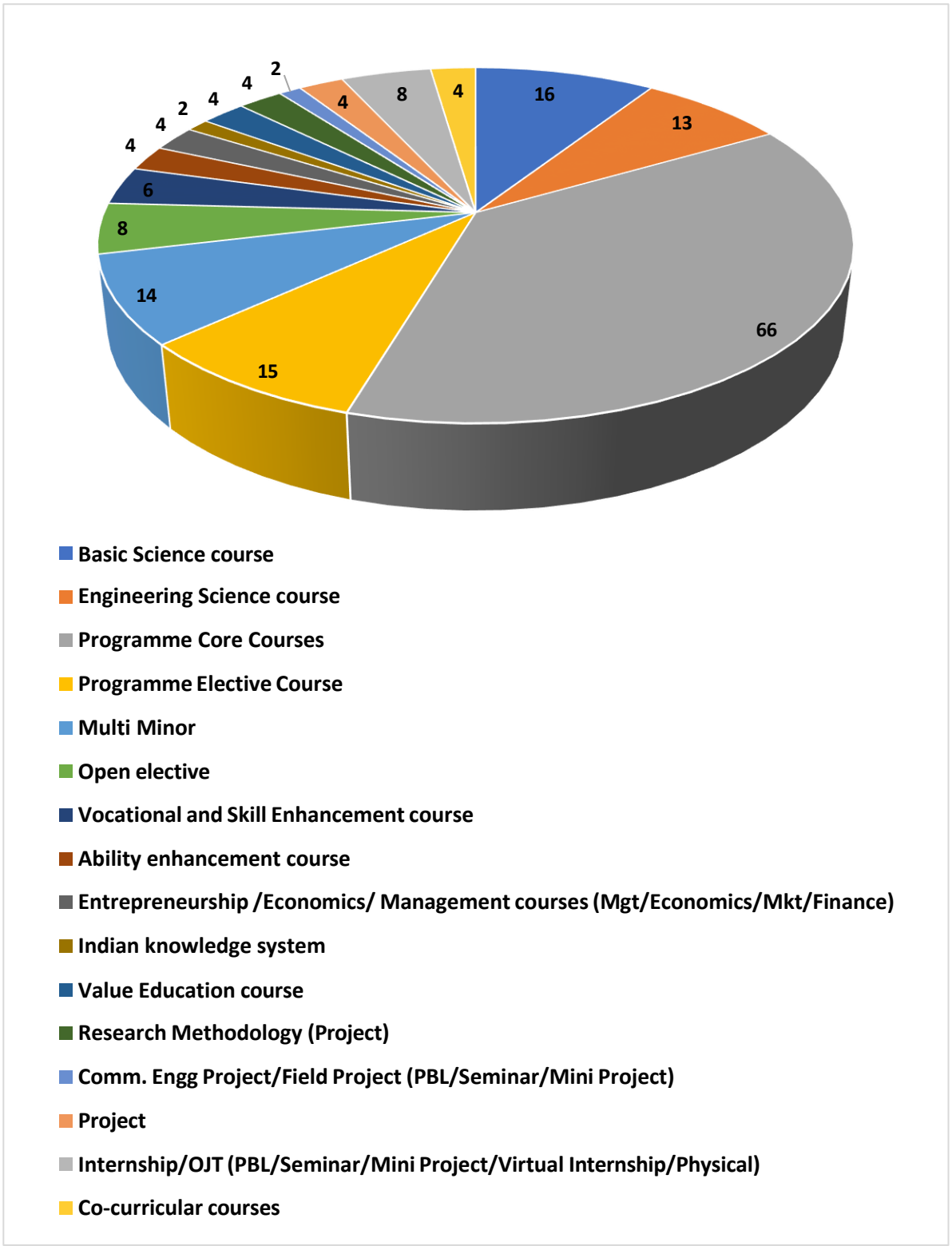
EX: EXIT COURSES - SY							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMEX0491	Certified Web Developer	3	-	-	3	3
2	UAMEX0492	Foundation Course in Machine Learning Using Python	3	-	-	3	3
3	UAMEX0493	Training	2	-	-	2	2
		Total:				**8**	**8**

EX: EXIT COURSES - TY							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMEX0691	Foundation Course in Artificial Intelligence Applications	3	-	-	3	3
2	UAMEX0692	Foundation Course in Information Security	3	-	-	3	3
3	UAMEX0693	Training	2	-	-	2	2
		Total:				**8**	**8**

HN: B. Tech Honors (Cyber Security)							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMHN0351	Fundamentals of Cyber Security	3	1	-	4	4
2	UAMHN0451	Applied Cryptography	3	1	-	4	4
3	UAMHN0551	Ethical Hacking	3	1	-	4	4
4	UAMHN0651	Blockchain Technology	3	1	-	4	4
5	UAMHN0751	Mini Project	2	-	-	2	2
					Total:	**18**	**18**

MN: Emerging Minor Specialization Courses							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UAMMN0361	Learning Analytics	3	1	-	4	4
2	UAMMN0461	ML DevOps	3	1	-	4	4
3	UAMMN0561	Advanced Deep Learning	3	1	-	4	4
4	UAMMN0661	Generative AI	3	1	-	4	4
5	UAMMN0761	Vision Transformer	2	-	-	2	2
					Total:	**18**	**18**

Credit Distribution



Pie chart showing the distribution of credits

SEMESTER VII													
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs/ Week**	**Credits**	**Evaluation Scheme (Components)**				
1	PC	UAMPC0701	Cyber and Blockchain Security	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
2	PC	UAMPC0702	Generative and Agentic AI	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
3	PC	UAMPC0703	ML DevOps	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
4	PE	UAMPE07**	Program Elective-III	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
5	OE	UAMOE0721	Open Elective-III	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
6	PC	UAMPC0731	Generative and Agentic AI Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10		
7	PC	UAMPC0732	ML DevOps Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10		
8	RM	UAMIL0771	Project-I	-	-	2	2	4	ISE I ESE (OE)	50 50	40		
12	MM	UAMMM07**	MM-5	3	-	-	3	3	ESE	100	40		
			Total:				**23**	**23**	**Total Marks: 800** **Total Credit: 23**				

Course Code:	UAMPC0701	L	T	P	Credit
Course Name:	Cyber and Blockchain Security	3			3

Course Prerequisites: Prerequisites: Basic knowledge of programming, machine learning fundamentals, computer networks, and information security.

Course Description:

This course focuses on applying machine learning techniques to cybersecurity and blockchain security for threat detection, malware analysis, intrusion detection, and fraud prevention. It also introduces blockchain security challenges and adversarial machine learning through real-world case studies.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the cyber threat landscape, blockchain fundamentals, and the role of machine learning in security systems	L2	Understand
CO2	Apply machine learning techniques for threat classification, anomaly detection, malware analysis, and blockchain fraud detection.	L3	Apply
CO3	Analyze cybersecurity and blockchain data using feature engineering and clustering to identify security threats.	L4	Analyze
CO4	Analyze Adversarial ML attacks and apply mitigation strategies to enhance model robustness.	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	2			3								2	
CO2	2		3		3	3						2		
CO3		3	2	2									2	
CO4		2	2		3	2						2		

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
2	Mid Semester Examination (MSE)	30%	50% of course contents. (30 Marks)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
4	End Semester Examination (ESE)	50%	100% course contents. (50 Marks)

Course Contents:

UNIT 1 **Introduction to ML in Cybersecurity** **8 Hours**

ML vs traditional security models, Cyber Threat Landscape: malware, phishing, ransomware, botnets, APT'. Attackers' ecosystem: underground markets & automated attack tools, applications in cybersecurity: spam filtering, intrusion detection, fraud analytics, Adversaries using ML for evasion and automated attacks, Limits of ML in cybersecurity: false positives, bias, model drift,

Case Study: AI-Based Email Spam Filtering (Google Gmail)

UNIT 2 **Security Data, Feature Engineering & Blockchain Data Fundamentals** **8 Hours**

Security data types: logs, PCAP, IDS/IPS data, malware features, phishing datasets, Data labeling issues and security metrics, Feature extraction & selection for security datasets, Dimensionality reduction and handling dataset bias,

Blockchain data basics: Blocks, transactions, smart contracts, Data immutability, transparency, cryptographic hashes, extracting blockchain transaction patterns

Case study: Phishing Website Detection Using Feature Engineering

UNIT 3	Blockchain Technology & Cybersecurity	8 Hours

Blockchain architecture: nodes, miners, distributed ledgers, Consensus algorithms: PoW, PoS, PBFT, Blockchain security properties: decentralization, integrity, trustless validation, Blockchain vulnerabilities: 51% attacks, Sybil attacks, double spending, Smart contract security flaws: reentrancy, logic bugs. Application of ML in blockchain security: Detecting fraudulent transactions, Classifying smart contract vulnerabilities, Blockchain anomaly detection

Case Studies: Ethereum DAO attack

UNIT 4	Threat Classification, Clustering & Anomaly Detection	7 Hours

Supervised ML algorithms for threat detection: Decision Trees, Random Forest, Clustering for attack grouping and anomaly identification, Evaluation metrics: precision, recall, F1-score, Anomaly detection in host, network., Unsupervised detection: k-means, DBSCAN, Practical issues: feature engineering, explainability, threshold tuning.

Case study: Intrusion Detection Using UNSW-NB15 Dataset

UNIT 5	Malware Analysis, Network Security & Web Protection	7 Hours

Malware analysis: static, dynamic, and hybrid analysis models for malware classification Network traffic analysis & botnet detection in detecting intrusions, DDoS, and APT behavior, Web security threats: account takeover, financial fraud. Blockchain network threats: node misbehavior, anomalous transaction flow, Deployment challenges: latency, scale, real-time detection.

Case study: ML-Based Botnet Traffic Detection

UNIT 6	Adversarial Machine Learning & Security Challenges	7 Hours

Introduction to adversarial ML, ML vulnerabilities: poisoning, evasion, inversion, model stealing, Attack techniques & transferability, Defenses: adversarial training, model hardening, input sanitization, Real-world adversarial cases in malware and blockchain-based ML models, Human-in-the-loop security, model interpretability & reliability

Case study: Evasion Attacks on Malware Classifiers

Text Books:

[1] Chio, Clarence, and David Freeman. *Machine Learning and Security*. 1st edition. O'Reilly Media, Inc., 2018

[2] S. Dua and X. Du, *Data Mining and Machine Learning in Cybersecurity*. Boca Raton, FL, USA: CRC Press, 2011.

[3] M. Yang, S. N. Mohanty, S. Satpathy, and S. Hu, Eds., *Demystifying AI and ML for Cyber–Threat Intelligence*, 1st ed. Cham, Switzerland: Springer, 2025.

[4] M. Morana, H. Singh, and F. Piccoli, *Blockchain Application Security: How to Design Secure and Attack Resilient Blockchain Applications*,

Reference Books:

[1] S. Dua and X. Du, Data Mining and Machine Learning in Cybersecurity. Boca Raton, FL, USA: CRC Press, 2016.

[2] A. Géron, Hands-On Machine Learning with Python. Sebastopol, CA, USA: O'Reilly Media, 2017.

[3] D. Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps. Berkeley, CA, USA: Apress, 2017.

[4] I. Bashir, Mastering Blockchain, 2nd ed. Birmingham, U.K.: Packt Publishing, 2018.

Web Resources:

[1] http://onlinecourses.nptel.ac.in/noc25_cs16/preview

[2] http://onlinecourses-archive.nptel.ac.in/noc18_cs47/course

[3]https://www.coursera.org/learn/blockchain-security

[4] https://www.coursera.org/learn/machine-learning-and-emerging-technologies-in-cybersecurity

[5]https://www.udemy.com/topic/cyber-security/

[6]https://www.udemy.com/topic/blockchain/

Course Code:	UAMPC0702	L	T	P	Credit
Course Name:	Generative and Agentic AI	3			3

Course Prerequsites:

Mathematicla Foundations , Machine Learning, Deep Learning Basics and Natural Langugage Processing fundamentals

Course Description:

This course provides a basic understanding of Genertive and Agentic AI with respect to its evolution, essentials, efficiency, delivery, user models, and working of different Generative and Agentic AI applications.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Understand fundamentals and impact of Generative AI	L2	Understand
CO2	Apply prompt engineering and reasoning techniques	L3	Apply
CO3	Analyze deep generative models and LLM architectures	L4	Analyze
CO4	Design and evaluate agentic AI solutions	L6	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	1				2	2				1	1		
CO2	2	3	1	2	2						2	2	2	
CO3	3	2	2		3			1	1		1	2	3	
CO4	3	3	3	2	3	1	1	2	1	1	2	3	3	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
2	Mid Semester Examination (MSE)	30%	50% of course contents. (30 Marks)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
4	End Semester Examination (ESE)	50%	100% course contents. (50 Marks)

Course Contents:

UNIT 1	Foundations of Generative AI and Deep Sequence Gen AI Language Models	8 Hours

Introduction to Generative AI – Difference between Generative AI , Agentic AI & Agent,Statistical Models: N-Gram, HMM, and their limitations– Word Embeddings: Word2Vec, GloVe, FastText – Contextual Embeddings – Applications ,Introduction to Sequence Models – Recurrent Neural Network (RNN) – Long Short Term Memory (LSTM) – Gated Recurrent Units (GRU) - Generative Models:Variational Audoencoders (VAE) - Generative Adversarial Networks (GAN) –CycleGAN – StyleGAN.

UNIT 2	Core Architectures of LLMs	8 Hours

Introduction to Transformers – Encoder-decoder architecture – Self-attention mechanism – Text Generation: Greedy Search Decoding, Beam Search Decoding, Sampling methods (Top-k, Nucleus Sampling) – Models: BERT, GPT-4, Claude 3, Llama 3, Gemini) - Evaluating model performance: BLEU, ROUGE

UNIT 3	Prompt Engineering	8 Hours

Fundamental of prompt engineering- Prompt Elements - Techniques: Zero-shot, oneshot, few-shot and Chain-of-thought (CoT) – Automatic Prompt Engineer (APE) – Graph Prompt - Vector Databases - FAISS - Pinecone – Parameter Efficient Fine Tuning - Prompting in Retrieval Augmented Generation (RAG) – Pipeline – Core Components - Forward-Looking Active Retrieval-Augmented Generation (FLARE).

UNIT 4	Deployment Models	8 Hours

Model Optimization for Deployment: Quantization Techniques - Cloud Hosting –OpenAI – Hugging Face – Vertex AI FastAPI – On-Premises Hosting Requirements and Challenges – DeepLake – vLLM – Ollama – Hybrid LLM Deployment – MCP Workflow, Case Study :Agno Framework.

UNIT 5	Agentic AI LLM Fine-tuning & Agent Development	7 Hours

Introduction to Agentic AI and autonomous systems ,Agent architectures: Single-agent vs. Multi-agent systems ,Reasoning frameworks: Chain-of-Thought, Tree-of-Thought, Graph-of-Thought ,Agent memory and state management ,evaluation metrics for AI agents ,Multi-agent systems: Coordination and communication .

UNIT 6	**Agentic AI & Enterprise Applications**	**6 Hours**

Agentic AI frameworks: LangChain, LlamaIndex, AutoGen, CrewAI Workflow , automation with AI agents. Agno framework

Text Books:

1. Tanmoy Chakraborty, "Introduction to Large Language Models – Generative AI for Text", Wiley, 1st Edition, 2024
2. Thimira Amaratunga, "Understanding Large Language Models: Learning Their Underlying Concepts and Technologies", Apress, 1st Edition, 2021.
3. Denis Rothman, Chip Huyen, "RAG-Driven Generative AI and AI Engineering".
4. Michael Albada, "Building Applications with AI Agents: Designing and Implementing Multiagent Systems".
5. Salvatore Raieli , Gabriele Iuculano, Ken Huang , "LLM Design Patterns: A Practical Guide to Building Robust and Efficient AI Systems, Building AI Agents with LLMs, RAG, and Knowledge Graphs".

Reference Books:

1. Christopher Raynor, "The Most Complete AI Agentic Engineering System: Step-by-step guide to build, optimize, and scale LLM agents—with exclusive monthly and rigorous metrics, and built-in self-improvement Paperback" – October 1, 2025.
2. Anjanava Biswas and Wrick Talukdar , "Building Agentic AI Systems: Create intelligent, autonomous AI agents that can reason, plan, and adapt".
3. Ben Auffarth (Author), Leonid Kuligin, "Generative AI with LangChain: Build production-ready LLM applications and advanced agents using Python, LangChain, and LangGraph", 2nd Edition.

Web Resources:

1. https://www.youtube.com/watch?v=y1fGlAECNFM&list=PLXV9Vh2jYcjbnv67sXNDJiO8MWLA3ZJKR
2. https://www.youtube.com/watch?v=yC36gN-rqjo&list=PLKnIA16_RmvYsvB8qkUQuJmJNuiCUJFPL

Course Code:	UAMPC0703	L	T	P	Credit
Course Name:	ML DevOps	3			3

Course Prerequsites:

Python, Machine Learning

Course Description:

This course introduces ML DevOps concepts including lifecycle management, drift detection, experiment tracking, pipeline automation, and deployment strategies. It covers cloud-native technologies such as AWS services, Docker, and Kubernetes, enabling students to efficiently build, deploy, and manage scalable and secure cloud-based applications.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the fundamentals of ML DevOps, the ML lifecycle, and different types of drift affecting ML models.	L2	Understand
CO2	Interpret key cloud computing concepts, architectures, and virtualization techniques used in modern computing environments.	L2	Understand
CO3	Apply AWS compute, storage, networking, serverless, and monitoring services in building cloud-based applications.	L3	Apply
CO4	Analyze AWS cloud security architecture and essential data protection mechanisms.	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	2	2			1	1				1		2	
CO2	2	2	1		2	2			2		1	1	2	
CO3	3	2	2		2	2	2		1		2	1	2	
CO4	2	2	2			3					2	1	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
2	Mid Semester Examination (MSE)	30%	50% of course contents. (30 Marks)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
4	End Semester Examination (ESE)	50%	100% course contents. (50 Marks)

Course Contents:

UNIT 1 Introduction to ML DevOps & ML Lifecycle — 8 Hours

Introduction – Definition, Evolution from DevOps to MLOps, Need for ML DevOps in modern ML systems.Types of Drift – Data Drift, Concept Drift, Feature Drift, Model Drift, Prediction Drift.Model Versioning (Model Registry). Reproducibility – Experiment Tracking

UNIT 2 Introduction to Cloud Computing — 8 Hours

Definition of Cloud Computing, Need for Cloud computing, key computing platforms and technologies. Concepts involved in building cloud computing environments, followed by the principles of parallel and distributed computing, including a comparison between parallel and distributed models. Discussion on the core elements of parallel and distributed systems and the technologies that support distributed computing. Examination of cloud characteristics, various virtualization techniques, the relationship between virtualization and cloud computing, and the advantages and limitations of virtualization.

UNIT 3 Cloud Reference Architecture and AWS EC2 Concepts — 8 Hours

Cloud Reference Model, Types of Clouds – Public, Private, Hybrid and Community cloud, Types of Services – IaaS, PaaS, SaaS, Economics of Clouds, Open Challenges, Public Clouds Service providers: Amazon Web Services (AWS), Google Cloud Platform (GCP), and Microsoft Azure. Introduction to the AWS Cloud, AWS core services by categories. Compute service: Introduction to EC2, Amazon Machine
Images, Instance Types. Instance Lifecycle.

UNIT 4	AWS Storage Services and Kubernetes–EKS Platform	7 Hours

AWS Storage service: Introduction to S3, working with Buckets, setting bucket security, S3 event and notifications, bucket properties, S3 lifecycle management, working with Elastic Block Store Volumes, and Object Storage Vs Block Storage. Difference between Virtualization and Containers. Introduction to Containers, Docker and its architecture, Understanding Docker and Kuberentes, EKS service

UNIT 5	Cloud Service Models on AWS: Network, Serverless, Monitoring, and Application Services	7 Hours

Network as a Service: Introduction to virtual private cloud, Subnet, Elastic Network Interfaces, Internet Gateways, Route Tables, Security Groups and network access control lists. Serverless Computing: Introduction, Working with Serverless environment, Basics of serverless events and functions, AWS Lambda. Monitoring as a service: Introduction to AWS CloudWatch, CloudWatch Metrics, CloudWatch Alarms. Content Delivery Services - Amazon CloudFront Deployment & Management Services: Amazon Elastic Beanstalk, Amazon CloudFormation. Application services: AWS Simple Notification Service (SNS), Simple Queue Service (SQS), and Simple Email Service (SES).

UNIT 6	Cloud Security	7 Hours

Security overview, cloud security and shared responsibility model, cloud security challenges, Cloud Security Risks and countermeasures, Host security in IaaS, PaaS and SaaS. Data Security, Data Security Concerns, Data Confidentiality and Encryption, Data Availability, Data Integrity, Cloud Storage Gateways, Cloud Firewall, Introduction to AWS Key Management Service (KMS)

Text Books:

1. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education, First Edition, 1 st July 2017.
2. Cloud Computing and Services by Arup Vithal, Bhushan Jadhav, Star Edu Solutions, SYBGEN Learning India Pvt. Ltd.
3. Cloud Computing: A Practical Approach for Learning and Implementation by A. Srinivasan, J. Suresh, Pearson, First Edition, 1 st January, 2014.
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz, Russell Dean Vines, Wiley & Sons, First Edition.

Reference Books:

1. Cloud Computing Black Book by Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Deven Shah, Dream tech Press, Second Edition, 1 st January 2014.
2. Amazon Web Services in Action by Michael Wittig, Andreas Wittig, Manning Publisher, Second Edition.
3. To the cloud: Cloud powering an Enterprise, Arora Pankaj, Raj Biyani, Salil Dave Tata Mc Graw Hill Education, First Edition, 20 th January,2012.
4. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Kai Hwang, Morgan Kaufmann Publishers Inc, First Edition, 22 nd November 2011.

Web Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc22_cs20/preview
2. OpenStack Installation Guide: https://docs.openstack.org/install-guide/
3. Eucalyptus Installation: https://docs.eucalyptuscloud.org/eucalyptus/4.4.4/install-guide-4.4.4.pdf
4. AWS Management Console: https://aws.amazon.com/console/
5. https://ndl.iitkgp.ac.in NOC: Cloud Computing https://rb.gy/wyjtjx
6. https://ndl.iitkgp.ac.in NOC :Cloud Computing and Distributed Computing –Virtualization https://rb.gy/uuyzq3

Course Code:	UAMPE0711	L	T	P	Credit
Course Name:	Data and Storytelling(PE-III)	3			3

Course Prerequsites:

Basic data literacy, familiarity with visualization tools (like Excel, Tableau, or Power BI), and a foundational understanding of data analysis concepts.

Course Description:

This course provides a teach professionals to translate complex data analytics into compelling, actionable narratives, combining data visualization with communication strategy to drive decision-making. It covers the more complex concepts that become involved when working beyond simple datasets. Exploring the connection between visual aspects and data understanding, we will examine how those concepts work together through data storytelling.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Understand different types, sources, and representations of data, and perform basic preprocessing using modern tools.	L2	Understand
CO2	Develop primary data collection strategies using surveys, interviews, and sampling techniques with ethical considerations.	L3	Apply
CO3	Make use of sensors for real-time data logging, transmission, and visualization while addressing data quality and privacy issues.	L3	Apply
CO4	Construct structured analysis reports and visual narratives to communicate insights clearly and ethically using dashboards and notebooks.	L3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	2	2											2		
CO2	3	2	3		2				2		2	3	3		
CO3	3	2			3	2	2				2	3			
CO4	2		2		2		2		1		3	2	3		

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

UNIT 1 Introduction — **7 Hours**

Understanding Data: Types, Sources, and Preparation: What is data and why it matters, Types of data – qualitative, quantitative, structured, unstructured, 3Vs of big data – volume, velocity, variety, Common data sources – government portals, sensors, APIs, crowd sourced platforms, Data representations – tabular, relational, JSON, XML formats, Introduction to spreadsheets and data frames, Basics of data preprocessing – missing value handling, normalization, type casting, cleaning workflows using Python (pandas) or spreadsheets

UNIT 2 Data Collection for Exploratory Research — **8 Hours**

Methods of primary data collection – surveys, interviews, FGDs, observations, Designing structured questionnaires and interview guides, Ensuring question clarity, neutrality, and goal alignment, Sampling strategies – random, stratified, purposive sampling, Field planning and respondent communication, Ethical considerations – consent, privacy, data sensitivity, Transcription and textual data cleaning.

UNIT 3 Sensor Data and Logging — **8 Hours**

Sensor Data Collection and logging: Introduction to IoT and embedded data logging, Sensor interfacing – temperature, humidity, motion, light sensors, Analog-to-digital conversion and signal conditioning, Sampling rates and real-time clock synchronization, Wireless transmission – BLE, Wi-Fi, LoRa, Local and remote data logging – SD cards, cloud platforms, Handling data quality issues – noise, missing values, power constraints, security and privacy (Man in the middle attacks). Real-time plotting, Visualizing trends, anomalies, and multi-sensor overlays, Debugging and optimizing embedded data pipelines, Mapping Urban Tree Inequality: A Data-Driven Look at Green Access, Building a Local Data Chain to Map Green Equity in Our Cities, Project Pakshi

UNIT 4	**Storytelling through Data:**	**8 Hours**
Communicating patterns and trends with clarity, Building simple, reproducible analysis notebooks, Introduction to data storytelling and presentation, Structuring analysis reports – insights, visuals, limitations, Creating visual narratives – dashboards, summaries, infographics, Ethical data interpretation – avoiding bias and misrepresentation		
UNIT 5	**Pseudoreplication**	**7 Hours**
Pseudoreplication in Action,Accounting for Pseudoreplication, Batch Biology,Synchronized Pseudoreplication , P VALUE AND THE BASE RATE FALLACY- The Base Rate Fallacy, Red Herrings in Brain Imaging,Controlling the False Discovery Rate		
UNIT 6	**Statistics Done Wrong:**	**7 Hours**
Statistical Significance, Statistical Power, and the Problem of Underpowered Studies, Pseudoreplication, Model Abuse, Researcher Freedom, Hiding the data. Final project – design, collect, visualize, and present data using field instruments, embedded systems, or secondary sources		
Text Books:		
1. Storytelling with Data: A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, Wiley Publications, 2015, ISBN-13: 978-1119002253. 2.Sensor Data Analysis and Management: The Role of Deep Learning, Editors: A. Suresh, R. Udendhran, M. S. Irfan Ahmed, Wiley-IEEE Press, 2021, ISBN-13: 978-1119682424.		
Reference Books:		
1. The Craft of Research, Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams, University of Chicago Press, Fifth Edition, 2024, ISBN-13: 978-0226826677. 2. Statistics Done Wrong: The Woefully Complete Guide, Alex Reinhart, No Starch Press, 2015, ISBN-13: 978-1593276201		
Web Resources:		
1. https://www.udemy.com/course/the-complete-data-storytelling-masterclass-certificate 2. Online Coursera Course, "https://www.coursera.org/specializations/Data Storytelling"		

Course Code:	UAMPE0712	L	T	P	Credit
Course Name:	Time Series Analysis (PE-III)	3			3

Course Prerequsites:

Probability & Statistics, Linear Algebra & Calculus,Basic Machine Learning

Course Description:

This course provides a comprehensive study of time series analysis, covering statistical models, forecasting techniques, and modern AIML applications such as ARIMA, GARCH, and deep learning methods for sequential data.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the fundamental concepts and components of time series data and their relevance in analysis.	L2	Understand
CO2	Analyze stationary and non-stationary time series models.	L4	Analyze
CO3	Evaluate various advanced forecasting techniques.	L5	Evaluate
CO4	Outline the theoretical applications of time series models.	L2	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2			1						1	3	1	
CO2	3	3	1	2	2						1	3	2	
CO3	2	3	2	2	3						2	3	3	
CO4	2	2	1		2	2	1		1		2	2	3	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
2	Mid Semester Examination (MSE)	30%	50% of course contents. (30 Marks)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
4	End Semester Examination (ESE)	50%	100% course contents. (50 Marks)

Course Contents:

UNIT 1	Introduction to Time Series	7 Hours

Time plots, Time series patterns, Seasonal plots, Seasonal subseries plots, Scatterplots, Lag plots, Autocorrelation, White noise, Time series decomposition, Time series features

UNIT 2	Time series regression models	7 Hours

The linear model,Least squares estimation,Evaluating the regression model,Selecting predictors, Nonlinear regression, Exponential smoothing

UNIT 3	ARIMA Models	8 Hours

Stationarity and differencing, Autoregressive models, Moving average models, Non-seasonal ARIMA models, Estimation and order selection, Seasonal ARIMA models, ARIMA vs SARIMA, ARIMA vs ETS, Box-Jenkins methodology

UNIT 4	Advanced Models	8 Hours

VAR, ARCH/GARCH models, State-space models and Kalman filters, LSTM/GRU models, Transformers

UNIT 5	Advanced forecasting methods	8 Hours

Complex seasonality, Prophet model, Vector autoregressions, Neural network models, Bootstrapping and bagging

UNIT 6	Applications & Case Studies	7 Hours

Financial forecasting: stock returns, volatility, portfolio risk ; Industrial applications: demand forecasting, predictive maintenance; Energy and climate data analysis; Real-world project: building and validating a forecasting model; Ethical and practical considerations in deploying time series models

Text Books:

1. Forecasting: Principles and Practice by Hyndman and Athanasopoulos.
2. Box, G. E. P., Jenkins, G. M., Reinsel, G. C., & Ljung, G. M. (2016). Time series analysis: Forecasting and control (5th Edition, Wiley Publication)
3. Brockwell, P. J., & Davis, R. A. (2016). Introduction to time series and forecasting (3rd ed.). Springer.
4. Hamilton, J. D. (1994). Time series analysis. Princeton University Press.

Reference Books:

1. Shumway, R. H., & Stoffer, D. S. (2017). Time series analysis and its applications: With R examples (4th ed.). Springer.
2. Chatfield, C. (2019). The analysis of time series: An introduction (7th ed.). Chapman & Hall/CRC.
3. Tsay, R. S. (2010). Analysis of Financial Time Series (3rd Edition, Wiley Publication)

Web Resources:

1. https://otexts.com/fpp3/
2. https://onlinecourses.nptel.ac.in/noc21_ch28/preview

Course Code:	UAMPE0713	L	T	P	Credit
Course Name:	Big Data Analytics (PE-III)	3			3

Course Prerequsites:

Python, Data Structures and Algorithm, DBMS

Course Description:

This course covers the fundamental concepts of Big Data, including data characteristics, architectures, distributed storage, and NoSQL models. It offers practical exposure to the Hadoop ecosystem—HDFS, YARN, MapReduce, Pig, and Hive—for large-scale data processing and querying. Students are further trained in Apache Spark for advanced analytics, Spark SQL operations, and graph computations using GraphX.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain fundamental concepts of Big Data, its characteristics, architectures, storage systems, NoSQL models, and distributed processing principles.	L2	Understand
CO2	Interpret Hadoop ecosystem components including HDFS, YARN, MapReduce, Pig, and Hive, along with their data models, operations, and query mechanisms.	L2	Understand
CO3	Apply Big Data processing techniques by developing programs using MapReduce, executing data transformations using Pig Latin, and performing data warehousing tasks using HiveQL.	L3	Apply
CO4	Analyze large-scale distributed datasets using Apache Spark by evaluating RDD operations, Spark SQL processing, and graph-based computations using GraphX.	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	2	2			1	1				1		2	
CO2	2	2	1		2	2			2		1	1	2	
CO3	3	2	2		2	2	2		1		2	1	2	
CO4	2	2	2			3					2	1	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
2	Mid Semester Examination (MSE)	30%	50% of course contents. (30 Marks)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
4	End Semester Examination (ESE)	50%	100% course contents. (50 Marks)

Course Contents:

UNIT 1	Big Data Concepts and Architecture	8 Hours

Understanding Big Data: Concepts and terminology, Big Data characteristics; Types of data – structured, semi-structured, unstructured; Identifying data characteristics; Big Data architecture; Big Data storage – File system and Distributed File System; NoSQL databases; Sharding, Replication; ACID and BASE properties

UNIT 2	Hadoop Framework and MapReduce	8 Hours

Hadoop ecosystem overview; HDFS architecture; YARN – ResourceManager and NodeManager; Hadoop I/O concepts; MapReduce programming model; Developing MapReduce programs – types and formats; Sorting, joins, and pipelining of MapReduce jobs.

UNIT 3	Hadoop Ecosystem – Pig	8 Hours

Introduction to Pig: What is Pig, Pig architecture, Pig on Hadoop, Pig philosophy; Parallel processing using Pig; Grunt shell; Pig data model – scalar, tuple, bag, map; Pig Latin – relational operators, eval functions, complex data types, User Defined Functions (UDFs); Pig scripts; HDFS commands; Piggy Bank; Pig vs Hive.

UNIT 4	Hadoop Ecosystem – Hive	7 Hours

Introduction to Hive: What is Hive, Hive architecture, Hive modules; Hive data types and file formats; HiveQL – DDL, DML, queries, and views; Hive scripts; RC file implementation; Partitioning vs Bucketing; Indexes and aggregate functions; User Defined Functions (UDFs).

UNIT 5	**Apache Spark Fundamentals**	**7 Hours**

Spark overview and evolution; Hadoop vs Spark – differences and use cases; Spark cluster architecture and cluster managers; RDDs – creation, operations, persistence; Transformations and actions; Lazy evaluation; Spark jobs and execution flow.

UNIT 6	**Spark Data Processing, SQL & GraphX**	**7 Hours**

Writing Spark applications in Scala, Python, Java, R; Spark execution model; Spark SQL – SQLContext, DataFrames; Importing, transforming, and saving data; SQL queries in Spark; GraphX overview – graph creation; Graph algorithms – PageRank, connected components, etc.

Text Books:

1. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers &Techniques, Pearson India Education Service Pvt. Ltd., First Edition, 2016.
2. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, Inc., Fourth Edition, 2015 3. Douglas Eadline,"Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1 stEdition, Pearson Education, 2016. ISBN-13: 978-9332570351

Reference Books:

1. Alan Gates, Programming Pig Dataflow Scripting with Hadoop, O'Reilly Media, Inc, 2011.
2. Jason Rutherglen, Dean Wampler, Edward Caprialo, Programming Hive, O'ReillyMedia Inc,2012
3. Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015. 4. Eric Sammer,"Hadoop Operations: A Guide for Developers and Administrators",1 stEdition, O'Reilly Media, 2012.ISBN-13: 978-9350239261

Web Resources:

1. https://nptel.ac.in/courses/106104189
2. https://www.coursera.org/learn/introduction-to-big-data-with-spark-hadoop

Course Code:	UAMPC0731	L	P	Credit
Course Name:	Generative & Agentic AI Lab		2	2

Course Prerequsites:

Python Programming Language, Machine Learning,Basics Of Linear Algebra,Probability and Stats .Basics Of Generative AI and Agentic AI

Course Description:

Understanding the concepts of Generative AI and Agentic AI Model with Implementation

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Implement Natural Language Processing techniques and apply word embeddings for real-world tasks.	L3	Apply
CO2	Design and train Generative AI models such as GANs and VAEs, and explore their practical applications.	L4	Analyze
CO3	**Design** and develop real-world AI applications such as intelligent assistants, RAG systems, and multi-agent solutions by integrating multiple generative AI models and tools.	L6	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO11	PSO1	PSO2	
CO1	3	2	2	2	3		2	3	2	1	3	3	2	
CO2	2	2	2	3	3		2	3	2	1	2	3	2	
CO3	3	3	2	3	3		2	3	2	2	3	3	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	100%	Quiz/Assignments/Group Discussions/Internal oral
2	ESE(POE)	100%	Assesment is based on practicle oral performance

Course Contents:

EXPERIMENT NO. 1	NLP Sentiment Analysis Pipeline	2 Hours

Tools: NLTK, Scikit-learn, Gensim

- Preprocess text (tokenise, remove stop words, lemmatise).
- Convert words to vectors using Word2Vec.
- Use Cosine Similarity to measure sentiment clusters.
- Train classifier (e.g. SVM or Logistic Regression) to label sentiment.

EXPERIMENT NO. 2	GAN for Digit Generation (MNIST)	2 Hours

● Build generator (Dense → ReLU → Tanh). ● Build discriminator (Dense → LeakyReLU → Sigmoid). ● Train with adversarial loss. ● Visualise generated digits vs real ones		
EXPERIMENT NO. 3	**Transformer-based Text Summariser**	**2 Hours**
Tools: Huggingface Transformers ● Use a pre-trained BART or T5 model. ● Fine-tune on summarisation dataset (e.g. CNN/DailyMail). ● Explain role of self-attention, positional encoding. ● Evaluate with ROUGE score.		
EXPERIMENT NO. 4	**GPT Chatbot for Student Queries**	**2 Hours**
Tools: OpenAI API ● Use few-shot prompting to handle questions like "When is the exam?" ● Add relevant context. ● Example prompt: "You are a student help bot. Q: When is exam? A: Exams are in May." ● Wrap in simple UI using Flask/Streamlit.		
EXPERIMENT NO. 5	**QnA with LangChain and Vector DB (RAG)**	**2 Hours**
Tools: LangChain, FAISS/Chroma, GPT API ● Load documents (e.g. college handbook). ● Create embeddings with OpenAI/any encoder. ● Store in FAISS DB. ● Query via LangChain RAG pipeline. ● Use LangChain tools like RetrievalQA.		
EXPERIMENT NO. 6	**Compare Prompting Methods for Math QnA**	**2 Hours**
● Write three prompts: o Zero-shot: "What is 12 + 15?" o Few-shot: Add examples. o CoT: "Let's think step by step." ● Evaluate accuracy on word problems. ● Compare output quality & reasoning steps.		
EXPERIMENT NO. 7	**Ethics + AI Art with Diffusion Model**	**2 Hours**
Tools: Stable Diffusion via Huggingface ● Generate art with prompts like: “A fantasy cityscape in rain.” ● Discuss: misuse (deepfakes), bias in training data, authorship. ● Add watermarking or disclaimers as ethical measures.		
EXPERIMENT NO. 8	**Duplicate Detection using BERT**	**2 Hours**

Tools: sentence-transformers
- Use SBERT to convert questions into vectors.
- Calculate cosine similarity.
- Mark duplicates if score > threshold (e.g., 0.85).
- Evaluate using a dataset like Quora duplicates.

EXPERIMENT NO. 9	**Resume Evaluator with Prompting Strategies**	**2 Hours**

- Input: Candidate resume (PDF/Text).
- Convert to structured info.
- Prompt:

"Evaluate the resume for data science job. Give strengths and weaknesses."

- Use ReAct prompting for feedback + suggestions.
- Output: Suggestions (skills to add, grammar issues, etc.).

EXPERIMENT NO. 10	**AI Tutor System Using Agentic AI**	**2Hrs**

Objective:- Build adaptive learning assistant Features:- Personalized lessons, Q&A, progress tracking
Tools:- RAG for educational content, assessment generation

EXPERIMENT NO. 11	**Micro Project /PBL**	**4 Hrs**

a) SkillTutor: AI-Powered Concept Explainer
b) ExamPal: Question Paper Generator
c) LegalBot: AI Legal Aid Assistant
d) TalkDoctor: Symptom Checker Chatbot
e) FeedbackGenie: AI Feedback for Assignments
f) PromptArt Master: AI Image Prompt Generator
g) LearnFlow: AI-Powered Flashcard Creator
h) PersonaGen: Character Generator for Stories or Games
i) TravelGPT: Custom Itinerary Planner
j) AdCopy AI: Product Ad Generator
OR
Any other of your choice

PROGRAM BASED LEARNING (PBL)	

A team may include to a maximum of 3 members.
1. Concepts studied in the subject to be used.
2. Down to earth application and innovative idea should have been attempted.
3. Report in Digital format with all evaluations and analysis to be submitted.

Assessment on a continuous basis with a minimum of 3 reviews.
Sample project domains:
1. Personalized AI Tutor using Agentic AI
2. Crop Disease Detection and Advisory System using Generative Vision AI
3. Healthcare Clinical Report Generation Assistant
4. Autonomous Multi-Agent Research Assistant

Text Books:	

1. Generative AI with Large Language, Models Lewis Tunstall, Leandro von Werra, Thomas Wolf Publisher: O'Reilly Media
2. Hands-On Large Language Models , Jay Alammar, Maarten Grootendorst Publisher: O'Reilly Media

Course Code:	UAMPC0732	L	T	P	Credit
Course Name:	ML DevOps Laboratory			2	1

Course Prerequsites:

Python, Machine Learning

Course Description:

This lab provides hands-on experience in ML DevOps through environment setup, model training, tracking, and containerization. Students will work with key AWS services such as IAM, EC2, S3, SageMaker, and serverless components to deploy and manage ML workflows. The course also emphasizes scalable deployment using Kubernetes and secure cloud practices including encryption and access management

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the fundamentals of ML DevOps workflows by understanding environment setup, virtual environments, model training, and experiment tracking using MLflow.	L2	Understand
CO2	Apply cloud computing and containerization skills by managing AWS IAM, configuring EC2 and S3 services, and containerizing ML applications using Docker."	L3	Apply
CO3	Analyze and implement scalable ML deployment architectures by using Kubernetes, training and deploying models with SageMaker, building serverless workflows, and applying secure data encryption on AWS	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	1	3	2	2					1		2	2	2		
CO2	1	2	3	3					2		2	2	2		
CO3	1	3	2	2					1		2	3	2		

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	50%	Quiz/Assignments/Group Discussions/Internal oral
2	POE	50%	Practical exam

Course Contents:

EXPERIMENT NO. 1	Environment Setup for ML DevOps	2 Hours

Set up Python, virtual environments, and essential ML libraries. Initialize Git repository and configure basic ML DevOps workspace.

EXPERIMENT NO. 2	Model Training & Experiment Tracking Using MLflow	2 Hours

Train ML models and log parameters, metrics, and artifacts using MLflow Tracking. Compare experiment runs for performance analysis.

EXPERIMENT NO. 3	Introduction to AWS , VertexAI	2 Hours

Manage IAM by exploring users, groups, and policies, adding users to groups, and understanding policy effects.

EXPERIMENT NO. 4	Introduction to Azure	2 Hours

Perform launching of an VM instance, configuring the required security groups, and monitoring as well as resizing the VM instance

EXPERIMENT NO. 5	Introduction to Amazon S3 and Azure Blob Storage	2 Hours

Create an S3 bucket, Azure BLOB, upload objects, and manage access using permissions and bucket policies.		
EXPERIMENT NO. 6	**To study and Implement Containerization using Docker**	**4 Hours**
Create a Dockerfile for ML inference, build a container image, and run the application in a portable containerized environment.		
EXPERIMENT NO. 7	**Deploying ML Model on Kubernetes**	**4 Hours**
Deploy a Kubernetes cluster, launch applications, create services, and manage YAML-based configurations and deployments.		
EXPERIMENT NO. 8	**Train a Machine Learning Model Using Amazon SageMaker and Azure Machine Learning (Azure ML)**	**4 Hours**
Split datasets, train an XGBoost model on SageMaker, and deploy the trained machine learning model with Azure ML		
EXPERIMENT NO. 9	**Implementing Serverless Architecture on MLflow, VertexAI and Azure**	**4 Hours**
Invoke Lambda using S3/DynamoDB triggers, configure SNS notifications, and build an end-to-end serverless workflow.		
EXPERIMENT NO. 10	**Encrypting Data at Rest by Using AWS Encryption Options**	**4 Hours**
creation of a KMS key, and encryption of EBS and S3 data		
Text Book		
1. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education, First Edition, 1 st July 2017. 2. Cloud Computing: A Practical Approach for Learning and Implementation by A. Srinivasan, J. Suresh, Pearson, First Edition, 1 st January, 2014. 3. Cloud Security: A Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz, Russell Dean Vines, Wiley & Sons, First Edition. 4. Cloud Computing Bible by Barrie Sosinsky, Wiley Publishing, First Edition, 11 th January,2011.		
Reference Books:		
1. Cloud Computing Black Book by Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Deven Shah, Dream tech Press, Second Edition, 1 st January 2014. 2. Amazon Web Services in Action by Michael Wittig, Andreas Wittig, Manning Publisher, Second Edition. 3. To the cloud: Cloud powering an Enterprise, Arora Pankaj, Raj Biyani, Salil Dave Tata Mc Graw Hill Education, First Edition, 20 th January,2012.		
Web Resources		
1. https://nptel.ac.in/courses/108103192 2. https://docs.aws.amazon.com/sagemaker/latest/dg/mlflow-tutorials.html 3. https://sagemaker-examples.readthedocs.io/en/latest/sagemaker-mlflow/sagemaker_deployment_mlflow.html 4. https://docs.aws.amazon.com/machine-learning		

Course Code:	UAMMM0741	L	T	P	Credit
Course Name:	AI-based Medical Automation (MM-V)	3			3

Course Prerequsites:

Students should have foundational knowledge of programming, data structures, machine learning, and basic biomedical concepts, including medical signals and imaging. Familiarity with Python, deep learning frameworks, and statistics will help in practical implementations

Course Description:

This course covers AI-based Medical Automation, integrating machine learning, deep learning, and medical imaging for intelligent healthcare systems, with emphasis on real-world clinical use cases, tools and ethical AI deployment

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Study biomedical systems & healthcare workflows for AI automation	L2	Understand
CO2	Summarize biostatistics, ML & soft computing for clinical decision models	L2	Understand
CO3	Explain DL & GenAI solutions for medical imaging & automation	L2	Understand
CO4	Interpret medical AI systems for security, ethics, compliance & deployment	L2	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	3	2	1	2	2	1		1		1	2	1	
CO2	3	3	2	3	3				1		1	3	3	
CO3	2	3	3	2	3			2	2	1	1	3	3	
CO4	1	2	2	2	2	3	3	1	2	1	3	2	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10
2	Mid Semester Examination (MSE)	30%	50% of course contents. (30 Marks)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10
4	End Semester Examination (ESE)	50%	100% course contents. (50 Marks)

Course Contents:

UNIT 1	Introduction to Medical Automation & Biomedical Foundations	6 Hours

Introduction - Evolution of Medical automation and digital health,AI-driven healthcare ecosystems and smart hospitals ,Overview of hospital automation workflows (OPD, IPD, ICU, Labs),Biomedical signals: ECG, EEG, EMG – acquisition and interpretation,Medical data types used in industry: EHR, sensor data, images, clinical text, Challenges in real-world healthcare data (noise, missing values, imbalance) Use case- Exploration of hospital workflow datasets, ECG Signal Visualization and Analysis, Tools- Python (NumPy, Pandas, Matplotlib, WFDB), Simple peak detection using Plot time-series ECG signal, Summary statistics (mean, variance, min, max)

UNIT 2	Biostatistics, Algorithms & Clinical Data Analytics	7 Hours

Role of biostatistics in evidence-based medicine,Descriptive and inferential statistics for clinical studies, Probability distributions in disease modeling,Hypothesis testing and confidence intervals in trials ,Algorithm selection for medical datasets,Risk scoring systems and predictive analytics, Clinical evaluation methods,Clinical trial data analysis,role of Clinical Data Analyst. Use case- Disease Risk Prediction Using Clinical Data, Population health analytics, Tools- Python (Pandas, SciPy, Scikit-learn, Matplotlib), Disease Risk Prediction Using Clinical Data with Random Forest Classifiers

UNIT 3	Soft Computing & Intelligent Medical Decision Systems	6 Hours

Soft computing paradigms in medical decision making,Fuzzy logic systems for diagnosis under uncertainty Neural networks for clinical decision support,Genetic algorithms for feature and parameter optimization ,Rule-based medical expert systems,Clinical decision support systems,Symptom-based diagnosis platforms, Early warning systems design. Use case- simulate a real CDSS using IBM Watson Health Tools-IBM Watson Studio, IBM Watson Assistant

UNIT 4	**Medical Image Analysis & Deep Learning Applications**	**8 Hours**

Medical imaging modalities: X-ray, CT, MRI, Ultrasound,Image acquisition pipelines in hospitals ,Image preprocessing and enhancement techniques,Feature extraction and deep feature learning, CNNs and transfer learning for medical diagnosis Segmentation, detection, and classification use cases. Ethical and regulatory considerations in imaging AI
Use case-Chest X-Ray Pneumonia Classification using Convolutional Neural Network Tool: Python (TensorFlow/Keras, OpenCV, Matplotlib)

UNIT 5	**AI-Based Medical Automation Systems & Generative AI**	**7 Hours**

End-to-end AI medical automation architectures,NLP pipelines for clinical text processing ,Generative AI for medical report and summary generation,AI medical chatbots and virtual health assistants ,Automation of clinical workflows, Automated discharge summary generation, Clinical text summarization, role of Generative AI Engineer – Healthcare
Use Case-Automated Discharge Summary Generation Using NLP
Tools- Python, Hugging Face Transformers, NLTK

UNIT 6	**Deployable Medical AI Systems**	**6 Hours**

AI System Building – Explainable disease prediction dashboards, End-to-End AI Pipeline Deployment, MLOps Tools for Healthcare AI. Use case - Deploy predictive models for patient risk assessment in hospitals, Train models across multiple hospitals without sharing sensitive data, Simulate multi-hospital model training using PySyft

Text Books:

1. S. Linda et al, “Artificial Intelligence in Healthcare”, Academic Press, 2020
2. Sandeep Reddy (Ed.), Translational Application of Artificial Intelligence in Healthcare: A Textbook, 1st Edition, Chapman & Hall, 2024

Reference Books:

1.Bhanu Chander, Koppala Guravaiah, B. Anoop & G. Kumaravelan (Eds.), Handbook of AI-Based Models in Healthcare and Medicine: Approaches, Theories, and Applications, CRC Press, 2024
2.Mehul S. Raval, Mohendra Roy, Tolga Kaya & Rupal Kapdi (Eds.), Explainable AI in Healthcare: Unboxing Machine Learning for Biomedicine, Chapman & Hall, 2024

Web Resources:

1.https://cloud.google.com/use-cases/ai-in-healthcare?utm_source=chatgpt.com
2.https://www.ibm.com/products/watsonx-ai?utm_source=chatgpt.com

Course Code:	UAMMM0742	L	T	P	Credit
Course Name:	Deep Learning for Finance	3			3

Course Prerequsites:

Stats & Probability Theory, Machine Learning, Deep Learning

Course Description:

This course introduces deep learning techniques for analyzing financial data and solving problems in trading, risk management, and asset pricing. It focuses on financial time-series, market challenges, and practical model implementation for real-world financial applications.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain financial markets, instruments, and data types.	L2	Understand
CO2	Apply deep learning foundations and data preprocessing techniques to prepare and model financial time-series data for predictive tasks.	L3	Apply
CO3	Analyze deep learning models (RNNs, CNNs, TCNs, RL) for financial forecasting, risk modeling, portfolio optimization, and high-frequency trading applications.	L4	Analyze
CO4	Design deep learning based financial solutions, including trading agents and analytical workflows using modern AI tools.	L3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	2	1	1	1	1	1		1	1	2	1	1	
CO2	3	3	2	2	2	1	1	1	1	1	2	2	3	
CO3	3	3	3	3	2	1	1	1	1	2	2	3	3	
CO4	3	3	3	2	3	1	1	2	2	2	2	3	3	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE)	100%	100% course contents. (50 Marks)

Course Contents:

UNIT 1	Introduction to Financial Systems	8 Sessions

Financial markets: equity, derivatives, commodities, forex
Financial instruments: stocks, options, futures, ETFs
Trading, returns, volatility, risk
Types of financial data: time-series, order book, tick data, macro data
Challenges in financial ML: noise, drift, non-stationarity

UNIT 2	Deep Learning Foundations for Finance	7 Hours

Review of DL architectures, Overfitting, regularization, dropout, batchnorm, Time-series DL challenges, Data preprocessing for financial series: log returns, normalization, windowing.

UNIT 3	Financial Time-Series Modelling	8 Hours

RNN, GRU, LSTM for financial forecasting, 1D CNNs for high-speed pattern detection, Temporal Convolutional Networks (TCN), ML vs DL comparison, Case study: stock price movement classification.

UNIT 4	High Frequency Trading	7 Hours

Limit Order Book (LOB) data, DL for LOB prediction (DeepLOB, CNN-LSTM models), Microstructure feature extraction, Latency & execution considerations

UNIT 5	Reinforcement Learning for Finance	6 Hours

RL fundamentals, Q-Learning, DQN, PPO, A2C, Reward design for trading, Market simulators & backtesting, Build: RL-based trading agent

UNIT 6	AI tools	6 Hours

Databricks Community Edition, KNIME Analytics Platform

Text Books:

Fundamentals of Financial Instruments: An Introduction to Stocks, Bonds, Foreign Exchange, and Derivatives, Sunil Parameswaran John Wiley Publications 2011

Reference Books:
1. Deep Learning for Finance by Sofien Kaabar. Orielly Publication 2024. 2. Deep Finance by Glenn Hopper
Web Resources:
https://www.youtube.com/watch?v=yGWKmypU99A&list=PLNRxk1s77zfgubs75vVMzHhPIhWqRo79C https://www.youtube.com/watch?v=UwpBRm-LG44&list=PLJRRZUk2U_9dOV1HLSMVxXqYqUS_kH6ZC

Course Code:	UAMMM0743	L	T	P	Credit
Course Name:	Embedded AI	3			3

Course Prerequsites:

Course Description:

This course introduces the principles, architectures, and implementation techniques of Embedded Artificial Intelligence (Embedded AI), focusing on deploying efficient neural network models on resource-constrained embedded and edge platforms.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the fundamentals of Embedded Artificial Intelligence, its evolution from cloud-	L2	Understand
CO2	Compare lightweight neural network architectures and convolution optimization	L2	Understand
CO3	Make use of deep neural network compression techniques, including pruning, quantization,	L3	Apply
CO4	Identify the role, architecture, and functioning of embedded AI hardware accelerators and	L3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	1			1						2	1	1	
CO2	2	2		1	1						2	2	2	
CO3	2	2	1	1	2						2	1	1	
CO4	2	2		1	2						2	2	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE)	100%	100% course contents. (50 Marks)

Course Contents:

UNIT 1	Embedded AI- Introduction	8 Hours

What Is Embedded Artificial Intelligence? Why Do You Need Embedded Artificial Intelligence? Initial Attempt: Cloud Computing Mode, From Cloud to Device: Local Mode -ARM, Google, Microsoft Technical Challenges of Embedded Artificial Intelligence, Approaches to Implementation Embedded Artificial Intelligence, Components of Embedded Artificial Intelligence Implementation,

UNIT 2	Principle of Embedded AI Chips	8 Hours

Parallel Computing, Systolic Array, Multi-Level Cache, Data Flow -Output Fixed Data Flow, Weight Fixed Data Flow, Input Fixed Data Flow, Row-Fixed Data Flow, Sparse Inference.

UNIT 3	Compression of Deep Neural Network	8 Hours

General Approaches of Neural Network Compression - Pruning, Weight Sharing, Quantization, Binary / Ternary, Winograd Convolution, Model Distillation Compression–Compilation co-Design Concept of Compression–Compilation co-Design Compressor Advantages of Compression–Compilation co-Design, Framework for Embedded Neural Network Applications

UNIT 4	Framework for Embedded Neural Network Architecture	7 Hours

Composition of Hierarchical Cascade System, Efficiency of Hierarchical Cascade System, Hierarchical Face Recognition System, Device-Cloud Collaboration Mode.

UNIT 5	Software Framework for Embedded Neural Networks	8 Hours

TensorFlow Lite, Introduction to TensorFlow Lite, How TensorFlow Lite Works, TensorRT ,Benefits of TensorRT , TensorRT Main Functions , How Tensor RT Works, OpenVINO, Introduction to OpenVINO, Structure of OpenVINO ,OpenVINO Application Development

UNIT 6	**Embedded AI Development Process**	**6 Hours**

General Embedded AI Development Process, Optimizing Embedded Neural Network Models, TensorFlow Model Optimization, Post-training Optimization, Optimization During Training, TensorRT Model Optimization, Integration with Mainstream Deep Learning Frameworks, Deployment to Embedded Systems, Comparison of Two Model Optimization Techniques

Text Books:

1. Li, Ben, and D. T. Nguyen. Embedded Artificial Intelligence: Principles, Platforms and Practices. Springer, 2024.

Reference Books:

1. TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers, Pete Warden & Daniel Situnayake O'Reilly Media, 2019 2.Deep Learning for Embedded Systems: A Practical Approach, Anirudh Koul, Siddha Ganju & Meher Kasam — O'Reilly Media, 2019
3.Deep Learning on Embedded Systems: Intelligent IoT Applications Valentina E. Balas & Lakhmi C. Jain (Eds.) — Elsevier, 2021

Web Resources:

https://www.youtube.com/watch?v=OJnaBhCixng.

https://www.youtube.com/watch?v=7uV3-eTB5es
https://www.youtube.com/watch?v=U8Xmr4rWlNQ
https://www.youtube.com/watch?v=1lXNFks23qE

Course Code:	UAMIL0771	L	P	Credit
Course Name:	Project-I		2	4

Course Prerequsites:

Mini Project, requsites: Knowledge of Project Based Learning (PBL) concepts.

Course Description:

Students are expected to choose real-world contemporary problem in AI & ML domain and apply the engineering principles learned, to solve the problem through building prototypes or simulations or writing codes or establishing processes/synthesis/correlations etc. The department constituted panel will decide the suitability and worthiness of the project

Course Outcomes:	After the completion of the course the student will be able	BL	Descriptio
CO1	**Identify** and analyze complex problems in AI & ML domains through literature survey and data exploration.	L4	Analyze
CO2	**Design** initial AI/ML-based solutions by applying appropriate algorithms, models, and tools.	L3	Apply
CO3	**Demonstrate** skills in project planning and teamwork for successful completion of projects.	L3	Apply
CO4	**Communicate** technical findings effectively through documentation and presentations.	L6	Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			2	1	1	3	1	1	2	3	
CO2	2	2			1	2	1	2	2		3	1	
CO3	2	2	3	3	3	2	2	2	1	3	2	2	3
CO4	2	2		3	3			2	2		3	3	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	100%	Demonstration/Panel Presentation /Assignments /Group Discussions/Internal oral
2	ESE(OE)	100%	Assesment is based on Progres of the project performance

Course Contents:

Guidelines for Project- I

Students must work in groups of 3–4 under a faculty supervisor and complete the project as per the supervisor's guidance. Project progress will be reviewed at least three times by a committee appointed by the HoD. At the end of the semester, students must submit a comprehensive Phase-I project report. Final evaluation will be based on the report and an oral presentation, jointly assessed by internal and external examiners.

I. **Problem Identification**

Prepare a clear problem statement and system/process specifications.
Include a Block Diagram or Concept Tree of the proposed system.
List possible solutions with alternatives, assumptions, and constraints.
Conduct a Cost–Benefit Analysis.
Prepare a Timeline of Activities (Gantt chart preferred).

II. Design Finalization

Prepare a report describing the finalized design.
Justify design decisions based on functional requirements, follow OOMD Design principles.
Include relevant standards, if applicable.

III. Presentation Requirements

Present the Implementation Plan (hardware, software, or both).
Explain the Testing and Validation Strategy.
Highlight Learning Outcomes and key observations.

IV. Consolidated Report Preparation

Prepare a final consolidated report including problem identification, design work, review improvements, implementation plans, testing strategies, and references.

Links for UML Diagrams

Following Platforms for UML, classes diagram and ER diagram:

1. https://staruml.io/
2. gleek.io/blog/uml-vs-erd
3. https://guides.visual-paradigm.com/class-diagram-vs-entity-relationship-diagram-erd-a-comparative-guide/
4. https://creately.com/guides/class-diagram-vs-erd/

SEMESTER VIII												
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs/ Week**	**Credits**	**Evaluation Scheme (Components)**			
1	PE	UAMPE08**	Program Elective-IV	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	OE	UAMPE08**	Program Elective-V	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	RM	UAMIL0871	Project-II	-	-	8	8	4	ISE I ESE (OE)	50 50	40	
4	OJT	UAMIL0872	Internship	-	-	12	12	6	ISE I ISE II	75 75	75	
5	CC	UAMCC0831	Co-curricular Activities-IV	-	-	2	2	1	ISE	50	20	
			Total:				**28**	**17**	**Total Marks: 500** **Total Credit: 17**			

Course Code:	UAMPE0811	L	T	P	Credit
Course Name:	Ethics in AI (PE-IV)	3			3

Course Prerequsites:

A foundational understanding of AI concepts (machine learning, algorithms), familiarity with data analysis (Python, Pandas), and a basic grasp of ethical principles, philosophy, or social sciences

Course Description:

This course Ethics in AI examines the moral, social, and legal implications of artificial intelligence technologies. The course focuses on ethical principles, responsible AI practices, bias and fairness, privacy, accountability, and regulatory frameworks, using real-world case studies to prepare students for ethical decision-making in AI development and deployment.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Understand, Identify ethical principles arising from developing and deploying AI technologies.	L2	Understand
CO2	Examine the moral agency and responsibility of AI systems and their creators.	L3	Apply
CO3	Make use of modern tools in solving ethical issues by exhibiting teamwork through oral presentations and reports.	L3	Apply
CO4	Evaluate the implications of AI on privacy, surveillance, and data ethics in contemporary society, thereby contributing to life-long learning.	L5	Evalute

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1		2					3				2	3	2		
CO2	2		2	2	2		2				2	3	3		
CO3	2	3	2	2	3		3			2	2	3	3		
CO4	2	3	2	3	2		3			2	3	2	3		

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

UNIT 1	Introduction	8 Hours

Introduction to AI and ethics - Strong and weak AI, Types of ethics - Descriptive, Normative, Meta, Relationship between ethics and law, Machine ethics examples, Moral Diversity and Testing
Core Ethical Principles- Bias and Fairness, Transparency and Explainability, Privacy and Security, Robustness and Reliability

UNIT 2	Bais and Fairness	7 Hours

Bias and Fairness – Understanding Bias in data and Models – How Bias can impact Decision Making Process, types of Bias , Examples of Real World Cases, Techniques to detect and Mitigate Bias, Implement Bias Detection and Fairness..

UNIT 3	Transparency and Explainability	8 Hours

Transparency and Explainability - Importance of Transparency and Explainability in AI Models, Methods for Achieving Explainable AI, Tools, Frameworks, and Implementation of Transparency and Explainability, Challenges and Solutions in Achieving Transparency and Explainability

UNIT 4	Privacy and Security	8 Hours

Privacy Concerns in AI - Potential Threats to Privacy , Privacy Attacks in AI Models , Mitigating Privacy Risks in AI
Security Concerns in AI - Potential Threats to Security , Mitigating Security Risks in AI

UNIT 5	Robustness and Reliability	7 Hours

Robustness and Reliability - Concepts of Robustness and Reliability- Metrics for Measuring Robustness and Reliability, Challenges in Achieving Robustness , Challenges in Ensuring Reliability – Data Quality, Model Drift, Uncertainty in AI Models		
UNIT 6	**Psychological Aspects of AI**	**7 Hours**
Problems of Anthropomorphisation,Persuasive AI, Unidirectional Emotional Bonding with AI,Ethical Issues Related to AI Enhancemen, Ethical Issues Related to Robots and Healthcare,Robots and Telemedicine, AI in Educational Administrative Support, Teaching, Forecasting Students' Performance		
Text Books:		
1. Bartneck, Christoph, Christoph Lütge, Alan Wagner, and Sean Welsh. An introduction to ethics in robotics and AI. Springer Nature, 2021, 1st edition, ISBN 978-3-030-51109-8.		
Reference Books:		
1. Avinash Manure Shaleen Bengani,Saravanan S, Introduction to Responsible AI: Implement Ethical AI Using Python, Apress Media LLC, 2023, 1st edition, ISBN-10 1484299817,ISBN-978-1484299814 2. Stahl, Bernd Carsten, Doris Schroeder, and Rowena Rodrigues,Ethics of Artificial Intelligence: Case Studies and Options for Addressing Ethical Challenges. Springer Nature, 2023, 1st edition, ISBN 978-3-031-17039-3.		
Web Resources:		
1. https://onlinecourses.nptel.ac.in/noc24_cs132/preview 2. https://www.udemy.com/course/the-ai-ethics-course-2025-work-with-ai-responsibly 3. https://www.coursera.org/learn/ethics-of-artificial-intelligence		

Course Code:	UAMPE0812	L	T	P	Credit
Course Name:	Introduction to Quantum Computing (PE-IV)	3			3

Course Prerequsites:

Basic Linear algebra is a pre-requisite

Course Description:

This course will provide introduction to Quantum Computation, starting with basic concepts such as superposition and entanglement, to discussing the quantum circuit model of computation and basic Quantum algorithms that demonstrate the power of computing with quantum bits. We will also introduce the idea of quantum error correction to mitigate the effects of noise in today's quantum devices. We will have full hands-on sessions for each concept taught using Qiskit, a pythonic way of programming and the IBM Circuit Composer.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the basic postulates of quantum mechanics	L2	Understand
CO2	Demonstrate the theoretical basics of qubits and their physical realisations	L2	Understand
CO3	Make use of important quantum algorithms.	L3	Apply
CO4	Identify states on the Bloch sphere, construct sinlge-qubit quantum circuits and their outputs.	L3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	3	2	2			1					1	1	2		
CO2	3	3	2	2		2				2	2	2	2		
CO3	2	3										2	2		
CO4	3	3	2	3	2	2				1	2	2	1		

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

UNIT 1	Introduction	8 Hours

Elementary quantum mechanics:, linear algebra for quantum mechanics,Quantum states in Hilbert space,The Bloch sphere, Density operators, generalized measurements, no-cloning theorem.Qubits versus classical bits Spin-half systems and photon polarizations ,Trapped atoms and ions ,Artificial atoms using circuits Semiconducting quantum dots , Single and Two qubit gates –

UNIT 2	Quantum correlations:	9 Hours

Quantum correlations: Bell inequalities and entanglement, Schmidt decomposition, Super Dense coding, teleportation. Review of Turing machines and classical computational compleity , Time and space complexity (P, NP, PSPACE) , Reversible Computation , Universal quantum logic gates and circuits, Quantum cryptography: quantum key distribution

UNIT 3	Quantum algorithms	9 Hours

Quantum gates and algorithms: Universal set of gates, quantum circuits, Solovay-Kitaev theorem, Deutsch-Jozsa algorithm, factoring, Bernstein - Vazirani algorithm Simon's algorithm, Database search - Grover's algorithm ,Quantum Fourier Transform and prime factorization Shor's Algorithm. Additional Topics in Quantum Algorithms Variational Quantum Eigensolver (VQE) HHL , QAOA

UNIT 4	Programming a quantum computer	9 Hours

The IBMQ, , Physical realizations of qubits and Qiskit, Coding a quantum computer using a simulator to carry out basic quantum measurement and state analysis.Quantum Communication Protocols, Introduction to Pulse Programming,Quantum Integer Programming (QuIP) to solve optimization problems efficiently on quantum devices.

UNIT 5	Error Correction & Cryptography	6 Hours
Introduction to Error correction - Fault-tolerance , Simple error correcting codes, public key cryptography and the RSA protocol. Post Quantum Cryptography (PQC), Introduce quantum key distribution (QKD) and discuss the BB84, E91 , BBM92. protocol.		
UNIT 6	**Survey of current status**	**4 Hours**
NISQ era processors, Quantum advantage claims , Roadmap for future		
Text Books:		
1. Chris Bernhardt, Quantum Computing for Everyone, The MIT Press,Cambridge, 2020 2.Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)		
Reference Books:		
1. Phillip Kaye, Raymond Laflamme et. al., An introduction to Quantum Computing, Oxford University press, 2007. 2. Quantum Computing, A Gentle Introduction , Eleanor G. Rieffel and Wolfgang H. Polak MIT press (2014). 3. Introduction to Quantum Computing: From a lay person to a programmer in 30 steps, Hui Yung Wong, 1st edition, Springer-Nature Switzerland AG (2022)		
Web Resources:		
1. https://nptel.ac.in/courses/106106232 2. https://www.ibm.com/think/topics/quantum-computing		

Course Code:	UAMPE0813	L	T	P	Credit
Course Name:	Edge and Fog Computing(PE-IV)	3			3

Course Prerequsites:

Course Description:

This course delves into the emerging field of edge computing, providing a comprehensive understanding of its architectures, systems, and technologies. Students will explore the limitations of traditional cloud computing and learn about the advantages and applications of edge computing.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explore technologies behind the communication and management of edge resources.	L2	Understand
CO2	Learn the techniques for storage and computation in edges and clouds.	L2	Understand
CO3	Develop Internet of Everything (IoE) applications through edge computing architecture.	L2	Apply
CO4	Apply optimization techniques for the different applications.	L2	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	1	1	1								1	1	1	
CO2	1	1							1		1	1		
CO3	2	2	1		1				1		2	1	1	
CO4	2	1	1		1						2	1	1	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
2	Mid Semester Examination (MSE)	30%	50% of course contents. (30 Marks)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
4	End Semester Examination (ESE)	50%	100% course contents. (50 Marks)

Course Contents:

UNIT 1	Introduction to New Computing Paradigms	8 Hours

Introduction - Relevant Technologies, Edge Computing Completing the Cloud, Hierarchy of Fog and Edge Computing, Business Models, Edge Computing Platforms, Opportunities and Challenges.

UNIT 2	Orchestration of Network Slices in Edge, and Clouds	6 Hours

Introduction, Background, Network Slicing, Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge, Network Models, Challenges and future aspects.

UNIT 3	Optimization Problems in Edge Computing	8 Hours

Preliminaries, The Case for Optimization in Fog Computing, Formal Modeling Framework for Fog Computing, Metrics, Further Quality Attributes, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle, Towards a Taxonomy of Optimization Problems in Fog Computing.

UNIT 4	Middleware for Edge Computing	8 Hours

Need for Edge Computing Middleware, Design Goals-State-of-the-Art Middleware Infrastructures, System Model - Case Study.

UNIT 5	Technologies in Edge Computing	7 Hours

Edge Data Management, Smart Building, Predictive Analysis example, Machine Learning in Edge Computing, Data Analytics in the Edge, Data Analytics in the Edge Architecture.

UNIT 6	**Applications of Edge Computing**	**8 Hours**

Exploiting Edge Computing in Health Monitoring, Smart Surveillance Video Stream Processing at the Edge for Real, Time Human Objects Trackin, Edge Computing Model for Evolving Smart Transportation Applications, Testing Perspectives of Edge-Based IoT Applications, Legal Aspects of Operating IoT Applications in the Edge.

Text Books:

Buyya Rajkumar and Satish Narayana Srirama, "Fog and Edge computing: Principles and Paradigms", 2019, 1st edition, John Wiley & Sons, USA.

Reference Books:

1. Rajiv Misra, Yashwant Pate, "Cloud and Distributed Computing: Algorithms and Systems", 2020, John Wiley & Sons, USA.
2. Bahga, Arshdeep, and Vijay Madisetti, "Cloud computing: A hands-on approach", 2014, 2ndedition, CreateSpace Independent Publishing Platform, USA.
3. OvidiuVermesan, Peter Friess, “Internet of Things –From Research and Innovation to Market Deployment”, 2014, 1st edition, River Publishers, India..

Web Resources:

https://nptel.ac.in/courses/106104449
https://www.youtube.com/watch?v=dmGybCohHsw&list=PLxCzCOWd7aiHRHVUtR-O52MsrdUSrzuy4

Course Code:	UAMPE0814	L	T	P	Credit
Course Name:	AI in Healthcare (PE-V)	3			3

Course Prerequsites:

Principles of Artificial Intlelligence and Data Science.

Course Description:

Comprehensive understanding of how Artificial Intelligence (AI) is transforming healthcare systems, clinical decision-making, medical research, and patient care. Learners will explore key AI technologies—including Machine Learning, Deep Learning, Natural Language Processing, and Medical Imaging

Course Outcome	After the completion of the course the student will be able to -	BL	Description
CO1	Understand the fundamentals of Artificial Intelligence, Machine Learning, and DL in a healthcare context.	L2	Understand
CO2	Develop applications of AI Tools, GenAI, and Healthcare Data to Build Real-World HealthTech Solutions.	L3	Apply
CO3	Apply AI and ML techniques to real-world healthcare problems	L3	Apply
CO4	Demonstrate proficiency in collecting, managing, cleaning, analyzing, and interpreting complex, multi-modal healthcare datasets	L2	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	1	1	3		2	1				2	1	2	2	
CO2	1	2		1	1	2	1			1		2	3	
CO3	1	1	2						1		2	3	2	
CO4	1		1	2	2	2	1					1	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
2	Mid Semester Examination (MSE)	30%	50% of course contents. (30 Marks)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
4	End Semester Examination (ESE)	50%	100% course contents. (50 Marks)

Course Contents

UNIT 1 Foundations of AI in Healthcare — **8 Hours**

Fundamental concepts of Artificial Intelligence, Machine Learning, and Deep Learning in the healthcare data ecosystem, including electronic health records (EHRs), medical imaging, genomics, and wearable data. Real-world business case examples how AI is applied across various data types in the healthcare domain.

UNIT 2 Clinical Data and Machine Learning Techniques — **8 Hours**

Essential machine learning methods such as regression, classification, clustering, and model evaluation. The focus is on how these techniques are used to extract insights from health data. The module includes simple examples and case studies to build a solid understanding of ML in clinical contexts.

UNIT 3 AI in Real-World Clinical Practice — **8 Hours**

AI integration into clinical workflows. Topics include AI in diagnosis, chronic disease management, hospital resource optimization, and decision support systems. Through real clinical examples and case studies, learners explore the challenges and opportunities of applying AI in everyday patient care.

UNIT 4 Generative AI, Explainable AI & Agentic AI in Healthcare — **8 Hours**

Cutting-edge AI tools and concepts transforming healthcare. Use ChatGPT-like models for clinical summarization, patient education, and data entry Understand AI decisions using SHAP and LIME for clinician trust and transparency. Explore Agentic AI and autonomous AI deployment in healthcare

UNIT 5	**AI for Wearables, Mobile Health, and Screening**	**7 Hours**
Application of AI in remote monitoring, mobile health platforms, and early screening tools. Learners explore how AI enhances wearable devices and mobile diagnostics, making healthcare more preventive, personalized, and accessible. Real-world product evaluations are included.		
UNIT 6	**Ethics, Deployment, and AI Strategy**	**6 Hours**
legal, ethical, and operational considerations of deploying AI systems in healthcare. Topics include patient data privacy, fraud detection, and compliance with industry standards such as HL7 and FHIR. Learners gain insights into how AI systems are introduced and scaled within healthcare organizations.		

Text Books:

Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9 th Edition, Pearson 2013.

Reference Books:

1. Translational Application of Artificial Intelligence in Healthcare: A Textbook edited by Sandeep Reddy (2024)
2. Foundations of Artificial Intelligence in Healthcare and Bioscience: A User Friendly Guide by Louis J. Catania (2020).
3. Artificial Intelligence in Healthcare: The Hope, the Hype, the Promise, the Peril by the National Academy of Medicine (2022)

Web Resources:

https://www.youtube.com/watch?v=Hg8zBJ1DhLQ
https://www.youtube.com/watch?v=si4PZX7swj4

Course Code:	UAMPE0815	L	T	P	Credit
Course Name:	Reinforcement Learning (PE-V)	3			3

Course Prerequsites:

Basic Probability and Statistics, linear algebra, Data Structures and Algorithms, Fundamentals of Machine Learning.

Course Description:

This course provides a comprehensive introduction to Reinforcement Learning (RL), focusing on algorithms that enable agents to learn optimal decision-making through interaction with an environment. It covers foundational concepts such as Markov Decision Processes, value functions, planning, and exploration–exploitation tradeoffs. The course explores model-free methods including Monte Carlo and Temporal Difference learning. It further introduces function approximation and deep reinforcement learning techniques. The course concludes with policy-based and actor–critic methods applied to real-world decision-making problems.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Understand the basic concepts and theoretical foundations of Reinforcement Learning and Markov Decision Processes.	L2	Understand
CO2	Apply planning and model-free reinforcement learning algorithms to solve sequential decision-making problems.	L3	Apply
CO3	Apply exploration–exploitation strategies and value-based reinforcement learning methods in standard RL environments.	L3	Apply
CO4	Analyze and compare value-based and policy-based reinforcement learning approaches for different decision-making scenarios.	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	3	2									2	3	2		
CO2	3	3	2	2	2						2	3	3		
CO3	3	3	2	2	3						2	3	3		
CO4	2	3	2	3	2						3	2	3		

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

UNIT 1	INTRODUCTION	7 Hours

Learning paradigms: Supervised vs Unsupervised vs Reinforcement Learning, Suitability and limitations of Reinforcement Learning, Components of RL: Agent, Environment, State, Action, Reward, Policy, Agent-Environment interaction cycle, Example Environments: Multi-Armed Bandit , Random Walk / Grid World, Markov Decision Process (MDP): States, Actions, Transition Function, Reward Signal , Markov Property.

UNIT 2	PLANNING AND VALUE FUNCTIONS	8 Hours

Objective of a Decision-Making Agent, Policies and Value Functions: State-Value Function, Action-Value Function, Advantage Function, Bellman Expectation Equation, Bellman Optimality Equation ,Optimal Policy and Policy Comparison, Dynamic Programming overview: Policy Evaluation, Policy Improvement, Value Iteration.

UNIT 3	EXPLOITATION AND EXPLORATION OF REINFORCEMENT LEARNING	8 Hours

Single-State Decision Problems, Multi-Armed Bandit (MAB) Problem, Exploration–Exploitation Tradeoff, Cost of Exploration Bandit Algorithms: Greedy & Random Strategies, ε-Greedy and Decaying ε-Greedy, Optimistic Initialization, Softmax Action Selection, Upper Confidence Bound (UCB), Thompson Sampling.

UNIT 4	MODEL FREE REINFORCEMENT LEARNING	8 Hours

Monte Carlo Methods: First-Visit MC, Every-Visit MC , Temporal Difference Learning: TD(0), N-step TD, TD(λ): Forward View & Backward View Generalized Policy Iteration (GPI), Control Algorithms:Monte Carlo Control, SARSA (On-policy),Q-Learning (Off-policy), Double Q-Learning.

UNIT 5	**FUNCTION APPROXIMATION & DEEP REINFORCEMENT LEARNING**	**7 Hours**

Limitations of Tabular RL, Function Approximation in RL:Linear Function Approximation, Non-linear Function Approximation, Value Function Approximation: Approximate V(s) and Q(s, a) Challenges: Bias–Variance Tradeoff, Stability Issues , Deep Reinforcement Learning: Deep Q-Networks (DQN),Experience Replay, Target Networks Continuous State & Action Spaces.

UNIT 6	**POLICY-BASED & ACTOR–CRITIC METHODS**	**7 Hours**

Policy-based reinforcement learning, REINFORCE algorithm and stochastic policy search , Actor–Critic Architecture, Advantage Actor-Critic (A2C), Asynchronous Advantage Actor-Critic (A3C), Generalized Advantage Estimation (GAE).

Text Books:

1. Miguel Morales, Grokking Deep Reinforcement Learning, Manning Publications, 2020.

Reference Books:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement learning: An Introduction, Second Edition, MIT Press, 2019.
2. Marco Wiering, Martijn van Otterlo(Ed),Reinforcement Learning, State-of-the-Art, Adaptation, Learning, and Optimization book series, ALO, volume 12, Springer, 2012.
3. Keng, Wah Loon, Graesser, Laura, Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison Wesley Data & Analytics Series, 2020.
4. Francois Chollet, Deep Learning with Python, Manning Publications, 2018.

Web Resources:

1. Online NPTEL Course, "https://onlinecourses.nptel.ac.in/noc21_cs71/preview".
2. Online Coursera Course, "https://www.coursera.org/specializations/reinforcement-learning"

Course Code:	UAMPE0816	L	T	P	Credit
Course Name:	Blockchain and Its Applications(PE-V)	3			3

Course Prerequsites:

Operating Systems, Computer Networks, Network Security and Cryptography.

Course Description:

This course provides a comprehensive understanding of blockchain technology, covering cryptographic foundations, decentralized systems, consensus mechanisms, and leading blockchain platforms. Learners gain theoretical and conceptual insights into the design, analysis, and application of blockchain solutions across real-world domains.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain core blockchain concepts, including cryptography, distributed ledgers, and consensus mechanisms.	L2	Understand
CO2	Analyze decentralization models and consensus algorithms with respect to security and scalability.	L4	Analyze
CO3	Analyze the architecture and transaction processes of major blockchain platforms such as Ethereum and Hyperledger.	L4	Analyze
CO4	Apply blockchain concepts to smart contracts, decentralized applications, and advanced blockchain	L3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	1								2		2	
CO2	2	3	2	1							2	2		
CO3	2	2	3	2	2						2		2	
CO4	2	2	3	1	3	1	1				2	2		

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
2	Mid Semester Examination (MSE)	30%	50% of course contents. (30 Marks)
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc. (10 Marks)
4	End Semester Examination (ESE)	50%	100% course contents. (50 Marks)

Course Contents:

UNIT 1	Introduction to Blockchain and Cryptographic Foundations	8 Hours

Overview of blockchain evolution, maturity, and adoption. Fundamentals of distributed systems, history of Bitcoin and electronic cash. Definition, architecture, core components, benefits, limitations, and types of blockchains. Consensus: Consensus mechanism and its role in blockchains. Types of consensus mechanisms. Consensus in blockchain systems. CAP theorem and blockchain. Cryptographic constructs and blockchain technology: homomorphic encryption, signcryption, secret sharing, commitment schemes, and zero-knowledge proofs. Digital signatures and their types. Encoding schemes. Applications of cryptographic hash functions in blockchain systems.

UNIT 2	Decentralization and Blockchain Ecosystems	8 Hours

Decentralization using blockchain. Methods of decentralization: disintermediation and contest-driven decentralization. Routes to decentralization: how to decentralize systems. Decentralization framework with examples. Blockchain and full ecosystem decentralization: decentralization of storage, communication, and computing power. Pertinent terminology: smart contracts and related concepts.

UNIT 3	Consensus Problem and Distributed Agreement	8 Hours

Introducing the consensus problem. The Byzantine Generals Problem. Fault tolerance in distributed systems. State machine replication. FLP impossibility result. Lower bounds on the number of processors required to solve consensus. Analysis and design of consensus algorithms: system models, processes, timing assumptions, and classification. Consensus algorithms: Crash Fault Tolerant (CFT) algorithms and Byzantine Fault Tolerant (BFT) algorithms. Choosing a consensus algorithm based on finality, speed, performance, and scalability.

UNIT 4	**Ethereum and Smart Contracts**	**7 Hours**

Ethereum overview. The Ethereum Yellow Paper. Ethereum from a user's perspective. The Ethereum network: mainnet, testnets, and private networks. Components of the Ethereum ecosystem: keys and addresses, accounts, transactions and messages, Ether cryptocurrency and tokens (ETH and ETC). Ethereum Virtual Machine (EVM): execution environment, machine state, and iterator function. Smart contracts and native contracts.

UNIT 5	**Hyperledger Technologies**	**7 Hours**

Hyperledger overview. Projects under Hyperledger: distributed ledgers, libraries, tools, and domain-specific projects. Hyperledger reference architecture and design principles. Hyperledger Fabric: membership services, blockchain services, smart contract services, APIs and CLIs, and core components. Applications on blockchain. Consensus in Hyperledger Fabric. Transaction lifecycle in Hyperledger Fabric. Fabric 2.0 features. Hyperledger Sawtooth: core features, consensus mechanisms, transaction lifecycle, and components.

UNIT 6	**Advanced Blockchain Concepts**	**7 Hours**

Autonomous agents and decentralized organizations. Decentralized Autonomous Organizations (DAOs), Decentralized Autonomous Corporations (DACs), and Decentralized Autonomous Societies. Decentralized applications (DApps). Advanced blockchain trends: interoperability, cross-chain communication, scalability solutions (Layer 2 solutions), blockchain oracles, privacy-preserving blockchains, governance models, and future research directions in blockchain technology

Text Books:

Imran Bashir, "Mastering Blockchain", 3rd Edition, Packt Publishing, 2020

Reference Books:

1. Daniel Drescher, "Blockchain Basics", 1st Edition, Apress, 2017.
2. Vikram Dhillon & David Metcalf & Max Hooper, "Blockchain Enabled Applications: Understand the Blockchain ecosystem and How to Make it Work for You", 1st Edition, Apress,2017
3. Melanie Swan, "Blockchain: Blueprint for a New Economy", 1st Edition, O'Reilly, 2015.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs47/preview
2. https://www.hyperledger.org/use/tutorials
3. https://ethereum.org/en/developers

Course Code:	UAMIL0871	L	P	Credit
Course Name:	Project-II		2	4

Course Prerequsites:

Mini Project, requsites: Knowledge of Project Based Learning (PBL) concepts.

Course Description:

In this course, the students will apply the knowledge of SDLC, project management & Project Based Learning to a multi-course environment for solving different real-world problems. The students shall use the concepts they have learned in S.Y. B.Tech & T. Y., B. Tech Program. Students will develop a solution to an identified problem.

Course Outcomes:	After the completion of the course the student will be	BL	Description
CO1	Identify test cases to validate AI/ML systems and meet functional requirements.	L3	Apply
CO2	Improve AI/ML solutions using SDLC to satisfy functional needs.	L6	Creating
CO3	Demonstrate effective communication of AI/ML technical concepts, methodologies, and project outcomes using appropriate technical and professional formats.	L2	Understand
CO4	Compile detailed project reports using documentation tools.	L6	Creating

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	3	3	3	2	1	3	3	3	3	3	3
CO2	2	2	3	3	3	2	1	3	3	3	3	3	3
CO3	2	2	3	3	3	2	2	3	3	3	3	3	3
CO4	2		3		3	2			3	3	3	3	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	100%	Demonstration/Panel Presentation /Assignments /Group Discussions/Internal oral
2	ESE(OE)	100%	Assesment is based on Presentation & Demonstration, Oral Exam

Course Contents:

Guidelines for Project- I

1. During the 8th semester, students have to complete the remaining project work.
2. At the end of the 8th semester, students will have to submit completed project work carrying 4 credits to a panel of examiners comprising a guide, an internal examiner, senior faculty, an external examiner, etc. The panel will assess the performance of the students, considering their quality of work.
3. Every student group will have to submit a completed report (Black Book with copies—Number of Students + 1 guide + 1 Department) * of the project work. Report preparation guidelines should be followed as per the given format. The students will prepare a PowerPoint presentation of the work, and the same will be presented to the panel.
4. Students have to submit over the project's code to the department.
5. The break-up of assessment and examination marks for phase 2 is as
follows: ISE – 50 Marks
ESE(OE) – 50 Marks
6. Phase – II Requirements
a) Coding / Implementation, 1 Min Video project implementation.
b) Use cases.
c) Testing / Trouble shooting.
d) Data dictionary / Documentation.
e) Finalization of project in all respects.