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

Department of Computer Science and Engineering (Data Science)

Curriculum and Syllabus

for

B. Tech. Computer Science and Engineering (Data Science)

Scheme: 2024-25 (As Per NEP)

ABOUT THE DEPARTMENT

Welcome to the department of Computer science and engineering (Data Science).The department is established in year 2021-22.Data Science is an interdisciplinary course combining various domains of Statistics, Analytics, Knowledge Extraction and Data Visualization. In today's technical world, the exponential growth of data, requires a science ensuring that the huge volumes of data is handled accurately, analyzed efficiently, knowledge is extracted appropriately and visualized perfectly. Data Science is a complete integration of all these requirements. This course helps students to build mathematical and engineering skills required to advance their career as a Data Scientist or Data Analyst or Data Engineer and many more. The department aims to train students in rapidly growing areas of data science and encourage them for global certifications. Department places emphasis on all the important aspects of computers engineering such as Programming, Algorithm Design, Operating Systems, Computer Networks, Mobile Communication, Artificial Intelligence, Machine Learning and many more.

Special focus is given to courses like Fundamentals of Data Science, Data Pre-processing, Data Wrangling, Data Analytics, Data Visualization, Big Data etc. These will help the students in acquiring the required knowledge and expertise to start their career as a Data Analyst, Data Engineer, Data Scientist and many other opportunities in the current industry. Many seminars, conferences, certifications, and training sessions will be conducted by the department to make the students develop themselves globally.

DEPARTMENT VISION

To emerge as a leading department in Technical Education and Research in Computer Science and Engineering, especially in the Data Science 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 Data Science amongst students to make them competent enough from 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 collaborate with the data science industry through project-based learning, internships enabling the students to explore, apply various directions of learning.
M4	To enable the graduates to use modern tools, to design and develop Data Science 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 expertise in different aspects of Computer Science and Data Science related fields such as Statistical foundations of data Science, data collection, visualization, processing and modelling of large data sets and related programming knowledge
PEO3	Graduate will demonstrate proficiency with statistical analysis, data management and create models using applied statistics mathematics to solve future challenges and real-world problems exhibit team management capability with proper communication in a job environment.
PEO4	Graduate will be trained as professionals to cater the growing demand for data scientists and engineers in industry.

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:** Understand fundamental concepts in statistics, mathematics and computer science and apply these concepts in core areas of the Data Science domain to solve industry and societal problems. Exposure to emerging trends and technologies to prepare students for industry ready.
PSO2	**Personal and Professional Competence:** Design and Develop models in Data Science for real life problem solving in multidisciplinary fields using visualization and interpretation, machine learning, deep learning, and Big Data analytics, through acquired knowledge and current industry trends based on modern tools to solve case studies by applying various technologies.

MAPPING OF PEOS TO POS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	1		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	UDSPC0301	Discrete Mathematics and Graph Theory	3	1	-	4	4	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	PC	UDSPC0302	Linear Algebra	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	PC	UDSPC0303	Advanced Data Structures	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4	PC	UDSPC0304	Database Management System	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5	VEC	UDSVE0305	Constitution of India	2	-	-	2	2	ISE	50	20	20
6	HSSM	UDSEM0306	Principles of AIDS	2	-	-	2	2	ESE	50	20	20
7	PC	UDSPC0331	Advanced Data Structures Laboratory	-	-	2	2	1	ISE ESE (POE)	25 50	10 20	
8	PC	UDSPC0332	Database Management System Laboratory			2	2	1	ISE ESE (POE)	25 25	10 10	
9	PC	UDSPC0333	Software System Tools Laboratory			2	2	1	ISE	25	10	
10	OJT	UDSIL0371	Mini Project-I			2	2	1	ISE	50	20	
11	MM	UDSMM03**	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	UDSPC0401	Computer Networks	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
2	PC	UDSPC0402	Automata Theory	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
3	PC	UDSPC0403	Design And Analysis of Algorithms	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
4	PC	UDSPC0404	Statistics and Probability	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
5	PC	UDSPC0405	Object Oriented Programming in Java	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20		40
6	VEC	UDSVE0406	Environmental Studies	2	-	-	2	2	ISE	50	20		20
7	PC	UDSPC0431	Object Oriented Programming Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10		
8	PC	UDSPC0432	Data Analytics & Visualization Tools Laboratory	-	-	2	2	1	ISE	25	10		
9	OJT	UDSIL0471	Mini Project-II	-	-	2	2	1	ISE	25	10		
10	VSEC	UDSVS0433	AI DS Tools Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10		
11	CC	UDSCC0434	Co-curricular Activities-II	-	-	2	2	1	ISE	50	20		
12	MM	UDSMM04**	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	UDSPC0501	Machine Learning	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	PC	UDSPC0502	Computer Organization and Operating System	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	PC	UDSPC0503	Exploratory Data Analytics	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4	PE	UDSPE05**	Program Elective-I	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5	OE	UDSOE0521	Open Elective-I	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
6	HSSM	UDSAE0534	Business Communication and Value Science	-	-	2	2	1	ISE	50	20	20
7	PC	UDSPC0531	Machine Learning Laboratory	-	-	2	2	1	ISE	25	10	
8	PC	UDSPC0532	Advanced Java Programming Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
10	VSEC	UDSVS0533	Exploratory Data Analytics Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
11	CEP	UDSIL0571	Mini Project (Android)-III	-	-	2	2	1	ISE	25	10	
12	MM	UDSMM05**	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	UDSPC0601	Deep Learning	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	PC	UDSPC0602	Natural Language Processing	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	PC	UDSPC0603	Image Processing & Computer Vision	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4	PE	UDSPE06**	Program Elective-II	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5	OE	UDSOE0621	Open Elective-II	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
6	HSSM	UDSEM0604	Software Engineering & Project Management	2	-	-	2	2	ESE	50	20	20
7	PC	UDSPC0631	Deep Learning Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
8	PC	UDSPC0632	Image Processing & Computer Vision Laboratory	-	-	2	2	1	ISE	25	10	
9	PC	UDSPC0633	Advanced Web Development Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
10	CEP	UDSIL0671	Mini Project -IV	-	-	2	2	1	ISE	25	10	
11	CC	UDSCC0634	Co-curricular Activities-III	-	-	2	2	1	ISE	50	20	
12	MM	UDSMM06**	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	UDSPC0701	Information Security	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	PC	UDSPC0702	Generative AI	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	PC	UDSPC0703	Internet of Things & Cloud Computing	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4	PE	UDSPE07**	Program Elective-III	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5	OE	UDSOE0721	Open Elective-III	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
6	PC	UDSPC0731	Advance Deep Learning Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
7	PC	UDSPC0732	ML DevOps Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
8	RM	UDSIL0771	Project-I	-	-	2	2	4	ISE I ESE (OE)	50 50	40	
12	MM	UDSMM07**	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	UDSPE08**	Program Elective-IV	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	OE	UDSPE08**	Program Elective-V	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	RM	UDSIL0871	Project-II	-	-	8	8	4	ISE I ESE (OE)	50 50	40	
4	OJT	UDSIL0872	Internship	-	-	12	12	6	ISE I ISE II	75 75	75	
5	CC	UDSCC0831	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	UDSPC0301	Discrete Mathematics and Graph Theory	3	1	-	4	4
2	UDSPC0302	Linear Algebra	3	-	-	3	3
3	UDSPC0303	Advanced Data Structures	3	-	-	3	3
4	UDSPC0304	Database Management System	3	-	-	3	3
5	UDSPC0331	Advanced Data Structures Laboratory	-	-	2	2	1
6	UDSPC0332	Database Management System Laboratory	-	-	2	2	1
7	UAMPC0333	Software System Tools Laboratory	-	-	2	2	1
8	UDSPC0401	Computer Networks	2	-	-	2	2
9	UDSPC0402	Automata Theory	3	-	-	3	3
10	UDSPC0403	Design And Analysis of Algorithms	3	-	-	3	3
11	UDSPC0404	Statistics and Probability	3	-	-	3	3
12	UDSPC0405	Object Oriented Programming in Java	2	-	-	2	2
13	UDSPC0431	Object Oriented Programming Laboratory	-	-	2	2	1
14	UDSPC0432	Data Analytics & Visualization Tools Laboratory	-	-	2	2	1
15	UDSPC0501	Machine Learning	3	-	-	3	3
16	UDSPC0502	Computer Organization and Operating System	2	-	-	2	2
17	UDSPC0503	Exploratory Data Analytics	3	-	-	3	3
18	UDSPC0531	Machine Learning Laboratory	-	-	2	2	1
19	UDSPC0532	Advanced Java Programming Laboratory	-	-	2	2	1
20	UDSPC0601	Deep Learning	3	-	-	3	3
21	UDSPC0602	Natural Language Processing	2	-	-	2	2
22	UDSPC0603	Image processing & Computer Vision	3	-	-	3	3
23	UDSPC0631	Deep Learning Laboratory	-	-	2	2	1
24	UDSPC0632	Image processing & Computer Vision Laboratory	-	-	2	2	1
25	UDSPC0633	Advanced Web Development Laboratory	-	-	2	2	1
26	UDSPC0701	Information Security	3	-	-	3	3
27	UDSPC0702	Generative AI	3	-	-	3	3
28	UDSPC0703	Internet of Things & Cloud Computing	3	-	-	3	3
29	UDSPC0731	Advanced Deep Learning Laboratory	-	-	2	2	1
30	UDSPC0732	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	UDSPE0511	Human Computer Interaction (UI/UX) (PE-I)	3	-	-	3	3
2	UDSPE0512	Intelligent Robot (PE-I)	3	-	-	3	3
3	UDSPE0513	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	UDSPE0611	Business Intelligence (PE-II)	3	-	-	3	3
2	UDSPE0612	Introduction to Augmented Reality Virtual Reality (ARVR) (PE-II)	3	-	-	3	3
3	UDSPE0613	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	UDSPE0711	AI in healthcare (PE-III)	3	-	-	3	3
2	UDSPE0712	Time Series Analysis (PE-III)	3	-	-	3	3
3	UDSPE0713	Data Mining (PE-III)	3	-	-	3	3

PE: PROGRAM ELECTIVE - IV							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSPE0811	Big Data Analytics (PE-IV)	3	-	-	3	3
2	UDSPE0812	Nature Inspired Computing (PE-IV)	3	-	-	3	3
3	UDSPE0813	Edge Computing (PE-IV)	3	-	-	3	3

PE: PROGRAM ELECTIVE - V							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSPE0814	AI in smart manufacturing (PE-V)	3	-	-	3	3
2	UDSPE0815	AI in finance (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	UDSMM0341	Basics of Biomedical Engineering (MM-I)	2	-	-	2	2
2	UDSMM0441	Biostatistics and Algorithms (MM-II)	3	-	-	3	3
3	UDSMM0541	Soft Computing (MM-III)	3	-	-	3	3
4	UDSMM0641	Medical Image Analysis (MM-IV)	3	-	-	3	3
5	UDSMM0741	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	UDSMM0342	Fundamentals of Finance for Engineering (MM-I)	2	-	-	2	2
2	UDSMM0442	Blockchain Technologies and FinTech (MM-II)	3	-	-	3	3
3	UDSMM0542	Time Series Analysis (MM-III)	3	-	-	3	3
4	UDSMM0642	Machine Learning for Finance (MM-IV)	3	-	-	3	3
5	UDSMM0742	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	UDSMM0343	Digital Electronics (MM-I)	2	-	-	2	2
2	UDSMM0443	Microprocessor and Microcontrollers (MM-II)	3	-	-	3	3
3	UDSMM0543	Embedded Systems (MM-III)	3	-	-	3	3
4	UDSMN0643	IoT with Arduino and Raspberry Pi (MM-IV)	3	-	-	3	3
5	UDSMM0743	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	UDSVS0433	AI DS Tools Laboratory	-	-	2	2	1
2	UDSVS0533	Exploratory Data Analytics Laboratory	-	-	2	2	1

AE: ABILITY ENHANCEMENT COURSE							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSAE0534	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	UDSEM0306	Principles of AIDS	2	-	-	2	2
2	UDSEM0604	Software Engineering & Project Management	2	-	-	2	2

VE: VALUE EDUCATION COURSE							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSVE0305	Constitution of India	2	-	-	2	2
2	UDSVE0406	Environmental Studies	2	-	-	2	2

IL: RESEARCH METHODOLOGY (PROJECT)							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSIL0771	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	UDSIL0571	Mini Project (Android)-III	-	-	2	2	1
2	UDSIL0671	Mini Project -IV	-	-	2	2	1

IL: PROJECT							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSIL0871	Project-II	-	-	2	2	4

IL: INTERNSHIP/ON JOB TRAINING							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSIL0371	Mini Project-I	-	-	2	2	1
2	UDSIL0471	Mini Project-II	-	-	2	2	1
3	UDSIL0872	Internship	-	-	12	12	6

CC: CO-CURRICULAR COURSES							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSCC0434	Co-curricular Activities-II	-	-	2	2	1
2	UDSCC0634	Co-curricular Activities-III	-	-	2	2	1
3	UDSCC0831	Co-curricular Activities-IV			2	2	1

EX: EXIT COURSES - SY							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSEX0491	Certified Web Developer	3	-	-	3	3
2	UDSEX0492	Foundation Course in Machine Learning Using Python	3	-	-	3	3
3	UDSEX0493	Training	2	-	-	2	2
		Total:				**8**	**8**

EX: EXIT COURSES - TY							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSEX0691	Foundation Course in Artificial Intelligence Applications	3	-	-	3	3
2	UDSEX0692	Foundation Course in Information Security	3	-	-	3	3
3	UDSEX0693	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	UDSHN0351	Fundamentals of Cyber Security	3	1	-	4	4
2	UDSHN0451	Applied Cryptography	3	1	-	4	4
3	UDSHN0551	Ethical Hacking	3	1	-	4	4
4	UDSHN0651	Blockchain Technology	3	1	-	4	4
5	UDSHN0751	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	UDSMN0361	Learning Analytics	3	1	-	4	4
2	UDSMN0461	ML DevOps	3	1	-	4	4
3	UDSMN0561	Advanced Deep Learning	3	1	-	4	4
4	UDSMN0661	Generative AI	3	1	-	4	4
5	UDSMN0761	Vision Transformer	2	-	-	2	2
					Total:	**18**	**18**

SEMESTER V													
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs/ Week**	**Credits**	**Evaluation Scheme (Components)**			
1	PC	UDSPC0501	Machine Learning	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	PC	UDSPC0502	Computer Organization and Operating System	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	PC	UDSPC0503	Exploratory Data Analytics	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4	PE	UDSPE05**	Program Elective-I	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5	OE	UDSOE0521	Open Elective-I	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
6	HSSM	UDSAE0534	Business Communication and Value Science	-	-	2	2	1	ISE	50	20	20
7	PC	UDSPC0531	Machine Learning Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
8	PC	UDSPC0532	Advanced Java Programming Laboratory	-	-	2	2	1	ISE	25	10	
10	VSEC	UDSVS0533	Exploratory Data Analytics Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
11	CEP	UDSIL0571	Mini Project (Android)-III	-	-	2	2	1	ISE	25	10	
12	MM	UDSMM05**	MM-3	3	-	-	3	3	ESE	100	40	
						Total:	**27**	**22**	**Total Marks: 800** **Total Credit: 22**			

Course Code:	UDSPC0501	L	T	P	Credit
Course Name:	Machine Learning	3			3

Course Prerequsites:

Python,Linear Algebra,Statistics

Course Description:

This course covers the fundamentals of Machine Learning, including supervised and unsupervised learning algorithms. It also addresses ethical AI principles and discuss the case studies in healthcare, finance, and other domains.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the Mathematical Intution and theory of diffrent Machine Learning algorithms.	L2	Understand
CO2	Apply performance metrics, hyperparameter tuning and regularization techniques to	L3	Apply
CO3	Analyze the results of different Machine Learning algorithm by solving the mathematical problems for given dataset.	L4	Analyze
CO4	Illustrate the full machine learning life cycle ,MLOps and Advanced ML.	L2	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	3	2	2	3				2		2	2	1	
CO2	2		2	2	2						2	1	2	
CO3	2	2	3	3	2	2	3	2	3	3	3	3	3	
CO4	1	2	2	2	2	2	2	2	2	2	3	3	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 to Machine Learning** **6 Hours**

Significance of Machine Learning,Traditional approch,Machine Learning approch,Types of ML-Supervised Learning,Unsupervised Learning,semi Supervised Learning ,Reinforecement Learning,Online ML,Offline ML,Instance Based ML,Model based ML,Challenges in ML,Applications of ML.

UNIT 2 **Supervised Learning-1** **8 Hours**

Regression Algorithms- Linear Regression, Understanding Simple Linear regression Equations,Cost Function,Convergence Algorithm,Multiple Linear Regression,Polynomial Regression,Gradient Descent,Local Minima ,Global Minima,Overfitting and Underfitting

Model evaluation metrics -(MAE,MSE,RMSE),Problem solving on evaluation metrics.

UNIT 3 **Classification,Model Evaluation, Hyperparameter Tuning, and Feature Engineering** **10 Hours**

Classification Algorithms- Sigmoid Function,Problem of Linear Regression for solving classification Problem, Logistic Regression,**Model Evaluation metrics** -(Confusion matrix, Precision, Recall, F1-score, ROC-AUC),Problem solving on evaluation metrics,Model Evaluation Techniques-Cross-validation: K-fold, Leave-One-Out,Hyperparameter Tuning-Grid Search and Random Search,Feature scaling: Normalization and Standardization,Regularization Technique-L1 (Lasso), L2 (Ridge)

UNIT 4 **Supervised Learning-2** **8 Hours**

Naive bayes,Decision Trees,k-Nearest Neighbors (kNN), Elbow method,Support Vector Machines (SVM),SVM Kernels,Ensemble Technique -Bagging and Boosting- Random Forest, Gradient Boosting Machines (GBM), XGBoost,Solve problems on entrophy,Gini Impurity,Information gain.

UNIT 5	**Unsupervised Learning**	**8 Hours**

Clustering-k-Means, Hierarchical Clustering, DBSCAN Clustering,Silhoutte Clustering,Dimensionality Reduction-Principal Component Analysis (PCA),Association Rule Learning,Anamoly Detection,Applications of unsupervised learning.

UNIT 6	**Advanced Machine Learning**	**5 Hours**

Concepts of ML lifeCycle,Ethical AI and Machine Learning- Bias, Fairness, Transparency,Explainable AI,ML case studies in healthcare, finance, and other domains.

Text Books:

Saikat Dutt, Subramanian Chandramouli, Amit Kumar Dos, "Machine Learning", 1 st edition, Pearson, 2019.
Ethem Alpaydin,"Introduction to Machine Learning‖, MIT Press, Prentice Hall of India, Third Edition 2014.
Tom Mitchell, —Machine Learning‖, McGraw Hill, 3rd Edition,1997. 4.. Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing 2020.
Christopher M. Bishop, —Pattern Recognition and Machine Learning‖, Springer 2011 Edition

Reference Books:

1. Aurelien Geron , " Hands on Machine Learning with Scikit -learning , Keras & Tensorflow ",Concepts , Tools & Techniques to build Intelligent systems
2. Andreas Mullerr, "Introduction to Machine Learning with Python: A Guide for Data Scientists", 1st Edition, O'Reilly Media, 2017.
3. Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021
4. Kevin P. Murphy, Machine Learning: a Probabilistic Perspective, The MIT Press, 2012

Web Resources:

1. https://www.youtube.com/watch?v=vStJoetOxJg&list=PLkDaE6sCZn6FNC6YRfRQc_FbeQrF8BwGI

2. https://www.youtube.com/watch?v=JxgmHe2NyeY

Course Code:	UDSPC0502	L	T	P	Credit
Course Name:	Computer Organization and Operating System	2			2

Course Prerequsites:

Knowledge of basic Computer Skills, Digital Systems.

Course Description:

This Course aims to have a thorough understanding basic structure and operation of Digital Computer and to demonstrate the knowledge of functions of operating system memory management scheduling, file system and interface, distributed systems, security and dead locks.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Demonstrate fundamental components of a computer system.	L2	Understand
CO2	Identify the role of operating systems in managing hardware and software resources.	L3	Apply
CO3	Apply strategies for deadlock handling and secure access control.	L4	Apply
CO4	Analyze the performance of various CPU scheduling , memory management techniques and disk scheduling techniques.	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2			2	1		1	1		1	2	1	
CO2	2	2			3	2		1	1	1	1	1	2	
CO3	1	2	2	1	2	2	1	1	1	1		2	2	
CO4	2	3		1	3	2		1	2	1	2	3	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 to Computer Organization	5 Hours

Introduction to RISC and CISC architectures,ALU and control unit, Hardwired vs. Microprogrammed control, Pipelining and its performance, Memory organization and types, Cache memory: Mapping techniques and replacement policies

UNIT 2	Introduction to Operating Systems- IPC,Synchronization	8 Hours

introduction, System calls and Operating System structure, Process Management: PCB, Process States, and Scheduling, CPU Scheduling: FCFS, SJF, Round Robin, Priority Scheduling. Inter-Process Communication - Pipe, Shared Memory, Message Passing Inter-Process Synchronization: The Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of Synchronization.

UNIT 3	Deadlocks & File Management	9 Hours

Deadlock: System Model; Deadlock Characterization; Methods for Handling Deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery from Deadlock . Buffer Cache: Buffer Headers, Structure of the Buffer Pool, Scenarios for Retrieval of a Buffer, Reading and Writing Disk Blocks, Advantages and Disadvantages of Cache.
Internal Representation of Files: I-nodes, Structure of a Regular File, Directories, Conversion of a pathname to i-node

UNIT 4	Memory Management	8 Hours

Memory background, Hierarchy, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory, Demand Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing.
Text Books:
1. "Operating System Concepts" – Abraham Silberschatz, Peter B. Galvin, Greg Gagne 2. "Operating Systems: Internals and Design Principles" – William Stallings 3. "Computer Organization and Design" – David A. Patterson, John L. Hennessy
Reference Books:
1. "Computer System Architecture" – M. Morris Mano 2. "Computer Organization" – Carl Hamacher, Zvonko G. Vranesic, Safwat Zaky 3. "Modern Operating Systems" – Andrew S. Tanenbaum
Web Resources:
https://onlinecourses.nptel.ac.in/noc22_cs88/preview?utm https://www.coursera.org/specializations/codio-introduction-operating-systems?utm

Course Code:	UDSPC0503	L	T	P	Credit
Course Name:	Exploratory Data Analytics	3			3

Course Prerequsites:

Statistics and Linear Algebra, Python Programming

Course Description:

This course will cover the exploratory data analytics, data pre-processing and data preparation for machine learning model.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the fundamental concepts in exploratory data analytics.	L2	Understand
CO2	Interpret various data preprocessing techniques in exploratory data analytics.	L2	Understand
CO3	Apply different techniques in EDA on real life data.	L3	Apply
CO4	Analyze different application dataset using EDA techniques	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	1		1		1		1			1	1		
CO2	2	2		2	2	1		1			1	1		
CO3	2	2		1	2	1		1			1	1	1	
CO4	2	1		1		1		1			1	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 EDA	8 Hours

EDA :- Defination, need, steps.
Introduction to Dataset :- Defination, Variables and their types, Identify numerical and categorical variables, Cardinality in categorical variables, Relationship between variables, Covariance and Correlation, concept of multicolinearity, Normal Distribution.

UNIT 2	Handling Missing Data and Data Encoding	8 Hours

Impute missing data: - Interpretation of missing data, handling missing data - mean, mode, median, min, max, forward fill, backward fill, remove missing data.
Data Encoding: - Significance of data encoding, Types of encoding techniques - one hot encoding, ordinal encoding, label encoding, mean encoding.

UNIT 3	Variable Discretization and Working with Outliers	8 Hours

Variable Discretization:- divide the variables into equal intervals, perform discretization followed by categorical encoding.
Working with outliers:- Interpretation of outliers , trimming outliers, capping the variables at arbitrary max and min values, performing zero coding.

UNIT 4	Feature Scaling	8 Hours

Significance of Feature Scaling, Related terms in feature scaling, Normalization, Standardization, difference between normalization and standardization, Types of Scalers - Max Abs scaler, Robust scaler, Quantile Transformer scaler, Power Transformer scaler.

UNIT 5	Feature Engineering	7 Hours
Curse of Dimentionality, Feature Elimination Techniques - PCA, LDA, Feature Selection - Wrapper, Embedded Techniques, Concept of Multicolinearity, VIF.		
UNIT 6	**Data Balancing**	**6 Hours**
Interpretation of classification dataset, Impact of imbalanced dataset, Techniques to handle imbalanced dataset - under-sampling, over-sampling, K-fold Cross-Validation, SMOTE, Balanced Bagging Classifier, Threshold moving.		
Text Books:		
"Python Feature Engineering Cookbook" by Soledad Galli - Packt Publication.		
Reference Books:		
“Python for data analysis “ by Wes Mckinney - O'Reilly Publication. "Hands-On Exploratory Data Analysis with Python" by Suresh Kumar Mukhiya, Usman Ahmed - Packt Publishing March 2020		
Web Resources:		
https://www.youtube.com/watch?v=11unm2hmvOQ&list=PLZoTAELRMXVMgtxAboeAx-D9qbnY94Yay&index=1 https://www.youtube.com/watch?v=fHFOANOHwh8		

Course Code:	UDSPE0511	L	T	P	Credit
Course Name:	Human Computer Interaction (UI/UX)	3			3

Course Prerequsites:

Basic understanding of computer science principles, programming concepts, and software development.

Course Description:

This Course helps to understand fundamental concepts principles and methods of Human-Computer Interaction (HCI), focusing on designing and evaluating user interfaces (UI) and user experiences (UX) with a usability-centered approach.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain Human Computer Interaction principles and usability goals.	L2	Understand
CO2	Apply design methods like participatory design and usability testing.	L3	Apply
CO3	Analyze interaction devices and menu systems.	L4	Analyze
CO4	Design user documentation and online help systems.	L5	Evaluate

CO-PO Mapping:

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

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 to Usability and Design Processes	9 Hours

Introduction: Usability of Interactive Systems- introduction, usability goals and measures, usability motivations, universal usability, goals for our profession
Managing Design Processes: Introduction, Organizational design to support usability, Four pillars of design, development methodologies, Ethnographic observation, Participatory design, Scenario Development, Social impact statement for early design review, legal issues, Usability Testing and Laboratories
Tool: Google Lighthouse – Evaluates website usability, performance, accessibility

UNIT 2	Menu Design and Data Entry Interfaces	7 Hours

Menu Selection, Form Fill-In and Dialog Boxes: Introduction, Task- Related Menu Organization, Single menus, Combinations of Multiple Menus, Content Organization, Fast Movement Through Menus, Data entry with Menus: Form Fill-in, dialog Boxes, and alternatives, Audio Menus and menus for Small Displays
Lucid chart – Useful for structuring menu hierarchies and content organization

UNIT 3	Interaction Devices and Command Languages	8 Hours

Command and Natural Languages: Introduction, Command organization Functionality, Strategies and Structure, Naming and Abbreviations, Natural Language in Computing
Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory Interfaces, Displays- Small and large
IBM Watson NLP – Analyzes naming conventions and abbreviations in commands
Google Bard / OpenAI API – Assists in generating and evaluating natural command structures

UNIT 4	Quality of Service and Design Aesthetics	8 Hours

Quality of Service: Introduction, Models of Response-Time impacts, Expectations and attitudes, User Productivity, Variability in Response Time, Frustrating Experiences
Balancing Function and Fashion: Introduction, Error Messages, No anthropomorphic Design, Display Design, Web Page Design, Window Design, Color
WebPageTest – Tests page load times under different network conditions

UNIT 5	User Documentation and Support Systems	7 Hours

User Documentation and Online Help: Introduction, Online Vs Paper Documentation, Reading from paper Vs from Displays, Shaping the content of the Documentation, Accessing the Documentation, Online tutorials and animated documentation, Online communities for User Assistance, The Development Process
FullStory – Detects rage clicks, dead clicks, and slow interactions

UNIT 6	Information Search and Visualization	6 Hours

Information Search: Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Searching Interfaces
Information Visualization: Introduction, Data Type by Task Taxonomy, Challenges for Information Visualization
Elasticsearch – Powerful full-text search engine for large datasets

Text Books:

1.[CP] Catherine Plaisant. Designing the User Interface, Strategies for Effective Human Computer Interaction: Pearson.
2.[WG] Wilbert O Galitz. The Essential guide to user interface design. 4th Edition. Wiley DreamaTech.

Reference Books:

1.[HS YR JP] Helen Sharp, Yvonne Rogers, Jenny Preece. Interaction Design: Beyond Human-Computer Interaction 6th Edition Wiley
2.[UP] Uijun Park Introduction to Design Thinking for UX Beginners Wiley 2023

Web Resources:

https://www.interaction-design.org
https://www.nngroup.com

Course Code:	UDSPE0512	L	T	P	Credit
Course Name:	Intelligent Robot	3			3

Course Prerequsites:

Basics of AI and ML, Mathematics and Linear Algebra, Algorithms and Data Structure, Ethics in AI.

Course Description:

The Intelligent Robots course is designed to provide students with a comprehensive understanding of the principles, technologies, and applications of intelligent robots. The course will cover various aspects, including perception, planning, control, and learning, with a focus on enabling robots to operate autonomously and interact with humans and the environment effectively.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	List the fundamentals of intelligent robots, including perception, planning, control, and learning	L2	Understand
CO2	Explain the various types of sensors and actuators used in intelligent robots and their role in robot perception and interaction	L2	Understand
CO3	Develop abilities to apply, build Intelligent robots using appropriate measures, AI & ML algorithms and modern tools.	L3	Apply
CO4	Apply ethical principles and safety standards in the design, development, and deployment of robotic systems, ensuring responsible innovation.	L3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	2	2	1	3	2						2	2	2		
CO2	1	2	2	3	2						2	2	2		
CO3	2	3	2	3	3						3	3	3		
CO4	2	3	1	2			3				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 TO INTELLIGENT ROBOT	7 Hours

Machine Intelligence, Machine vs Robot, Overview of intelligent robots, The role of AI in robotics, History and evolution of intelligent robots, Types of Robots, Key applications of intelligent robots in industries.

UNIT 2	ROBOTIC SYSTEMS AND ARCHITECTURE	8 Hours

Components of a robot: sensors, actuators, and control systems Robot kinematics and dynamics, Robot perception systems, Localization and mapping. **Robotics Paradigm:** Setting up your Robot: Technical requirements, Robot anatomy, SubSumption architecture, Display devices, Software and Hardware setup, **Robot sensors:** proximity sensors- range sensors- tactile sensors- visual sensors- sensors for mobile robots.

UNIT 3	AUTONOMOUS SYSTEMS AND NAVIGATION	8 Hours

Autonomous robot behavior, SLAM (Simultaneous Localization and Mapping),Navigation in unknown environments, Multi-robot systems and swarm robotics. **Robot programming and applications:** Robot Operating System (ROS) - Simulation, Working, Applications, and Benefits.

UNIT 4	MACHINE LEARNING FOR ROBOTICS	8 Hours

Introduction to machine learning and AI, Supervised vs. unsupervised learning. **Neural Network Based Robot Control:** Neural Network Feedback Linearization Controller, Radial Basis Function Based Neural Network Controller – Application towards trajectory tracking of robot arm. **Search Based and Reinforcement Learning Based Robotics:** Search Method-A-star and Planning Method-RRT approaches Introduction to Reinforcement Learning (RL) – Environment, Reward, Agent, Q-learning **Fuzzy Logic Based Robotics:** Fuzzy C-means Clustering for Redundant Robot Arm Control.

UNIT 5	**FOUNDATION FOR ADVANCED ROBOTICS AND AI**	**7 Hours**

Law's of robotics, Path planning for mobile robot, Classification of Path Planning, Types of obstacles, Obstacle avoidance, The Dynamic Window Approach (DWA) algorithm, Visibility graph for navigation. **Artificial Personality:** Emotion state machine, Creating a model of human behavior, Robot emotion engine, Human emotional model

UNIT 6	**ETHICAL CONSIDERATIONS AND SAFETY IN ROBOTICS**	**7 Hours**

Ethical concerns: AI, autonomy, and decision-making, Safety protocols and fail-safes in intelligent robots, Regulations in autonomous systems, Social and cultural impacts of robotics. **Case study and Applications:** Applications in healthcare, manufacturing, and autonomous vehicles, Robotics in space exploration, Assistive robots for elderly and disabled, Intelligent robots in hazardous environments

Text Books:

1. Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms" by Nikolaus Correll, Bradley Hayes, et al.
2. Building Smart Robots Using ROS: Design, Build, Simulate, Prototype and Control Smart Robots Using ROS, Machine Learning and React Native Platform (English Edition)
3. Robin R Murphy, Introduction to AI Robotics, MIT Press, 2019
4. Building Smart Robots Using ROS: Design, Build, Simulate, Prototype and Control Smart Robots Using ROS, Machine Learning and React Native Platform (English Edition)
5. John Baichtal, Building Your Own Drones: A Beginner‘s Guide to Drones, UAVs, and ROVs, 2015

Reference Books:

1. L. Sciavicco and B. Siciliano, “Modelling and Control of a Robot Manipulators,” Springer, 2000.
2. John J. Craig, “Introduction to Robotics: Mechanics and Control,” Pearson, 2004 3.
Francis X. Govers, “Artificial Intelligence for Robotics”, Packt Publishers, 2018
4. Mark. W. Spong and M. Vidyasagar, “Robot Dynamics andControl,” January 28, 2004
5. J. Craig, Introduction to Robotics Mechanics and Control, Pearson, 2018.

Web Resources:

1. NPTEL Course on, "Intelligent Control of Robotic Systems", By Prof.M.Felix Orlando, IIT Roorkee
2. Coursera, edX, and MIT OpenCourseWare (for supplementary materials and video lectures).

Software and Tools:

1. Simulation Software: ROS (Robot Operating System), Gazebo, V-REP
2. Programming Languages: Python, C++, MATLAB
3. Machine Learning Libraries: TensorFlow, PyTorch, OpenCV

Course Code:	UDSPE0513	L	T	P	Credit
Course Name:	Storage Area Networks	3			3

Course Prerequsites:

Basics of Operating System

Course Description:

This course focuses on Finding key challenges in information management, Storage system architecture and data protection and to gain knowledge of Storage Area Network- concepts, components and protocols. Also to get
familiar with Network -Attached Storage - concepts, components, implementation and protocols

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Define the features of Information management	L2	Understand
CO2	Explain process related concepts such as Storage system architecture and data protection, knowledge of Storage Area Network- concepts, components and protocols.	L2	Understand
CO4	Identify the Need of Replication, Replication techniques and Storage Security	L3	Apply
CO3	Analyze Network -Attached Storage - concepts, Components,	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3		2	3					2		3	2
CO2	3	3	2	3	3					2		3	3
CO3	2	3	3	3	3		2		2	3	2	3	3
CO4	3	3	3	3	3	3	2	2	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 to information storage — 7 Hours

Storage technology Architecture, Data Center Infrastructure, Components of Storage System Environment, Disk Drive Components, Disk Drive Performance,Logical Components of Host, Application requirements and disk performance, Intelligent Storage System, Data Protection: Components of Intelligent Storage System, Intelligent Storage Array. Direct Attached Storage – Types, Disk drive Interface, Data Protection (RAID):- Implementation of RAID, RAID array components, RAID levels, Comparison, RAID ,Impact on disk performance, Hot Spares

UNIT 2 — Strorage Area Network — 8 Hours

Signal Encoding, FC-1: 8b/10b encoding, ordered sets and link control protocol, FC-2: data Transfer, FC-3: common Services, FC-4 and ULPs, Fibre Channel SAN – point-to- point topology, Fabric topology, Arbitrated loop topology, Hardware components of Fibre channel SAN. IP SAN – iSCSI – components, connectivity, topology, protocol stack, discovery, names, session, PDU

UNIT 3 — Network -Attached Storage — 8 Hours

Local File Systems, Network File System and File Servers, Benefits of NAS, NAS file I/O, Components of NAS, NAS Implementations, NAS File sharing Protocols, NAS I/O operations, Factors affecting NAS Performance. Case Study: Direct Access File System, Shared Disk File System Comparison: NAS, Fibre Channel SAN and iSCSI SAN

UNIT 4 — Storage Virtualization — 7 Hours

Introduction, Virtualization in the I/O path, Limitations and requirements, Definition of Storage Virtualization, Implementation considerations, Storage Virtualization on block, level, File level Virtualization, Storage Virtualization on various levels of the storage, network, Symmetric and Asymmetric Storage Virtualization.

UNIT 5	**Business Continuity, Backup and Recovery**	**8 Hours**
Introduction, Information Availability, Measuring information Availability, Consequences of down time, BC terminology, Failure Analysis, BC Technology Solutions, Backup- Considerations, Granularity, Methods, Process, Restore Operations, Topology, NAS environment, Technologies.		
UNIT 6	**Replication and Storage Security**	**7 Hours**
Local Replication, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations. Storage Security: Storage Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking.		

Text Books:

1. Somasundaram, G., & EMC Education Services. (2009). Information Storage and Management: Storing, Managing, and Protecting Digital Information. Wiley India Edition.
2. Troppens, U., Erkens, R., & Müller, W. (2009). Storage Networks Explained: Basics and Application of Fibre Channel, SAN, NAS, ISCSI, InfiniBand and FCoE (2nd ed.). Wiley India Edition.

Reference Books:

1. Poelker, C., & Nikitin, A. (2009). Storage Area Networks for Dummies. Wiley Publishing.
2. ate, J., Gonzaga, L., & Moore, R. (2003). The Complete Guide to SANs. IBM Press.
3.Long, J. (2013). Storage Networking Protocol Fundamentals. Cisco Press.

Web Resources:

1. https://download.e-bookshelf.de/download/0000/6294/34/L-G-0000629434-0007576353.pdf

Course Code:	UDSOE0521	L	T	P	Credits
Course Name:	Corporate Finance	3			3

Course Prerequsites:

Basic knowledge of accounting, financial statements, and time value of money is essential.

Course Description:

This course covers corporate finance essentials financial statements, capital budgeting, cost of capital, capital structure, and dividend policy using tools like NPV, WACC, and financial ratios for real-world decision-making

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Understand the core concepts of corporate finance, including financial goals, financial statements, time value of money, and the risk-return trade-off	L2	Understand
CO2	Apply financial decision-making tools such as NPV, IRR, WACC, and capital budgeting	L3	Apply
CO3	Analyze capital structure and working capital management strategies to assess their impact on firm valuation and operational efficiency.	L4	Analyze
CO4	Access dividend policies and payout decisions using theoretical models and real-world practices to enhance shareholder value.	L5	Evaluate

CO-PO Mapping:

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

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 to Corporate Finance — **7 Hours**

Nature and scope of corporate finance ,Goals of financial management – Profit vs. Wealth maximization, Functions of a finance manager, Types and sources of long-term and short-term finance, Financial environment and institutions, Risk and return trade-off ,Role of corporate governance and ethics in finance Overview of financial statements and their relevance in decision-making

UNIT 2 Time Value of Money — **8 Hours**

Concept and rationale for time value, Future value and compounding, Present value and discounting, Annuities and perpetuities, Effective annual rate and annual percentage rate ,Applications in investment decisions, Loan amortization schedules, Use of financial calculators and spreadsheets for TVM

UNIT 3	Capital Budgeting Techniques	8 Hours
Capital budgeting process and importance, Cash flow estimation and relevant cash flows ,Payback period and discounted payback, Net Present Value (NPV),Internal Rate of Return (IRR) and Modified IRR, Profitability Index (PI),Comparison of techniques and decision criteria, Risk analysis in capital budgeting – sensitivity and scenario analysis		
UNIT 4	**Cost of Capital and Capital Structure**	**8 Hours**
Concept and components of cost of capital , Cost of debt, equity, and preference capital, Weighted Average Cost of Capital (WACC), Capital structure and value of the firm, Business and financial risk , Capital structure theories: Net income, Net operating income, MM approach, and Traditional approach, Factors influencing capital structure decisions ,EBIT-EPS analysis and leverage		
UNIT 5	**Working Capital Management**	**7 Hours**
Concept and importance of working capital, Determinants of working capital needs, Operating cycle and cash conversion cycle, Inventory management techniques , Receivables management and credit policy, Payables management and trade credit, Cash management and liquidity analysis, Working capital financing and sources		
UNIT 6	**Dividend Policy and Valuation**	**7 Hours**
Dividend concepts and forms, Factors influencing dividend decisions, Stability of dividends ,Dividend relevance theories – Walter and Gordon models, Dividend irrelevance theory – MM hypothesis, Stock dividends, stock splits, and repurchase, Dividend policy and shareholder value ,Legal and procedural aspects of dividend declaration		
Text Books:		
1.S. A. Ross, R. W. Westerfield, and B. D. Jordan, Fundamentals of Corporate Finance, 11th ed. New York, NY: McGraw-Hill Education, 2018. 2. M. Y. Khan and P. K. Jain, Financial Management: Text, Problems and Cases, 8th ed. New Delhi, India: McGraw-Hill Education, 2018. 3. R. A. Brealey, S. C. Myers, F. Allen, and P. Mohanty, Principles of Corporate Finance, 12th ed. New Delhi, India: McGraw-Hill Education, 2019.		
Reference Books:		
1. P. Chandra, Financial Management: Theory and Practice. New York, NY, USA: McGraw-Hill Education 2..I. M. Pandey, Financial Management, 11th ed. New Delhi, India: Vikas Publishing House, 2015		
Web Resources:		
1. https://onlinecourses.nptel.ac.in/noc22_mg12/preview 2. https://www.udemy.com/course/the-complete-corporate-finance-course 3. https://www.coursera.org/specializations/financial-management		

Title of the Course: Business Communication and Value Science (Practical) **Course Code:** UDSAE0534	**L**	**T**	**P**	**Credits**
	-	-	2	1

Course Pre-Requisite: Basics of Communication Skills, LSRW Skills, Grammar etc.

Course Description:

This practical course is designed to build essential communication, emotional, and professional skills among undergraduate engineering students. Through engaging and hands-on activities, role plays, reflections, and presentations, students will enhance their self-awareness, emotional intelligence, intercultural sensitivity, teamwork, and workplace readiness.

Course Learning Objectives:

By the end of this course, students will be able to:

1. Conduct self-assessments to identify personal strengths and areas for growth.
2. Develop life skills like empathy, resilience, and interpersonal communication.
3. Understand and apply soft skills and ethics in real-life contexts.
4. Demonstrate professional communication in interviews, group tasks, and presentations.
5. Enhance employability quotient through resume writing, group discussion, and mock interviews.
6. Apply emotional intelligence and cross-cultural communication in workplace scenarios.
7. Practice leadership, motivation, and storytelling techniques for professional success.

Course Outcomes:

CO	**After Completion of the course, the student should be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the importance of life skills for holistic personality development	**2**	Understand
CO2	Apply verbal and non-verbal communication skills in presentations and group activities	**3**	Apply
CO3	Analyze individual personality traits, values, and competencies for self-growth	**4**	Analyze
CO4	Evaluate cross-cultural cues and use emotional intelligence in workplace situations	**5**	Evaluate
CO5	Create job-oriented content such as resumes, cover letters, and participate in interviews	**6**	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO01	PSO02
CO1							2	1	1		2		
CO2							3	3	1		2		
CO3							3	1	3		2		
CO4							2	2	2		2		
CO5							2	2	1		2		

Assessment:

In Semester Evaluation for 50 Marks:
Assessment will be based on:
Practical performance, Presentations, Group Discussions, Interviews, Assignments, Quizzes, Demonstrations, etc.

Course Contents:

Practical 1: Self-Awareness and SWOT	**2 Hours**

Understanding personal traits. SWOT and TOWS analysis.
Presentation on self-strengths and surviving in the VUCA world.
Reflection journal submission.

Practical 2: Soft Skills and Workplace Ethics	**2 Hours**

Introduction and importance of Soft Skills.
Checklist on Soft Skills and action plan for improvement.
Peer discussion on ethical challenges- Participants will read case studies, discuss, and list down the soft skills.

Practical 3: Assertive Communication and Positive Attitude	**2 Hours**

Positive self-talk, attitude, and goal setting.
Checklist on Positive self-talk, Positive Attitude and Self-Esteem, Goal setting, right attitude
Assertiveness Self-assessment Test:
https://www.psychologytoday.com/intl/tests/personality/assertiveness-test

Practical 4: Employability Quotient 1: Employment Correspondence	**2 Hours**

Drafting resume, cover letter, and professional email. Formatting, tone, and clarity practice.

Practical 5: Employability Quotient 2: Workplace Expectations	**2 Hours**
Open discussion on the topic, "Employers' expectations and the need for new skillset for the changing workforce trends." The focus is on raising learning and adaptability through employment perspective. A detailed checklist is provided to the participants to match their skills and employer's expectations.	
Practical 6: Employability Quotient 3: Group Dynamics	**2 Hours**
Participants will be engaged in Group Discussion activity to harness effective communication skills, self-confidence, assertive self-expression, team work and constructive exchange of ideas and thoughts.	
Practical 7: Employability Quotient 4: Interview Techniques	**2 Hours**
Mock interviews with peer and faculty feedback. Tips on etiquette, articulation, and handling stress.	
Practical 8: Professional Presentation Skills	**2 Hours**
Participants will prepare and deliver a presentation on their technical projects/mini-projects. The focus will be on body language, voice modulation, team coordination, engagement with audience, time management, slide design/visuals, technical depth.	
Practical 9: Emotional Intelligence	**2 Hours**
Strategies to hone EI. Video screening and discussion. Extempore based on EI topics. Peer feedback. EQ test and reflection.	
Practical 10: Motivation and Leadership	**2 Hours**
Participants are given few case studies/ video samples to understand motivation. Participants will talk about their favourite leader and motivation through their life.	
Practical 11: Cross- cultural Communication	**2 Hours**
Techniques to facilitate cross-cultural communication. Participants will be provided a set of case scenarios to analyse cross-cultural communication. Participants will attempt a quiz based on different cultures.	
Practical 12: Storytelling for Business	**2 Hours**
Create and present a technical story. Emphasis on narrative, engagement, and audience connection.	
Reference Books:	
1. Dryden, W. & Constantinou, D. (2004). *Assertiveness Step by Step*. Sheldon Press. 2. Goleman, D. (2006). *Emotional Intelligence*. Bloomsbury Publishing.	

3. Northouse, P. G. (2021). *Leadership: Theory and Practice*. Sage Publications.
4. Maslow, A. H. (1943). *A Theory of Human Motivation*.
5. Raman, M. & Sharma, S. (2013). *Communication Skills*. Oxford University Press.

Online Resources:

1. Ted Talk: How to Speak So That Others Want to Listen- https://www.youtube.com/watch?v=eIho2S0ZahI1
2. TEDx talk by Adam Galinsky: How to speak up for yourself- https://www.ted.com/talks/adam_galinsky_how_to_speak_up_for_yourself?language=en
3. https://www.youtube.com/watch?v=FFjGGZecO04
4. Steve Jobs: Connecting the dots- https://news.stanford.edu/2005/06/14/jobs-061505/

Course Code:	UDSPC0531	L	T	P	Credit
Course Name:	Machine Learning Lab			2	1

Course Prerequsites:

Python Programming Language

Course Description:

Study and implement Machine Learning Concepts.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	**Apply** different machine learning algorithms s to solve classification and regression problems.	L3	Apply
CO2	**Analyze** the performance of different machine learning models using evaluation metrics to	L4	Analyze
CO3	**Create** a Machine learning Model for different applications.	L6	Create

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	100%	Quiz/Assignments/Group Discussions/Internal oral
2	ESE(POE)	------	

Course Contents:

EXPERIMENT NO. 1 Introduction — **2 Hours**

Introduce Scikit-learn Librarie and its modules.Explore multiple tools for data mining and data analysis like and key modules like sklearn.linear_model, sklearn.tree, sklearn.svm, sklearn.cluster, sklearn.neighbors etc.

EXPERIMENT NO. 2 Linear Regression — **2 Hours**

Implement a simple Linear Regression and Multiple Linear Regression model on given Datadet.Evaluate the model with MAE,MSE,RMSE.

EXPERIMENT NO. 3 Logistic Regression for Classification — **2 Hours**

Build a Logistic Regression model for binary classification.Evaluate the model with Confusion Matrix,Accuracy,Precision,Recall.

EXPERIMENT NO. 4 k-Nearest Neighbors (kNN) for Classification — **2 Hours**

Implement the k-Nearest Neighbors (kNN) algorithm for classifying the Iris dataset.Normalize data using StandardScaler.Evaluate using accuracy, confusion matrix, classification report.Try different k values and visualize performance.

EXPERIMENT NO. 5 Support Vector Machine Learning — **2 Hours**

Build a Support Vector Machine Learning model for binary classification, Normalize features.
Train SVM model (e.g., with linear kernel),Evaluate the model,Try different kernels for comparison

EXPERIMENT NO. 6 Decision Trees for Regression	**2 Hours**
Build a Decision Tree for regression dataset. Use DecisionTreeRegressor() model,Evaluate the model with MSE, R^2 Score.	
EXPERIMENT NO. 7 Decision Trees for Classification	**2 Hours**
Build a Decision Tree for classification dataset.Use DecisionTreeClassifier(),Evaluate the model with Accuracy, Confusion Matrix, Classification Report,plot_tree() with class names.	
EXPERIMENT NO. 8 Adaboost in Ensemble Learning	**4 Hours**
Implement a Adaboost algorithm to improve the accuracy of predictions on Classification and Regression Dataset.Explore and Preprocess the Dataset.Initialize the Base Estimator.Build and Evaluate the AdaBoost Model.Tuning and Experimentation. 1. Vary the number of estimators 2. Change the learning rate 3. Try different base estimators 4. Observe how the performance changes	
EXPERIMENT NO. 9 Random Forest in Ensemble Learning	**4 Hours**
Implement a Random Forest algorithm to improve the accuracy of predictions.Initialize the Random Forest Model With n_estimators ,criterion (like Gini or Entropy),max_depth, random_state, etc.Inmpliment Feature Importance ,Experiment with Parameters like Number of estimators,Maximum depth.	
EXPERIMENT NO. 10 Clustering	**2 Hours**
Perform Clustering on a dataset ,Choose the number of clusters (k),Plot Elbow Method Graph,Fit KMeans model on the data,Predict the cluster labels,Evaluate clustering using Silhouette Score.	
EXPERIMENT NO. 11 PBL Application Project	**2 Hours**
Implement one problem statememt using various ML algorithm and Evaluate the result.(kaggle Competition)	

PROGRAM BASED LEARNING (PBL)

A team may include to a maximum of 4 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. Healthcare
2. E-Learning
3. Smart village
4. Smart agriculture Image recognition

Text Books:

1. Machine Learning Aurelien Geron , " Hands on Machine Learning with Scikit -learning , Keras & Tensorflow ",Concepts , Tools & Techniques to build Intelligent systems , O'Reilly Media
2. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Dos, "Machine Learning", 1 st edition, Pearson, 2019.
3. Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", 1st Edition, O'Reilly Media, 2017

Course Code:	UDSPC0532	L	T	P	Credit
Course Name:	Advanced Java Programming Laboratory			2	1

Course Prerequsites:

Core Java Programming

Course Description:

This lab covers core as well as advanced Java concepts including collections, exception handling, multithreading, and concurrency. Students will practice thread synchronization, Executor Framework, and concurrent collections. It also introduces Spring Boot for RESTful APIs and front-end development with React JS, Angular JS, and Node JS.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Apply collection framework operations such as adding, removing, iterating, and sorting elements in Java collections.	L3	Apply
CO2	Experiment with multithreading by implementing the Thread class, Runnable interface, and synchronization techniques.	L3	Apply
CO3	Examine the functionality of CRUD operations in a Spring Boot application and distinguish the role of different HTTP methods in RESTful services.	L4	Analyzing

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	50%	Quiz/Assignments/Group Discussions/Internal oral
2	ESE(POE)	50%	Assessment is based on practical oral performance

Course Contents:

EXPERIMENT NO. 1	Introduction to Collection Framweork	2 Hours

Perform operations like add, remove, iterate, and sort. on ArrayList, LinkedList, HashSet, LinkedHashet, Tree Set etc Demonstrate a program to remove duplicates from given list

EXPERIMENT NO. 2	Map Collection	2 Hours

Perform operations like add, remove, iterate, and sort. on map like HashMap, LinkedHashMap, TreeMap Apply different methods of maps to find duplicates from given list

EXPERIMENT NO. 3	Exception Handling Mechanisms	2 Hours

Demonstrate custom exception classes and exception propagation.

EXPERIMENT NO. 4	**Multithreading**	**2 Hours**
Implement multithreading using Thread class and Runnable interface. Use join() and sleep() methods for thread synchronization.		
EXPERIMENT NO. 5	**Thread Synchronization**	**2 Hours**
Demonstrate synchronized keyword for thread safety. Use wait(), notify(), and notifyAll() for communication between threads.		
EXPERIMENT NO. 6	**Executor Framework**	**2 Hours**
Implement Executor Service for managing thread pools. Use Callable and Future for handling multithreading with return values.		
EXPERIMENT NO. 7	**Concurrent Collections**	**2 Hours**
Implement Concurrent HashMap, CopyOnWriteArrayList, and BlockingQueue.		
EXPERIMENT NO. 8	**Spring Boot**	**4 Hours**
Create a basic Spring Boot application with REST endpoints.		
EXPERIMENT NO. 9	**React JS**	**4 Hours**
Design Student registration Form using React JS		
EXPERIMENT NO.10	**Angular JS**	**4 Hours**
Design Employee Registration Form using Angular JS		
EXPERIMENT NO.11	**Node JS**	**4 Hours**
Design User registration Form using Node JS		
Text Books:		
1. Herbert Schildt, Java: The Complete Reference, 12th Edition, McGraw-Hill, 2022. 2. Joshua Bloch, Effective Java, 3rd Edition, Addison-Wesley, 2018. 3. Craig Walls, Spring in Action, 6th Edition, Manning Publications, 2022.		
Referance Books:		
1. Brian Goetz, Java Concurrency in Practice, 1st Edition, Addison-Wesley, 2006. 2. Felipe Gutierrez, Pro Spring Boot 3, 1st Edition, Apress, 2022. 3. Cay S. Horstmann, Core Java Volume I & II, 11th Edition, Pearson, 2019.		
Web Resources :		
https://onlinecourses.nptel.ac.in/noc22_cs47/preview?utm https://nptel.ac.in/courses/106105184 https://nptel.ac.in/courses/106105161		

Course Code:	UDSVS0533	L	T	P	Credit
Course Name:	Exploratory Data Analytics Lab			2	1

Course Prerequsites:

Statistics and Linear Algebra, Python Programming

Course Description:

This course will cover the exploratory data analytics, data pre-processing and data preparation for machine learning model.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Apply appropriate EDA techniques to real-world datasets to understand its underlying structure.	L3	Apply
CO2	Make use of appropriate EDA techniques to performdata preprocessing.	L3	Apply
CO3	Analyze real world data using appropriate EDA techniques.	L4	Analyze

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	100%	Lab assignments, Quiz, etc. (25 Marks)
2	End Semester Evaluation (ESE)	100%	Practical Oral Examination (25 Marks)

Course Contents:

Experiment No. 1 — **2 Hours**

Load any dataset from Kaggle and perform the following using pandas:-
1. Read the dataset into Jupyter Notebook or Google Colab.
2. Understand the dataset using - head, tail, loc, iloc, info, describe, shape, dtypes, mean, median, mode, etc.

Experiment No. 2 — **4 Hours**

Perform following Exploratory data analytics on a dataset:-
1. Identify Missing Values.
2. Explore About the Numerical Variables.
3. Explore About categorical Variables.
4. Perform various types of data imputations operations.

Experiment No. 3 — **4 Hours**

Perform various types of data cleaning operations on the data collected in the previous lab using data exploration, imputation etc.
1. Identify and work with duplicate values.
2. Identify and work with Outliers.

Experiment No. 4 — **4 Hours**

Perform different encodings on categorical variables using Scikit learn library.

Experiment No. 5		**4 Hours**
Perform feature scaling on a data set Max Abs scaler, Robust scaler, Quantile Transformer scaler, Power Transformer scaler.		
Experiment No. 6		**4 Hours**
Perform dimensionality reduction on a dataset to identify the most significant features using PCA.		
Experiment No. 7		**2 Hours**
Perform dimensionality reduction on a dataset to identify the most significant features using LDA.		
Experiment No. 8		**2 Hours**
Perform feature selection using wrapper and embedded technique.		
Experiment No. 9		**2 Hours**
Perofrm feature selection using the Pearsons Corelation.		
Experiment No. 10		**2 Hours**
Implement SMOTE technique for handling imbalanced dataset.		
Text Books:		
"Python Feature Engineering Cookbook" by Soledad Galli - Packt Publication.		
Reference Books:		
“Python for data analysis “ by Wes Mckinney - O'Reilly Publication. "Hands-On Exploratory Data Analysis with Python" by Suresh Kumar Mukhiya, Usman Ahmed - Packt Publishing March 2020		
Web Resources:		
https://www.youtube.com/watch?v=11unm2hmvOQ&list=PLZoTAELRMXVMgtxAboeAx-D9qbnY94Yay&index=1 https://www.youtube.com/watch?v=fHFOANOHwh8		

Course Code:	UDSIL0571	L	T	P	Credit
Course Name:	MiniProject(Android)-III			2	1

Course Prerequsites:

Knowledge of Software Development Tools and Technologies.

Course Description:

Course Description: In this mini project, the students will apply multi-course environment for solving different real- world problems. The students shall use the concepts they have learned in their previous & the courses they are learning in the current semester and students will develop a solution to an identified problem

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Analyze real world user needs with mobile application problems solved by Android development.	L4	Analyze
CO2	Design strategies to propose robust,scalable android application solution with effective document.	L5	Evaluate
CO3	Create intutive UI/UX interfaces and feature rich android applications using Android SDK libraries.	L6	Create
CO4	Integrate and deploy Android applications using industry standard tools,testing stragtgies with performance	L6	Create

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Problem Statement, SRS, Design
2	In Semester Evaluation 2 (ISE2)	50%	Implmentation, Presentation, Demo of working model

Course Contents:

Guidelines for Mini Project -II

1. The primary objective of the mini project-II is to achieve multi course real world problem-based learning.
2. Course Instructor shall form the project team of 3 to 4 students in the batch of students
3. Each team shall use the knowledge they learned in the previous courses to identify the real world problem and solve using learnt technology
4. The solution shall be using the tools & techniques from multiple courses - e.g a solution shall be using data structures, Computer Networks, Data Science and ML modeling to develop mini project.
5. The evaluation shall be done in two phases

a. Phase 1 ISE-1 In ISE 1 the students shall be graded based on the skills demonstrated to identify the problem statement, define the problem statement & Designing its solution. The partial working model is expected to be completed.

b. Phase 2 ISE-2 In ISE 2 the students shall be graded based on the complete project implementation and its working. Followed by the detailed project report which shall cover the technical aspects of the project.

6. It's recommended to share a common project report format to all batches.
7. All course instructors shall coordinate and work towards a common evaluation process.
8. Course instructors shall demonstrate and discuss sample case studies with students to help them understand the mini project deliverables.
9. Design using UML, classes diagram and ER diagram.

Guidelines for Evalutions:

Guidleines for the Evaluations:
Below Criteria points can be used for Students Project Evaluation. Problem Statement
Software Requirement Specification (SRS) Detailed Design using UML, classes diagram and ER diagram.
Implementation
Testing and Team Communication
Checking Projects for Expected Analysis and Result Project Final Demonstration with detailed Report

MM: Multi-Disciplinary Minor Courses - Biomedical Engineering (Basket 1)							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSMM0341	Basics of Biomedical Engineering (MM-I)	2	-	-	2	2
2	UDSMM0441	Biostatistics and Algorithms (MM-II)	3	-	-	3	3
3	UDSMM0541	Soft Computing (MM-III)	3	-	-	3	3
4	UDSMM0641	Medical Image Analysis (MM-IV)	3	-	-	3	3
5	UDSMM0741	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	UDSMM0342	Fundamentals of Finance for Engineering (MM-I)	2	-	-	2	2
2	UDSMM0442	Blockchain Technologies and FinTech (MM-II)	3	-	-	3	3
3	UDSMM0542	Time Series Analysis (MM-III)	3	-	-	3	3
4	UDSMM0642	Machine Learning for Finance (MM-IV)	3	-	-	3	3
5	UDSMM0742	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	UDSMM0343	Digital Electronics (MM-I)	2	-	-	2	2
2	UDSMM0443	Microprocessor and Microcontrollers (MM-II)	3	-	-	3	3
3	UDSMM0543	Embedded Systems (MM-III)	3	-	-	3	3
4	UDSMN0643	IoT with Arduino and Raspberry Pi (MM-IV)	3	-	-	3	3
5	UDSMM0743	AI in Embedded Systems (MM-V)	3	-	-	3	3
					Total:	**14**	**14**

Course Code:	UDSMM0541	L	T	P	Credit
Course Name:	Soft Computing (MM-III)	3			3

Course Prerequsites:

Strong mathematical background, Proficiency with algorithms, critical thinking

Course Description:

The major goal of the Soft Computing Techniques to Improve Data Analysis Solutions initiative is to foster greater communication between the research communities of soft computing and statistics in order to generate activities for mutual improvement and cross-pollinate both domains. A collection of approaches known as "soft computing" that together offer a body of ideas and methods for creating intelligent systems.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Understand the basic concepts of Soft Computing.	L2	Understand
CO2	Learn various techniques like neural networks, genetic algorithms.	L2	Understand
CO3	Apply various soft computing techniques for complex problems	L3	Apply
CO4	Examine various techniques in soft Computing (such as, Fuzzy systems,ANN, Optimization).	L4	Analyz

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	1	1		1							1			
CO2	3	1									1		1	
CO3	3	1	2	1	3							3	1	
CO4	2	1	2	1	3							3	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 to Soft Computing — 6 Hours

What is Soft Computing, Requirement of Soft computing, Characteristics of Soft computing, Applications of Soft Computing, Basic tools: Fuzzy logic, Neural Networks, and Evolutionary Computing

UNIT 2 — Fuzzy Systems — 8 Hours

Introduction to Fuzzy Logic, fuzzy sets, membership functions, fuzzy relations, defuzzification, fuzzy arithmetic and fuzzy measures, fuzzy rule base, and approximate reasoning, introduction to fuzzy decision making, Fuzzy logic controller design, applications of Fuzzy logic.

UNIT 3 — Artificial Neural Networks — 9 Hours

What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons , Back Propagation networks, Architecture of Backpropagation(BP) Networks, Backpropagation Learning, Variation of Standard Backpropagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

UNIT 4	**Genetic algorithms**	**8 Hours**
History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization, Applications		
UNIT 5	**Hybrid Systems**	**6 Hours**
Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems		
UNIT 6	**Multi-objective Optimization Problem Solving**	**8 Hours**
Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.		

Text Books:

1. D. K. Pratihar, Soft Computing, Narosa Publishing House, 2008.
2. S. Haykin, Neural Networks: A Comprehensive Foundation, 2nd Ed, Pearson Education, 1999.
3. G. Chen and T. T. Pham, Introduction to Fuzzy Sets, Fuzzy Logic, and Fuzzy Control Systems, CRC Press, 2001.

Reference Books:

1. P. M. Dixit, U. S. Dixit, Modeling of metal forming and machining processes: by finite element and soft computing methods, 1st Ed, Springer-Verlag, 2008. 2. K. Deb, Optimization for Engineering Design: Algorithms and Examples, Prentice Hall, 2006.
3. R. A. Aliev, R. R. Aliev, Soft Computing and its Applications, World Scientific Publishing Co. Pte. Ltd., 2001.
4. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
5. Genetic Algorithms: Search and Optimization, E. Goldberg.

Web Resources:

1. http://ndl.iitkgp.ac.in/he_document/nptel/nptel/courses_106_105_106105173_video_lec40?e=3|soft%20computing
2.http://ndl.iitkgp.ac.in/he_document/nptel/nptel/106105173_1fzh8r0um_tfjqru630xbosfl_w7zunob?e=1|soft%20computin
g3.Artificial intelligence and soft computing : 11th international conference, ICAISC 2012, Zakopane, Poland, April 29 - May 3, 2012 : proceedings / Leszek Rutkowski [and others] (eds.).

Course Code:	UDSMM0542	L	T	P	Credit
Course Name:	Time Series Analysis (MM-III)	3			3

Course Prerequsites:

Basic knowledge of statistics and probability theory. Familiarity with programming languages such as Python or R. Understanding machine learning concepts, especially regression and Deep Learning.

Course Description:

This course covers the fundamentals of time series analysis and forecasting, including types of time series data.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Interpret the basic concepts of Time Series Analysis.	L2	Understand
CO2	Apply EDA concepts and traditional forecasting methods to solve realworld problems.	L3	Apply
CO3	Identify appropriate machine learning and Deep Learning approaches towards Time Series Forecasting.	L3	Apply
CO4	Summarize the different application of TSA using various ML and DL methods.	L2	Understand

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	2		1			1		1		3	1		
CO2	2	2		1			1		1		3	1		
CO3	2	2		1			1		1		3	1	1	
CO4	1	2		1			1		1		3		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	Time series Analysis Overview	7 Hours

Time series analysis and forecasting, Understanding time series data, Types of time series data, Components of time series, Residual Importance and applications of time series forecasting

UNIT 2	Exploratory Data Analysis for Time Series	8 Hours

Data visualization techniques for time series data Identifying trends, seasonality, and patterns Decomposition methods: additive and multiplicative Handling missing values and outliers in time series data.

UNIT 3	Traditional Time Series Forecasting Methods	7 Hours

Moving average method Exponential smoothing methods: Simple Exponential Smoothing, Holt's Exponential Smoothing, Holt-Winters Exponential Smoothing Autoregressive Integrated Moving Average (ARIMA) model Seasonal ARIMA (SARIMA) model

UNIT 4	Machine Learning Approaches for Time Series Forecasting	8 Hours

Introduction to machine learning for time series forecasting-Feature engineering for time series data Regression based methods: Linear Regression, Polynomial Regression Tree-based methods: Decision Trees, Random Forest Support Vector Machines (SVM) for time series forecasting

UNIT 5	Deep Learning Techniques for Time Series Forecasting	8 Hours
Introduction to deep learning for time series forecasting-Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks, Recurrent Units (GRUs) for sequential data-Convolutional Neural Networks (CNNs) for time series forecasting-Attention mechanisms in sequence-to-sequence forecasting		
UNIT 6	**Applications of Time Series Analysis**	**7 Hours**
Healthcare Application -Financial Applications- Predicting stock prices with machine learning and deep learning techniques - TSA for Government - Predicting sales for retail businesses using advanced time series methods - Time series forecasting for anomaly detection.		
Text Books:		
1. Joseph, M. 2023. Modern Time Series Forecasting with Python. Packt Publishing 2. Nielsen, A. 2019. Practical time series analysis: Prediction with statistics and machine learning. O'Reilly Media. 3. Brockwell, P. J., & Davis, R. A. 2016. Introduction to time series and forecasting (3rd ed.). Springer International Publishing.		
Reference Books:		
1. George, E. P., Gwilym, M., Jenkins, G. C., & Reinsel, G. M. (n.d.). Time Series Analysis: Forecasting and Control.		
Web Resources:		
1. Time Series Analysis and Forecasting using Python -Udemy Course https://www.udemy.com/course/machinelearning-time-series-forecasting-in python/?couponCode=LEADERSALE24A		

Course Code:	UDSMM0543	L	T	P	Credit
Course Name:	Embedded Systems (MM-III)	3			3

Course Prerequsites:

Strong mathematical background, Proficiency with algorithms, critical thinking

Course Description:

The major goal of the Embedded system is to Improve Introductory topics of Embedded System design, Characteristics & attributes of Embedded System, Introduction of Embedded System Software and Hardware development and RTOS based Embedded system design. A collection of approaches known as "Embedded System" that together offer a body of ideas and methods for creating intelligent systems.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain characteristics of Embedded System design	L2	Understand
CO2	Interpret the basic concepts of circuit emulators, debugging and RTOS	L2	Understand
CO3	Design embedded systems for various application challenges.	L3	Apply
CO4	Analyze embedded system software and hardware requirements	L4	Analyz

CO-PO Mapping:

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

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 to Embedded Systems	8 Hours

Introduction: Embedded Systems and general-purpose computer systems, history, classifications, applications and purpose of embedded systems, Core of Embedded Systems: Microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little-endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components, PCB and passive components

UNIT 2	Quality attributes of Embedded System	8 Hours

Characteristics and quality attributes of embedded systems: Characteristics, Operational and nonoperational quality attributes, application specific embedded system - washing machine, domain specific – automotive

UNIT 3	Hardware Modelling, Design and Development	8 Hours

Hardware Software Co design and Program Modelling : Fundamental issues in Hardware Software Co-design, Computational models in Embedded System Design Embedded Hardware Design and Development: Analog Electronic Components, Digital Electronic Components, VLSI & Integrated Circuit Design, Electronic Design Automation Tools

UNIT 4	Embedded Firmware Design and Development	6 Hours
Embedded Firmware Design Approaches: Super loop based approach, Embedded OS based approach, Design methodology , Embedded Firmware Development Languages: C, C++, Python, JAVA, Assembly		
UNIT 5	**Embedded System Development Environments**	**6 Hours**
Embedded System Development Environments: Types of files generated on cross compilation (only explanation – programming codes need not be dealt), disassemble/decompliler, Simulators, Emulators and Debugging		
UNIT 6	**Real-time Operating System(RTOS) based Embedded System Design**	**6 Hours**
Real-time Operating System(RTOS) based Embedded System Design: Operating System basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling		

Text Books:

1. ?Shibu K V, "Introduction to Embedded Systems", Second Edition, McGraw Hill Education
2. ?David E. Simon, "The Embedded software primer", Addison-Wesley ISBN 13:9780201615692
3. Microcontroller Theory and Application, Ajay, Deshmukh, McGraw Hill Education, New Delhi,2011,ISBN-9780070585959

Reference Books:

1. Manuel Jiménez Rogelio,PalomeraIsidoroCouvertier "Introduction to Embedded SystemsUsing Microcontrollers and the MSP430" Springer Publications, 2014
2. Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/Software Introduction", John Wily & Sons Inc.2002.
3. Peter Marwedel, "Embedded System Design", Science Publishers, 2007.
4. Arnold S Burger, "Embedded System Design", CMP Books, 2002.
5. Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications,Second Edition, 2008.

Web Resources:

1. http://ndl.iitkgp.ac.in/he_document/nptel/nptel/108102169_1voacji9oygsgudc7bryi7sxv5mfbhpod?e=1|embedded%20system|||
2. http://ndl.iitkgp.ac.in/he_document/nptel/nptel/108102169_irwk7k8lgvo?e=2|embedded%20system|||
3. https://hdl.handle.net/2027/mdp.39015036297607
4. E-Pathshala https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=fBYckQKJvP3a/8Vd3L08tQ==

SEMESTER VI

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs/ Week	Credits	Evaluation Scheme (Components)			
1	PC	UDSPC0601	Deep Learning	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2	PC	UDSPC0602	Natural Language Processing	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3	PC	UDSPC0603	Image Processing & Computer Vision	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4	PE	UDSPE06**	Program Elective-II	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5	OE	UDSOE0621	Open Elective-II	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
6	HSSM	UDSEM0604	Software Engineering & Project Management	2	-	-	2	2	ESE	50	20	20
7	PC	UDSPC0631	Deep Learning Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
8	PC	UDSPC0632	Image Processing & Computer Vision Laboratory	-	-	2	2	1	ISE	25	10	
9	PC	UDSPC0633	Advanced Web Development Laboratory	-	-	2	2	1	ISE ESE (POE)	25 25	10 10	
10	CEP	UDSIL0671	Mini Project -IV	-	-	2	2	1	ISE	25	10	
11	CC	UDSCC0634	Co-curricular Activities-III	-	-	2	2	1	ISE	50	20	
12	MM	UDSMM06**	MM-4	3	-	-	3	3	ESE	100	40	
			Total:				**29**	**24**	**Total Marks: 850** **Total Credit: 24**			

Course Code :	UDSPC0601	L	P	Credit
Course Name:	Deep Learning	3		3

Course Prerequsites:

Python,Machine Learning, Statistics

Course Description:

This course covers the basic concepts for deep learning such as various activation functions, optimizers and various architectures . Specifically Artificial Neural Networks , convolutional neural networks, recurrent neural networks and LSTM , Transfer learning , generative adversarial networks. The course also focuses on the deep architectures used for solving various complex problems in deep learning .

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the basic concepts related to Deep learning	L2	Understand
CO2	Identify various Learnings in Deep Neural Networks to bulid a Multi Perceptron neural	L3	Apply
CO3	Apply various Activation Functions , Regularization, Optimization Strategies for solving real	L3	Apply
CO4	Analyze the results of state-of-the-art deep learning models	L4	Analyze

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	3	3	2
CO2	2	1	2	3	1			1	1	1	3	3	2
CO3	2	2	2	3	1			1	1	1	3	2	3
CO4	2	1	2	3	1			1	1	1	3	2	2

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**

Introduction of Artificial Neural Networks (ANN) – Perceptron model, Single layer and Multi-Layer Perceptron models, Architectures of neural network. Feed Forward Neural Networks, Back propagation Neural Networks and weight updation formula, Chain rule of derivatives , Learning process in ANN classification / clustering problems - Applications.

UNIT 2	**Activation Functions in Deep Networks**	**8 Hours**

Functions in ANN, Vanishing Gradient problem, Types of activation functions, Sigmoid Activation Functions, Tanh activation function, Rectified Linear Unit (ReLU) and its variants - Leaky Relu, Parametric Relu, Exponential Linear Unit ,Softmax Activation function

UNIT 3	**Optimization - Improving Deep Neural Networks**	**9 Hours**

Loss function , Cost Function, MSE, MAE, Root mean squared error, Cross entropy for classification and activation , Binary Cross Entropy , Categorical Cross entropy, Sparse Categorical Cross Entropy , Optimizers - Gradient Descent, Stochastic Gradient Descent, Minibatch SGD, Batch learning, SGD with momentum, AdaGrad, RMSProp and Adam optimizer, Exploding Gradient

UNIT 4	**Regularization- Improving Deep Neural Networks**	**7 Hours**

Hyper-parameter tuning, L1 & L2 Regularization - Dropouts, Data Augmentation, Generalization Gap – Under-fitting Vs Over-fitting, Learning rate scheduler , Batch Normalization, Dropout layer, Early stopping

UNIT 5	**Convolutional Neural Networks**	**7 Hours**

CNN Operations, RGB & Grey Scale images , Max Pooling,Min Pooling, Basic architecture, Variants of the Basic Convolution Model –Transfer Learning Advanced architectures : VGG16, VGG19, AlexNet, ResNet, GoogleNet,EfficientNetV2 and others.		
UNIT 6	**Recurrent Neural Networks**	**7 Hours**
Recurrent Neural Networks - Encoder, Decoder, Sequence-to-Sequence Architectures, Deep Recurrent Networks, Long Short Term memory ,Basics of Generative Adversarial Networks (GANs) & Transformers		
Text Books:		
1. Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017 2. Neural Networks and Deep Learning, Michael Nielsen,, Determination Press 3. Learning deep architectures for AI, by Bengio, Yoshua		
Reference Books:		
1. Deep Learning Step by Step with Python, N D Lewis, 2016 2. Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017 3. Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks, Umberto Michelucci, Apress, 2018.		
E- Resources link		
1. National Digital Library of India (NDLI) - http://ndl.iitkgp.ac.in/he_document/nptel/106106224_nfeapwz_drq 2. World Digital Library (WDL) - https://www.loc.gov/ 3. HathiTrust Digital Library - https://www.hathitrust.org/ 4. Government eBook Portals - https://www.govinfo.gov/ 5. UGC e-Pathshala - https://epgp.inflibnet.ac.in/ 6. Vidya-Mitra - https://vidyamitra.inflibnet.ac.in/		

Course Code:	UDSPC0602	L	T	P	Credit
Course Name:	Natural Language Processing	3			3

Course Prerequsites:

Basic Probability & Statistics, Basic understanding of Python programming

Course Description:

This Course helps to understand fundamental concepts for natural language processing and automatic speech recognition as well as technologies involved in developing speech and language applications.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the fundamental concept of Natural Language Processing.	L2	Understand
CO2	Illustrate the syntactic and semantic accuracy of natural language.	L2	Understand
CO3	Build a suitable language modelling & feature representation for real world application.	L3	Apply
CO4	Apply Machine learning and deep learning methods for Real World NLP based Applications	L3	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	3	2	2	3				2		2	2	1	
CO2	2		2	2	2						2	1	2	
CO3	2	2	3	3	2	2	3	2	3	3	3	3	3	
CO4	1	2	2	2	2	2	2	2	2	2	3	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 NLP and Modern Text Processing	7 Hours

Computational frameworks for natural language processing ,Large Language Models (LLMs) as a new paradigm for NLP ,Text preprocessing pipeline for modern NLP systems ,Tokenization: Byte-Pair Encoding (BPE), SentencePiece, WordPiece , • Tokenization for LLMs: Understanding token limitations and strategies • Stemming, Lemmatization, and modern text normalization • Spell correction using statistical and neural approaches • Multilingual text processing challenges • Language Modeling fundamentals • N-gram models with modern smoothing techniques • Morphological analysis and Part-of-Speech tagging

UNIT 2	Advanced Word Representations and Sequence Modeling	8 Hours

• Distributional semantics and traditional embeddings • Contextual embeddings: From Word2Vec to ELMo, BERT, and GPT embeddings • Continuous representations: Word2Vec, GloVe, fastText • Parameter learning and optimization for embeddings • Language modeling: From statistical to neural approaches • Transformer-based language models and their impact • Entropy, cross-entropy, and perplexity in modern LLMs • Good-Turing and modern smoothing techniques • Sequence labeling: POS tagging with deep learning • Hidden Markov Models and their limitations • Lexical semantics: WordNet and similarity metrics • Modern word sense disambiguation using contextual embeddings • Text classification with traditional and neural approaches • Text summarization: Statistical and neural methods

UNIT 3	Neural Architectures and Modern NLP	8 Hours

• Neural language models: Evolution and architectures • Recurrent Neural Networks for sequence modeling • Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRU) •Attention mechanisms and self-attention • Transformers: Architecture and implementation • BERT and encoder-only transformer models • GPT and decoder-only transformer models • Parameter calculation and model scaling laws • Computational morphology with neural approaches • Syntax analysis: Probabilistic Context-Free Grammars • Dependency parsing with neural networks • Distributional semantics and topic modeling • Multi-modal representations: Vision-Language models • Introduction to Generative AI in NLP • Prompt engineering for large language models • Zero-shot, few-shot, and chain-of-thought prompting • Instruction tuning and alignment techniques • Summarization using generative models • Information Extraction using LLMs• Retrival- Augmented Generation(RAG) for factual accuracy		
UNIT 4	**Agentic AI for NLP Applications**	**7 Hours**
• Introduction to Agentic AI in NLP • LLM based Agents: Architecture and Components• Tool use and function calling in NLP agents • ReAct framework for reasoning and acting • Multi-agent systems for complex NLP tasks• Autonomous research and writing assistants • Code generation and analysis agents• Customer support automation agents • Business Intelligence and report generation • Evaluting NLP agents: Metrics and benchmarks		
Text Books:		
1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2024 Lewis Tunstall, Leandro Von Werra, Thomas Wolf. 2. Natural Language Processing with Transformers, O'Reilly, 2023 Sowmya Vajjala, Bodhisattwa Majumder, Anju Gupta, Harshit Surana. 3. Practical Natural Language Processing, O'Reilly, 2021 James Allen. Natural language Understanding 2e, Pearson Education, 2007 Akshar Bharati, Vineet Chaitanya, Rajeev Sangal. 4. Natural Language Processing: A Paninian Perspective, PHI, 2023 Tanveer Siddiqui., U.S. Tiwary. 5. Natural Language Processing and Information Retrieval, OUP, 2008		
Reference Books:		
1. [SEE] Steven Bird, Ewan Klein, and Edward Loper. 2019. Natural Language Processing with Python (1st ed.). O'Reilly Media, Inc.		
Web Resources:		
https://www.youtube.com/watch?v=u3924yvlWBo&list=PLzJaFd3A7DZutMK8fFxZx_mhmFQgzijGE https://www.youtube.com/watch?v=8rXD5-xhemo&list=PLoROMvodv4rOhcuXMZkNm7j3fVwBBY42z		

Course Code:	UDSPC0603	L	T	P	Credit
Course Name:	Image Processing and Computer Vision	3			3

Course Prerequsites:

Python, Linear Algebra, Probability,Basics of Machine Learning and Deep Learning

Course Description:

This course covers fundamental and advanced techniques in image processing and computer vision, including feature extraction, object recognition, motion analysis, and deep learning.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain fundamental concepts of computer vision and image processing techniques	L2	Understand
CO2	Make use of image processing techniques for segmentation and feature extraction	L3	Apply
CO3	Inspect object detection, recognition, and classification techniques	L4	Analyze
CO4	Examine results of various object detection and recognition algorithms in real-time	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	3	2	2	3	2			1		2	2	3	
CO2	3	2	2	2	2				1		2	2	3	
CO3	2	3	3	2	2	2			1		2	1	3	
CO4	2	2	2	2	2				1		2	1	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	Fundamentals of Digital Image Processing	8 Hours

Introduction to Digital Image Processing and Computer Vision,Fundamental Steps in Digital Image Processing,Components of Image Processing Systems,Image Sensing and Acquisition: CMOS, CCD, LiDAR, ToF Sensors,Image Sampling, Quantization, and Color Spaces (RGB, HSV, LAB, YCbCr),Basic Relationships between Pixels: Neighbors, Adjacency, Connectivity,Distance Measures and Geometric Transformations,Real-world Applications in Industry

UNIT 2	Advanced Image Enhancement and Filtering	8 Hours

Intensity Transformation and Spatial Filtering,Histogram Processing: Equalization, Matching, Contrast Stretching,Frequency Domain Filtering: Fourier Transform, Wavelet Transform,Modern Filtering Techniques: Bilateral Filter, Guided Filter, Anisotropic Diffusion,Edge Detection: Sobel, Prewitt, Canny, Laplacian of Gaussian (LoG),Morphological Operations: Advanced Techniques for Industrial Applications,Noise Models and Denoising Algorithms,Image Restoration Techniques

UNIT 3	Modern Feature Extraction and Segmentation	8 Hours

Traditional Feature Extraction: Harris Corner, SIFT, SURF, ORB, FAST,Modern Feature Descriptors: HOG, LBP, Gabor Filters,Image Segmentation Techniques:(– Traditional: Thresholding, Region-based, Edge-based
– Modern: Watershed Algorithm, Mean-Shift, Graph-Cut, GrabCut
– Deep Learning: U-Net, Mask R-CNN, Segment Anything Model (SAM)
– Real-time Segmentation for Industry Applications),Multi-modal Segmentation Techniques

UNIT 4	Deep Learning for Computer Vision	8 Hours

Introduction to Neural Networks for Vision Tasks,Convolutional Neural Networks (CNNs): Architectures and Optimization,Modern CNN Architectures: ResNet, DenseNet, EfficientNet,Vision Transformers (ViT),Transfer Learning and Fine-tuning for Vision Tasks,Object Detection Frameworks:(– Two-stage: R-CNN, Fast R-CNN, Faster R-CNN, Mask R-CNN,– One-stage: YOLO Series (YOLOv5, YOLOv8, YOLO-NAS), SSD, RetinaNet),Object Tracking Algorithms: SORT, DeepSORT, ByteTrack,Model Optimization: Quantization, Pruning, Distillation		
UNIT 5	**Advanced Computer Vision Applications**	**6 Hours**
3D Computer Vision: Stereo Vision, Depth Estimation, Point Cloud Processing,Motion Analysis and Video Processing:(– Optical Flow: Lucas-Kanade, Farneback, Deep Learning based,– Action Recognition and Video Classification,– Video Object Segmentation and Tracking,Generative Models in Computer Vision:– GANs for Image Generation and Enhancement,Self-supervised and Semi-supervised Learning for Vision, Few-shot and Zero-shot Learning in Vision,Explainable AI (XAI) for Vision Models.		
UNIT 6	**Industry Applications and Emerging Technologies**	**7 Hours**
Autonomous Systems:(Autonomous Vehicles: Perception Systems,– Drone Vision and Aerial Imaging,– Robotics Vision Systems),Healthcare and Medical Imaging:(Medical Image Analysis: X-ray, MRI, CT Scan,– Disease Detection and Diagnosis,– Surgical Assistance Systems,– Biomedical Image Processing), Industrial Automation:(Quality Inspection and Defect Detection - Industrial Robotics Vision, Predective Maintenance using Vision, Mainufacturing Process Monitoring), Emerging Technologies:(Digital Twins and Virtual Reality Applications, -Edge AI for Vision Applications, - Vision Language Models(VLMs)- Multi-model AI Systems, - Ethical Considerations in Computre vision,- Deployment Strategies: Cloud, Edge, Hybrid		
Text Books:		
1. Digital Image Processing, Author: Bhabatosh Chanda and Dwijesh Mujumder, Publisher:PHI 2.Computer Vision- A Modern approach, Author:D. Forsyth and J. Ponce, Publisher: Prentice Hall 3.. Feature Extraction & Image processing for computer vision, author: Mark Nixon and Alberto S. Aquado, Third Edition, Academic Press, 2018		
Reference Books:		
1. Linear Algebra and Its Applications - Gilbert Strang 1995 2. Computer Vision: Models, Learning, and Inference - Simon J. D. Prince 2012 3. Image Processing and Analysis - Stan Birchfield 2018,		
Web Resources:		
https://www.computervision.zone/ https://www.ibm.com/think/topics/computer-vision		

Course Code:	UDSPE0611	L	T	P	Credit
Course Name:	Business Intelligence	3			3

Course Prerequsites:

Course Description:

This course provides a basic understanding of the business intelligence with respect to its evolution, essentials, efficiency, delivery, user models, and working of different business intelligence case studies

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Interpret the basics and essentials of business intelligence.	L2	Understand
CO2	Summarize the business intelligence user models.	L2	Understand
CO3	Explain the working of business intelligence architecture, knowledge delivery.	L2	Understand
CO4	Interpret the different business intelligence applications.	L2	Understand

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		1	1		
CO3	1	2	1		1	2			1		2	1	1	
CO4	1	1	1			2					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 Business Intelligence — **8 Hours**

Introduction - Definition, History and Evolution, Data, Information, and Knowledge, Business Intelligence Segments, Difference between Information and Intelligence, Defining Business Intelligence Value Chain, Factors of Business Intelligence System, Real time Business Intelligence. Ethics and Business Intelligence.

UNIT 2 Essentials of Business Intelligence — **8 Hours**

Creating Business Intelligence Environment, Business Intelligence Landscape, Types of Business Intelligence, Business Intelligence Platform, Applications in Business Analytics, Dynamic roles in Business Intelligence, Challenges in Business Intelligence Tools,Modern Business Intelligence,Enterprise Business Intelligence, Information Workers.

UNIT 3 Business Intelligence User Model — **8 Hours**

Business Intelligence Opportunity Analysis Overview - Content Management System - End User Segmentation - Basic Reporting and Querying - Online Analytical Processing - OLAP Techniques - OLAP Applications - Applying OLAP to Data Warehousing - Benefits of using OLAP – Dashboard -Key Performance Indicators -Advanced/Emerging BI Technologies - Future of Business Intelligence- Critical Challenges for Business Intelligence success.

UNIT 4 Knowledge Delivery — **8 Hours**

Business Intelligence user types, Standard Reports, Interactive Analysis and Ad-hoc Querying, Parametrized and Self Servicing Reports, Dimentional Analysis, Visualizations - Charts, Graphs, Widgets, Scoreboards, Dashboards.

UNIT 5 Efficiency — **7 Hours**

Efficiency Measures - CCR Model: Defination of Target Objectives, Peer groups – Identification of good operating practices, Cross Efficiency Analysis – Virtual Inputs and Outputs, Other models. Pattern matching – cluster analysis, outlier analysis.

UNIT 6	**Business Intelligence Applications**	**6 Hours**
Marketing models – Logistic and Production models – Case studies such as Airbnb, Starbucks etc.		
Text Books:		
Efraim Turban, Ramesh Sharda, Dursun Delen, “Decision Support and Business Intelligence Systems”, 9 th Edition, Pearson 2013.		
Reference Books:		
1. Larissa T. Moss, S. Atre, “Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making”, Addison Wesley, 2003. 2. Carlo Vercellis, “Business Intelligence: Data Mining and Optimization for Decision Making”, Wiley Publications, 2009. 3. David Loshin Morgan, Kaufman, “Business Intelligence: The Savvy Manager‟s Guide”, Second Edition, 2012.		
Web Resources:		
https://www.youtube.com/watch?v=Hg8zBJ1DhLQ https://www.youtube.com/watch?v=si4PZX7swj4		

Course Code:	UDSPE0612	L	T	P	Credits
Course Name:	Immersive Technologies – ARVR	3			3

Course Prerequsites:

Basic Knowledge of C# programming and a foundational understanding of mathematics.

Course Description:

This course introduces the core concepts and technologies behind Augmented Reality (AR) and Virtual Reality (VR). Students will explore the hardware, software, and development tools used in AR/VR, focusing on creating immersive environments and interactive experiences.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the basics of AR, VR, and MR, along with their industry applications.	L2	Understand
CO2	Identify and explain the hardware and software used in AR and VR.	L2	Understand
CO3	Build basic AR and VR applications in Unity with user interaction systems.	L3	Apply
CO4	Analyze AR and VR applications across industries and identify emerging trends in AR & VR	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	1	1		1	2	1	1			1	1	1	2	
CO2	2	1		1	2					1		1	1	
CO3	2	3	3	2	3			1	1		2	3	2	
CO4	2	1		2			2		2	2	2	1	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 to AR and VR	7 Hours

Overview of AR and VR: Definitions of AR, VR, and Mixed Reality (MR), History and Evolution of AR and VR, Key differences between AR, VR, and MR, Real-world Applications: gaming, healthcare, education, architecture

UNIT 2	AR and VR Hardware and Software	8 Hours

AR Hardware : Smartphones, tablets, AR glasses, and wearable devices, Sensors, cameras, and displays used in AR
VR Hardware : Head-Mounted Displays (HMDs) and motion tracking. VR controllers and interaction devices
Development Platforms: ARCore, ARKit (AR development), Unity, Unreal Engine (VR development)

UNIT 3	Fundamentals of AR and VR Development	8 Hours

AR Development: Marker-based and markerless AR, Spatial mapping and object recognition in AR
VR Development : 3D environment design and interaction in VR, Scene setup, navigation, and physics in VR environments

UNIT 4	**Interaction Design in AR and VR**	**8 Hours**
User Interaction in AR: Gesture recognition, touch, and voice interfaces, Interaction with 3D objects in the real world User Interaction in VR: Hand controllers, gestures, and motion tracking, Locomotion techniques in virtual environments, Haptic feedback and immersive interaction		
UNIT 5	**AR and VR in Industry**	**7 Hours**
Applications of AR: AR in retail, education, healthcare, and entertainment Applications of VR: VR for training, gaming, healthcare, architecture Industry Case Studies: Real-world use cases and industry examples		
UNIT 6	**Future Trends and Challenges in AR and VR**	**7 Hours**
Emerging Technologies: AI, 5G, mixed reality, and future trends Challenges in AR/VR Development: Hardware limitations, comfort, motion sickness, and ethical considerations The Future of AR and VR: Social VR, Metaverse, and market predictions		

Text Books:

1. R. Azuma, "A survey of augmented reality," Presence: Teleoperators and Virtual Environments, 1997.
2. S. M. LaValle, Virtual Reality. Cambridge, U.K.: Cambridge Univ. Press, 2017.
3. C. Tynan and P. McKeown, Developing Augmented Reality with Unity: A Step-by-Step Guide. Berkeley, CA, USA: Apress, 2020.

Reference Books:

1. R. Dörner, W. Broll, and B. Jung, Augmented Reality: A Practical Guide. Cham, Switzerland: Springer, 2013.
2. W. R. Sherman and A. B. Craig, Understanding Virtual Reality: Interface, Application, and Design, 2nd ed. Cambridge, MA, USA: Elsevier, 2018.
3. J. Rauseo, The Future of Augmented Reality and Virtual Reality. Cham, Switzerland: Springer, 2021.

Web Resources:

1. https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/foundation-course-on-virtual-reality-and-augmented-reality/
2. https://youtu.be/WzfDo2Wpxks?si=rlcSQW-Uhjz4SrHW

Course Code:	UDSPE0613	L	T	P	Credit
Course Name:	Robotic process Automation	3			3

Course Prerequsites:

Knowledge of basic computer systems, Knowledge of Programming , Scripting and Knowledge of database.

Course Description:

This course provides a comprehensive understanding of the fundamental concepts, tools, and techniques required to automate repetitive and rule-based tasks using software robots. Students will gain hands-on experience with popular RPA tools and learn how to design, implement, and manage RPA solutions in various industries

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Understand basic components of RPA , different types of variables and control flow activities.	L2	Understand
CO2	Explain different data manipulation and automation techniques.	L2	Understand
CO3	Apply various types of exceptions and strategies to handle the user events.	L3	Apply
CO4	Implement RPA-based automation solutions using industry-standard tools and best practices.	L3	Apply

CO-PO Mapping:

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

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 TO RPA	7 Hours

ROBOTIC PROCESS AUTOMATION: History of Automation, Automation and its benefits, Introduction to RPA, Automation vs RPA, Process and Flowchart, RPA Programming Constructs, Robots in RPA, Introduction to Robots, Types of Robots, Implementation of RPA.

UNIT 2	INTRODUCTION TO RPA TOOL	8 Hours

RPA TOOL BASICS: RPA Development Life Cycle, Working of RPA, Challenges in RPA, Variables and its Types, Arguments, Variables vs. Arguments, Namespaces, and Importing New Namespace,
CONTROL FLOW ACTIVITY: Sequences, Control Flow and its types, Decision control-IF, Switch, IF vs Switch, Loops-Do While, While, for each, other control flow activities - Delay, Break, Assign, Continue and Parallel **UiPath:** Installation details of UiPath, Designer, Peoperities, activities.

UNIT 3	DATA MANIPULATION	8 Hours

DATA MANIPULATION: Data Manipulation and Its Importance, String Manipulations, Data Table Manipulations, Collection, Its Types and Manipulations.
UI AUTOMATION & SELECTORS: UI interactions, Input actions and Input methods, Containers, Recording & its types, Selectors, Types of Selectors- Full and Partial, Containers and Partial Selectors, Dynamic Selectors

UNIT 4	AUTOMATION CONCEPTS & TECHNIQUES	8 Hours

DATA EXTRACTION: Desktop and Web Recording, Extraction and its techniques- Screen scraping, Data scraping and PDF Extraction. Automation Techniques- Workbook and Excel automation (read/write).
EMAIL AUTOMATION: Incoming Email automation - Sending Email automation

UNIT 5	ERROR AND EXCEPTION HANDLING:	7 Hours
ERROR AND EXCEPTION HANDLING: Errors, Error handling approach, Try Catch, Retry Scope, Exception Handling, Types of Exceptions, Global Exception Handler, Best Practice for Error Handling		
UNIT 6	**ORCHESTRATOR & SELENIUM**	**7 Hours**
ORCHESTRATOR: Overview, Orchestrator Functionalities, Orchestrator User Interface Automations, Management and Monitoring. **Selenium :** UiPath Vs Selenium, automate various browser tasks using Selenium.		
Text Books:		
1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A press 2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packet Publishing Release Date: March 2018 ISBN: 9781788470940		
Reference Books:		
1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation. 2. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant. 3. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation. 4. https://www.uipath.com/rpa/robotic-process-automation.		
Web Resources:		
1. Online Udemy Course, "RPA Overview - Robotic Process Automation", by Bryan Lamb. 2. Online Coursera Course, "Robotic Process Automation (RPA) Specialization", by UiPath. 3. Online edx Course, "ACCA: Robotic process and intelligent automation for finance", by ACCA.		

Course Code:	UDSOE0621	L	T	P	Credits
Course Name:	Engineering Econometrics	3			3

Course Prerequsites:

Basic Knowledge of mathematics , statstics and economics

Course Description:

This course introduces the principles and applications of econometrics in engineering and management. It covers regression models, assumption violations, time series analysis, and panel data techniques. Emphasis is placed on using econometric tools for demand forecasting, cost estimation, production analysis, and project evaluation in engineering decision-making

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the fundamental econometric methods and their applications in engineering	L2	Understand
CO2	Apply simple and multiple regression models to interpret engineering data and validate	L3	Apply
CO3	Analyze violations of classical regression assumptions and implement appropriate remedies	L4	Analyze
CO4	Evaluate time series and panel data models for accurate forecasting and effective decision-making in engineering contexts.	L5	Evaluate

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	1	1		1	2						2	1	2	
CO2	2	1		1	2						2	1	1	
CO3	2	3	3	2	3						2	3	2	
CO4	2	1		2							2	1	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 to Econometrics — **7 Hours**

Definition, nature, and scope of econometrics in engineering. Link between economic theory, mathematical economics, and econometrics. Types of models: linear/nonlinear, static/dynamic, deterministic/stochastic. Structure of a model: variables and error term. Econometric research process: formulation, estimation, testing, forecasting. Types of data: cross-sectional, time-series, panel. Classical Linear Regression Model (CLRM): assumptions and importance. Uses and limitations of econometrics in engineering decisions.

UNIT 2 Simple and Multiple Linear Regression Models — **8 Hours**

Concept and formulation of simple regression models.,OLS estimation method.,Assumptions and properties of OLS estimators.,Interpretation of coefficients and R^2, adjusted R^2,Multiple regression: concept, formulation, estimation.,Hypothesis testing: t-test, F-test.,Functional forms: linear, log-linear, semi-log, double-log,Dummy variables and their applications

UNIT 3	Violations of Classical Assumptions and Remedies	8 Hours
Multicollinearity: causes, consequences, Detection: correlation matrix, VIF, condition index.,Heteroscedasticity: meaning, causes, effects.,Detection: graphs, Breusch-Pagan, White's test.,Autocorrelation: concept, causes, effects.,Detection: Durbin-Watson, runs test, plots.,Model specification errors and their consequences.,Remedies: Cochrane-Orcutt, WLS, model correction		
UNIT 4	**Time Series Econometrics**	**8 Hours**
Time-series data features: trend, seasonality, cycle.,Stationarity concept and its importance.,Unit root tests: ADF, Phillips-Perron.,Differencing, detrending techniques, AR, MA, ARMA, ARIMA models basics,Model selection: AIC, BIC.,Intro to ARCH, GARCH volatility models,Forecasting methods for engineering data.		
UNIT 5	**Simultaneous Equation Models & Advanced Techniques**	**7 Hours**
Concept and examples of simultaneous systems, Structural and reduced forms,Identification problem: order, rank conditions.Estimation: ILS, 2SLS methods.Estimator properties in simultaneous systems.Panel data: concept, structure, benefits.Fixed and Random Effects Models.Hausman test for model selection		
UNIT 6	**Applications of Econometrics in Engineering**	**7 Hours**
Demand forecasting using regression..Cost and productivity analysis models. Estimation of production functions.Price and market analysis models. Project evaluation and feasibility studies.Risk and uncertainty analysis with regression.Interpretation of intervals and forecasting errors.Case studies on infrastructure and industry.		
Text Books:		
1. D. N. Gujarati and D. C. Porter, Basic Econometrics. New York, NY, USA: McGraw-Hill Education. 2.J. M. Wooldridge, Introductory Econometrics: A Modern Approach, 7th ed. Cengage Learning, 2019. 3. D. N. Gujarati, Econometrics by Example. Palgrave Macmillan, 2015.		
Reference Books:		
1. Stock, J.H. & Watson, M.W. Introduction to Econometrics, Pearson Education 2. A. Koutsoyiannis, Theory of Econometrics, 2nd ed. Palgrave Macmillan		
Web Resources:		
1. https://www.coursera.org/learn/econometrics 2. https://onlinecourses.nptel.ac.in/noc22_mg12/preview		

Course Code:	UDSEM0604	L	T	P	Credit
Course Name:	Software Engineering and Project Management	2			2

Course Prerequsites:

Introduction to Programming, Concepts of Software, Phases in software development and Software Project management strategy. Knowledge of Any programming Language.

Course Description

Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers. Recognize the importance of Project Management with its methods and methodologies.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Define Software Engineering lifecycle models with software project management	L1	Remember
CO2	Compare process models to judge which process model has to be adopted for the given scenarios.	L2	Understand
CO3	Explain the role of project planning and quality management in software developmen to enhance software quality.	L2	Understand
CO4	Analyze the importance of various software testing methods and agile methodology.	L4	Analyze

CO-PO Mapping:

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

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**

Software and Software Engineering: The nature of Software, The unique nature of WebApps, Software Engineering, Software Engineering Practice, Software Myths. Process Models: A generic process model, Prescriptive process models: Waterfall model, Incremental process models, Evolutionary process models

UNIT 2 Requirement and Modelling — **7 Hours**

Understanding Requirements: Requirements Engineering, Establishing the groundwork, Eliciting Requirements, Developing use cases Requirement Analysis, Scenario based modeling, UML models that supplement the Use Case, Requirement Modeling Strategies: Flow oriented Modeling, Behavioral Modeling.

UNIT 3 Agile Development — **8 Hours**

What is Agility?, Agility and the cost of change. What is an agile Process? Extreme Programming (XP), Other Agile Process Models, A tool set for Agile process. Principles that guide practice: Software Engineering Knowledge, Core principles, Principles that guide each framework activity. Jira Agile- Benefits of Jira Agile, Advanced Jira Agile Features, Best Practices using Jira. Scrum Master Framework, 8 Stances of Scrum Master.

UNIT 4 Project Management — **7 Hours**

Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Planning-monitoring, Risk Evalution, Software Quality

Text Books:

1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2. Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill.

Reference Books:

1. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.
2. Hans van Vliet “Software Engineering: Principles and Practice", Wiley India, 3rd Edition, 2010.

Web links and Video Lectures:

1. https://scrumorg-website-prod.s3.amazonaws.com/drupal/2017-05/The%208%20Stances%20of%20a%20Scrum%20Master%20Whitepaper%20v2_0.pdf
2. https://onlinecourses.nptel.ac.in/noc19_cs70/preview

Course Code:	UDSPC0631	L	P	Credit
Course Name:	Deep Learning Lab		2	2

Course Prerequsites:

Python Programming Language, Machine Learning

Course Description:

Study and implement Deep Learning Concepts.

Course Outcomes:	After the completion of the course the student will be able	BL	Description
CO1	Apply different Deep learning methods and libraries to build models for solving classification and regression problems	L3	Apply
CO2	Analyze the performance of the deep learning models using evaluation metrics	L4	Analyze
CO3	Develop deep Learning models for different real life applications.	L6	Develop

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

EXPERIMENT NO. 1	Single perceptron Neural Network model	2 Hours

Installation and working on python, Juypter, and its different libraries for deep learning (Tensor Flow, NumPy, Kera, Pandas, Matplotlib, etc.)

1. Implement a Single perceptron Neural Network model for a given task using linear output activation function using Keras with TensorFlow

2. Make Use of dataset shared with you for prediction in (a) Perform Exploratory Data Analysis

(b) Use Parameters, Understand how each parameter varies

(c) Draw inference using Correlation matrix and Histograms

(d) Prepare dataset train_test_split.

(e) Build Single layer Perceptron Model, compile and fit the model

(f) Evaluate Model performance using r2_square , Analyze r2_square values using scaling techniques before and after scaling

EXPERIMENT NO. 2	Multilayered perceptron Neural Network model	2 Hours

Implement a multilayer perceptron (MLP) model Neural Network model with sigmoid activation function using Keras with TensorFlow for a given dataset.
(a) Perform Exploratory Data Analysis
(b) PrePreprocess Dataset
(c) Build MLP model
(d) Evaluate Model Performance Matrices accuracy_score, ConfusionMatrix before and after scaling
(e) Predict for test data.

EXPERIMENT NO. 3	**Multiclass classifier using ANN & CNN**	**2 Hours**

Build a Multiclass classifier using using keras with TensorFlow. Use MNIST and CIFAR dataset.
a)Perform Data Pre-processing
b) Define Model and perform training
c) Evaluate Results using confusion matrix.

EXPERIMENT NO. 4	**Transfer Learning using VGG16 , VGG19**	**2 Hours**

Design and implement VGG16, VGG19 using CNN for Image Classification.
a. Select a suitable image classification dataset (medical imaging, agricultural, etc.).
b.Optimized with different hyper-parameters including filter size, no. of layers, optimizers, dropouts. etc.

EXPERIMENT NO. 5	**Convolution Neural Networks : AlexNet, ResNet-50 using C**	**2 Hours**

(a) Design and implement AlexNet, ResNet-50 , Densenet using CNN for Image Classification.
(b) Define Model and perform training
(b) Evaluate Results using two performance measure matrix. Select a suitable image classification dataset.

EXPERIMENT NO. 6	**Transfer Learning :MobileNetV2, InceptionNet , ResNet and DenseNet**	**2 Hours**

Apply transfer learning technique in deep neural network. Use two pre-trained models such as MobileNetV2, InceptionNet , ResNet and DenseNet on suitable datasets.

EXPERIMENT NO. 7	**Transfer Learning**	**4 Hours**

Perform experiment for VGG16,VGG19, ResNET Comparative Analysis , Transfer Learning

EXPERIMENT NO. 8	**Hyper Parameter Optimization**	**4 Hours**

Train VGG16 & VGG-19 from scratch as well as using transfer learning approach. Fine-tune the hyper-parameters and compare their performance for a suitable application.

EXPERIMENT NO. 9	**Convolution Neural Network application**	**4 Hours**

Implement a CNN for any application in given images with accuracy score. (Facebook Segment Analytical Model (SAM)).)		
EXPERIMENT NO. 10	**Recurrent Neural Networks: Stock Market Prediction**	**2 Hrs**
Write a program for Stock Market Prediction using LSTM.		
EXPERIMENT NO. 11	**Application PBL Project**	**4 Hrs**
Implement one problem statememt using DL and Evaluate the result.		

PROGRAM BASED LEARNING (PBL)

A team may include to a maximum of 4 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. Healthcare
2. E-Learning
3. Smart village
4. Smart agriculture Image recognition

Text Books:

1. Deep Learning with TensorFlow: Explore neural networks with Python, Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Packt Publisher, 2017.
2. Deep Learning with Keras, Antonio Gulli, Sujit Pal , Packt Publishers, 2017.
3."Deep Learning with Python", Francois Chollet, Manning Publications,

Course Code:	UDSPC0632	L	T	P	Credit
Course Name:	Image Processing and Computer vision Lab			2	1

Course Prerequsites:

Core Python,Numpy,Machine learning Claffication Algorithms

Course Description:

The course aims to give exposure to image analysis and processing and practical aspects of computer vision

Course Outcomes:	After the completion of the course the student will be able	BL	Descriptio
CO1	Apply image processing techniques such as reading, writing, and displaying images using OpenCV.	L3	Apply
CO2	Utilize various image transformation techniques for enhancement, including contrast stretching, bit-plane slicing, and histogram equalization.	L3	Apply
CO3	Analyze different noise models and Examinee the effectiveness of various filtering techniques for image restoration.	L4	Analyze

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	100%	Quiz/Assignments/Group Discussions/Internal oral

Course Contents:

EXPERIMENT NO. 1	Image Read, Write, and Display using OpenCV	2 Hours

Understand various functionalities of python and OpenCV: Read, Write and display an image using OpenCV

EXPERIMENT NO. 2	Image Transformations for Enhancement	2 Hours

Write and Execute various Image transformations for Image enhancement: Image Negative, Contrast Stretching, Bit plane slicing, Gray level slicing

EXPERIMENT NO. 3	Image Enhancement using Histogram Equalization	2 Hours

Enhance the image using Histogram equalization

EXPERIMENT NO. 4	Noise Models and Image Restoration using Filters	2 Hours

Study various Noise Models and Restore the degraded image using following filters: Arithmetic mean, Midpoint, Alpha trimmed mean		
EXPERIMENT NO. 5	**Edge Detection using Canny and Sobel Algorithms**	**2 Hours**
Write a program to detect the edges of the given input image using following Edge detection algorithms: Canny Edge Detection, Sobel Edge Detection.		
EXPERIMENT NO. 6	**Image Forgery Detection using Machine Learning**	**2Hours**
Implement Image Forging Detect and Classify forged images using OpenCV and Python. Use Machine learning technique.		
EXPERIMENT NO. 7	**Face Detection and Recognition using OpenCV**	**2 Hours**
Implement Face detection and recognition using OpenCV and python.		
EXPERIMENT NO. 8	**Number Plate Recognition using CNN**	**4 Hours**
To develop a system that detects and recognizes vehicle number plates from images using a CNN		
EXPERIMENT NO. 9	**Brain Tumor Classification using ResNet-18**	**4 Hours**
Classify brain MRI images as tumorous or non-tumorous using ResNet-18 model.		
EXPERIMENT NO. 10	**COVID-19 Detection using VGGNet**	**4 Hours**
Classify chest X-rays as COVID-19 positive or normal using VGG16 or VGG19		
EXPERIMENT NO. 11	**Digital Twin Simulation using MobileNet**	**4 Hours**
Simulate and detect faults in machine parts using real and generated images by using OpenCV + TensorFlow		
PROGRAM BASED LEARNING (PBL)		
1. Detect the RGB color from a webcam using Python – OpenCV 2. Brightness Control With Hand Detection using OpenCV in Python 3. Video Analysis with Convolutional LSTM Networks 4. Basic Image Filters (Blur, Sharpen) 5. Basic Image Filters (Blur, Sharpen)		
Text Books:		

1. Digital Image Processing, Rafael C. Gonza Lez and Richard E. Woods, Fourth Edition, Pearson, 2018.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd Edition, The University of Washington, 2022.
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing Analysis and Machine Vision”, Fourth Edition, Cengage Learning

Web Resources

1. Digital Image Processing by Prof. P.K. Biswas, IIT Kharagpur
Course Link: Digital Image Processing - NPTEL
2. Computer Vision by Prof. Sukhendu Das, IIT Madras
Course Link: Computer Vision - NPTEL
3. Computer Vision and Image Processing – Fundamentals and Applications by Prof. M. K. Bhuyan, IIT Guwahati
Course Link: Computer Vision and Image Processing - NPTEL

Course Code:	UDSPC0633	L	T	P	Credit
Course Name:	Advanced Web Development Lab			2	1

Course Prerequsites:

Fundamentals of Python, Database Management System, Programming skills, Computer Network.

Course Description:

Enable students to build dynamic web applications by integrating RESTful APIs for real-time data communication. It also aims to familiarize them with the deployment and management of full-stack web solutions using modern cloud platforms. Additionally, the course equips students with essential security practices in web development, including secure authentication and data protection.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	**Apply** Concepts of frontend technologies using HTML, CSS, Java Script and Flask application Server	L3	Apply
CO2	**Develop** web application using HTML, CSS, Java Script and Flask application Server Develop Machine Learning web application using Flask and FastAPI Machine Learning web application using Flask and FastAPI	L6	Create
CO3	Develop and manage Containerizer application using Docker, Kubernetes, Jenkins and EKS (Elastic Kubernetes Service)	L6	Create

CO-PO Mapping:

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

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		2 Hours

Design Student registration Form using HTML and CSS

Develop a Web application for student registration. Design HTML components for Student registration. Display Students details on second HTML Page

EXPERIMENT NO. 2		2 Hours

Flask Web Framework Installation and Configuration

Install Flask web framework for Python. Configure Flask Web framework and test Hello Flask Application

EXPERIMENT NO. 3		**2 Hours**
Flask Web Application with Flask Virtual Environment Develop and deploy a Web Application for student registration in Flask Virtual Environment mode		
EXPERIMENT NO. 4		**2 Hours**
Flask Routing configuration Design Flask routes to Add, View, Search details of Student Information in Student registration Web application.		
EXPERIMENT NO. 5		**2Hours**
Database component of Flask Web Framework Deploy Student Registration Flask application to perform Database Create, Retrieve, Update, and Delete Operation. Install My SQL Workbench Database Product Suit. Configure Database to Store Student information. Configure Flask Server for Database Connection. Deploy Student Registration web application to Perform Database Create, Retrieve, Update, and Delete Operation with the help of Flask Routes.		
EXPERIMENT NO. 6		**2 Hours**
Machine Learning Model Integration in Flask web Framework Create Web Application to take input from user and Train your ML Model. Deploy ML model using Flask to show prediction output to the User		
EXPERIMENT NO. 7		**2 Hours**
FastAPI Interface Installation Set up FastAPI Interactive API Documentation Swagger UI to add endpoints, methods, and schemas and Users		
EXPERIMENT NO. 8		**2 Hours**
Develop weather prediction ML Web Application. Configure FastAPI end point to send user data in request and get ML model output as response message from Flask Web Application		
EXPERIMENT NO. 9		**2 Hours**
Design ML application with Flask and FastAPI Interface with Database integration Design and Deploy ML application in Both Flask web Framework and FastAPI with Database operation.		
EXPERIMENT NO. 10		**4 Hours**

Modern Tools Used for Machine Learning

1. Create and train an ML model using AutoML tools without writing manual code.
2. Use BentoML to package and deploy the trained ML model as a service.
3. Manage code and collaborate using GitHub with GitHub Copilot for assisted coding.
4. Track and version ML models and experiments using MLflow.
5. Manage dataset versioning and reproducibility using DVC (Data Version Control).

EXPERIMENT NO. 11		**4 Hours**

Introduction to Containerized Deployment

1. Containerize the application using Docker to ensure consistent environment.
2. Push Docker images to Docker Hub for centralized image storage and sharing.
3. Deploy and manage containers at scale using Kubernetes.
4. Automate ML workflows and pipeline orchestration using Kubeflow on Kubernetes.
5. Implement CI/CD pipeline using Jenkins or GoCD for automated build, test, and deployment.

EXPERIMENT NO. 12		**4 Hours**

Introduction to Cloud Plateform

1. Launch and manage virtual servers using AWS EC2 for compute needs.
2. Store and manage Docker images using Amazon ECR (Elastic Container Registry).
3. Run containerized applications using AWS ECS (Elastic Container Service).
4. Orchestrate and scale Kubernetes workloads using AWS EKS (Elastic Kubernetes Service).
5. Build, train, and deploy ML models using AWS SageMaker.

Text Books:

1. HTML & CSS: The Complete Reference, Fifth Edition by ThomasPowell
2. Flask Web Development, 2nd Edition by Miguel Grinberg Released March 2018 Publisher(s): O'Reilly Media, Inc.
3. FastAPI by Bill Lubanovic Released November 2023 Publisher(s): O'Reilly Media, Inc.

Web Resources:

1. https://flask.palletsprojects.com/en/3.0.x/
2. https://fastapi.tiangolo.com/

Course Code:	UDSIL0671	L	T	P	Credit
Course Name:	MiniProject-IV			2	1

Course Prerequsites:

Knowledge of Software Development Tools and Technologies.

Course Description:

Course Description: In this mini project, the students will apply multi-course environment for solving different real- world problems. The students shall use the concepts they have learned in their previous & the courses they are learning in the current semester and students will develop a solution to an identified problem

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Analyze real world problems and define solvable AI & ML -based problem statements.	L4	Analyze
CO2	Evaluate and document solutions using structured technical reports.	L5	Evaluate
CO3	Design language models and feature representations for real-world applications.	L6	Create
CO4	Develop and Test complete CS-based solutions using suitable technologies.	L6	Create

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Problem Statement, SRS, Design
2	In Semester Evaluation 2 (ISE2)	50%	Implmentation, Presentation, Demo of working model

Course Contents:

Guidelines for Mini Project -III

1. The primary objective of the mini project-II is to achieve multi course real world problem-based learning.
2. Course Instructor shall form the project team of 3 to 4 students in the batch of students
3. Each team shall use the knowledge they learned in the previous courses to identify the real world problem and solve using learnt technology
4. The solution shall be using the tools & techniques from multiple courses - e.g a solution shall be using data structures, Computer Networks, Data Science and ML modeling to develop mini project.
5. The evaluation shall be done in two phases

a. Phase 1 ISE-1 In ISE 1 the students shall be graded based on the skills demonstrated to identify the problem statement, define the problem statement & Designing its solution. The partial working model is expected to be completed.

b. Phase 2 ISE-2 In ISE 2 the students shall be graded based on the complete project implementation and its working. Followed by the detailed project report which shall cover the technical aspects of the project.

6. It's recommended to share a common project report format to all batches.
7. All course instructors shall coordinate and work towards a common evaluation process.
8. Course instructors shall demonstrate and discuss sample case studies with students to help them understand the mini project deliverables.

Guidelines for Evalutions:

Guidleines for the Evaluations:
Below Criteria points can be used for Students Project Evaluation. Problem Statement
Software Requirement Specification (SRS) Detailed Design Using UML, classes diagram and ER diagram.
Implementation
Testing and Team Communication
Checking Projects for Expected Analysis and Result Project Final Demonstration with detailed Report

MM: Multi-Disciplinary Minor Courses - Biomedical Engineering (Basket 1)							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UDSMM0341	Basics of Biomedical Engineering (MM-I)	2	-	-	2	2
2	UDSMM0441	Biostatistics and Algorithms (MM-II)	3	-	-	3	3
3	UDSMM0541	Soft Computing (MM-III)	3	-	-	3	3
4	UDSMM0641	Medical Image Analysis (MM-IV)	3	-	-	3	3
5	UDSMM0741	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	UDSMM0342	Fundamentals of Finance for Engineering (MM-I)	2	-	-	2	2
2	UDSMM0442	Blockchain Technologies and FinTech (MM-II)	3	-	-	3	3
3	UDSMM0542	Time Series Analysis (MM-III)	3	-	-	3	3
4	UDSMM0642	Machine Learning for Finance (MM-IV)	3	-	-	3	3
5	UDSMM0742	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	UDSMM0343	Digital Electronics (MM-I)	2	-	-	2	2
2	UDSMM0443	Microprocessor and Microcontrollers (MM-II)	3	-	-	3	3
3	UDSMM0543	Embedded Systems (MM-III)	3	-	-	3	3
4	UDSMN0643	IoT with Arduino and Raspberry Pi (MM-IV)	3	-	-	3	3
5	UDSMM0743	AI in Embedded Systems (MM-V)	3	-	-	3	3
					Total:	**14**	**14**

Course Code:	UDSMM0641	L	T	P	Credit
Course Name:	Medical Image Analysis	3	-	-	3

Course Prerequsites:

Basics of Biomedical Engineering.

Course Description:

This course deals with automated analysis of diagnostic medical images, namely X-rays, CT and MRI scans. We will start with some basic material on how to visualize medical images and how to interpret the resolution of medical images correctly in addition to standard techniques for image processing.

Course Outcomes:	After the completion of the course the student will be able to -	Bloom's Level	Description
CO1	Show the importance of Medical image analysis through different imaging techniques.	L2	Understand
CO2	Explain the principle, components and procedure of different imaging modalities.	L2	Understand
CO3	Apply suitable imaging technique for particular application.	L3	Apply
CO4	Classify the images obtained from different imaging techniques for diagnosis and treatment.	L4	Analyze

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	1	1			1					1	1	2	
CO2	2	1	1			1					1	1	2	
CO3	2	2	3			1					1	1	1	
CO4	1	2	3			1					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-I	Introduction to Medical Imaging	6 Hours

Basic imaging principle, Imaging Modalities-Projection radiography, Computed Tomography, Nuclear medicine, Ultrasound imaging, Magnetic Resonance Imaging.

UNIT-II	X-Ray and Radiography:	8 Hours

Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers, X-Ray detectors, Conventional X-Ray radiography, Fluoroscopy, Angiography, Digital radiography, X-Ray image characteristics, Biological effects of ionizing radiation.

UNIT-III	**Computed Tomography**	**7 Hours**

Conventional tomography, Computed tomography principle, Generations of CT machines – First, Second, Third, Fourth, Fifth, Sixth & Seventh, Projection function, Reconstruction algorithms.

UNIT-IV	**Reconstruction Algorithms**	**8 Hours**

Phonetics: Pronunciation, Clarity of Speech Reduction of MTI in spoken English, Importance of Questioning: Question formation with emphasis on common errors made during conversation.

UNIT-V	**Infrared and Radio Nuclide Imaging**	**8 Hours**

Radio Nuclide Imaging: Interaction of nuclear particles and matter, Nuclear sources, Radionuclide generators, Nuclear radiation detectors, Rectilinear scanner, scintillation camera, SPECT, PET.
Infrared Imaging: Physics of thermography – imaging systems – pyroelectric vidicon camera clinical thermography – liquid crystal thermography.

UNIT-VI	**Magnetic Resonance Imaging:**	**8 Hours**

Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency, Rotating frame of reference, Free induction decay, Relaxation times, Pulse sequences, Generation and Detection of NMR Imager. Slice selection, Frequency encoding, Phase encoding, Spin-Echo imaging, Gradient-Echo imaging, Imaging safety, Biological effects of magnetic field, Introduction to Functional MRI.

Text Books:

1. Principles of Medical Imaging, K Kirk Shung, Michael B Smith & Benjamim M W Tsui, Academic Press Inc.
2. Hand Book of Biomedical Instrumentation, R S Khandpur, Tata McGraw Hill Publication, Second Edition.

Reference Books:

1. Medical Imaging Signals and Systems, Jerry L Prince & Jonathan M Links, Pearson Prentice Hall.
2. The physics of medical imaging, Steve Webb, Adam Hilger, Bristol, England, Philadelphia, USA, 1988.
3. Basics of MRI, Ray H Hashemi & William G Bradley Jr, Lippincott Williams & Wilkins.
4. Diagnostic Ultrasound Principles & Instruments, 5th Edition, Frederick W Kremkau.

Web Resources:

1. Medical Image Analysis (NPTEL), "https://archive.nptel.ac.in/courses/108/105/108105091/".
2. Principles of Medical Imaging (MIT OCW), "https://ocw.mit.edu/courses/22-058-principles-of-medical-imaging-fall-2002/".

Course Code:	UDSMM0642	L	T	P	Credit
Course Name:	Machine Learning for Finance	3			3

Course Prerequsites:

Basic Computer Skills, Programming skills, Mathematics skills

Course Description:

This course emphasizes the various mathematical frameworks for applying machine learning in quantitative finance, such as quantitative risk modeling with kernel learning and optimal investment with reinforcement learning.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain fundamentals of statistical learning theory.	II	Understand
CO2	Describe basics of Gaussian Processes for financial risk modeling	III	Apply
CO3	Describe basics of Reinforcement Learning for optimal stochastic control problems in finance	II	Understand
CO4	Will gain hands on experience working with real market data and implementing machine learning methods in Python	II	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	3		2										
CO2	3	3		3	2							3	2	
CO3	3	3	2	3	3							3	3	
CO4	3	3	3	3	3				2	3	2	3	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 **Fundamentals of statistical learning theory** **8 Hours**

Convergence and learnability, Kullback-Leibler Information, Model selection and the bias variance trade-off Cross-validation, Regularization, Generative vs Discriminative models .

UNIT 2 **Recurrent Neural Networks for Econometrics** **7 Hours**

Econometric models for time series prediction, Filtering for time series, Recurrence in neural networks and relation to ARIMA, Gated Recurrent Unit (GRU) and Long Short-Term Memory (LSTM) networks as a dynamic econometrics model, Application to forecasting models used in algorithmic trading

UNIT 3 **Bayesian Machine Learning** **8 Hours**

Bayesian inference, filtering and prediction, Kernel learning, Gaussian processes (GPs), Multi-GPs
GPs for derivative pricing and risk management

UNIT 4 **Introduction to Reinforcement Learning** **7 Hours**

Markov Decision Processes (MDPs), with examples in finance, Partially Observable MDPs, Value and action-value functions, Bellman optimality, Policy iteration, Q-learning, Exploitation versus exploration

UNIT 5 **Introduction to Inverse Reinforcement Learning** **8 Hours**

Imitation learning, Constraints based inverse reinforcement learning,Maximum entropy inverse reinforcement learning, Applications in algorithmic trading

UNIT 6	**Investment Management and Risk Management**	**7 Hours**

Merton's optimal consumption, Optimal hedging strategies, Robo-advisors for optimal allocation
Learning an investor's preferences. Model-free derivative pricing, Value-at-risk estimation with GPs
Credit Value Adjustment with GPs.

Text Books:

1. Hastie, T., Tibshirani, R., & Friedman, J. H. (2009). The Elements of Statistical Learning: Data Mining, Inference, and Prediction (2nd ed.). New York: Springer. (Open Access)
2. Rasmussen, C. E., & Williams, C. K. I. (2006). Gaussian Processes for Machine Learning. MIT Press.

Reference Books:

1. . Sutton, R. S., & Barto, A. G. (2018). Introduction to Reinforcement Learning (2nd ed.). MIT Press.
2. Cambridge, MA, USA. Open Access,
3. Tsomocos, D. P., & Wilkens, S. (2020). Machine Learning in Financial Markets: A Guide to Contemporary Practices. Cambridge University Press

Course Code:	UDSMM0643	L	T	P	Credit
Course Name:	IoT with Ardinuo and Raspberry Pi	3			3

Course Prerequsites:

Knowledge of Computer Networking, Knowledge of Microprocessor, Knowledge of Python and Assembly Programming.

Course Description:

This Course Introduces to necessary fundamentals of IOT, introduction of Raspberry Pi with Python Programming and it aims to develop applications related to Smart Home Application, Electric vehicles and its Networks.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Illustrate Key Concepts and Terminologies related to IOT.	II	Understand
CO2	Outline Raspberry Pi Programs and Arduino Programs.	II	Apply
CO3	Explain IOT Servers and Cloud Services.	II	Understand
CO4	Analyze IOT Solutions for real life Problems.	III	Apply

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2		2	2					2				
CO2	3	3	2	3	3					2		3	2	
CO3	3	3	2	3	3							3	3	
CO4	3	3	3	3	3	3	2	2	2	3	3	3	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 to internet of things** **6 Hours**

Introduction, Physical Design of IOT, Logical Design of IOT,Working with IOT Devices, IOT Templates, Application of IOT.

UNIT 2 **Fundamentals of IOT mechanisms and key technologies** **8 Hours**

Structural Aspects of IOT: Environment Characteristics, Traffic Characteristics, Scalability, Security and Privacy. IOT Technologies: RFID, Sensor, Satellite, Nano, Smart Tech, Cloud Computing. IOT Standards: Bluetooth Smart, ULE, IEEE 802.11ah,Thread, Zigbee, Zwave, 6LoWPAN, IETF IPv6 Routing Protocols for RPL Roll.

UNIT 3 **IOT Physical Servers and Cloud Offerings** **6 Hours**

Introduction to Cloud Storage Models and Communication API's, WAMP- AutoBahn for
IOT, Amazon Web Services for IOT, Xively Cloud Services, Django Model and Architecture,
Python Web Application Framework.

UNIT 4 **Arduino and its Functions** **10 Hours**

Introduction to Arduino, Pin Configuration and Architecture, Digital and Analog Ports , ARduino Interrupts,

UNIT 5 **Raspberry Pi for Applications** **8 Hours**

Peripherals of Raspberry Pi, Pin Numbering Formats, LED Interfacing, Applications of Raspberry Pi- MP3 Player, Video Player, , Online video Streaming

UNIT 6 **CASE STUDIES ILLUSTRATING IOT DESIGN** **7 Hours**

Introduction, Home Automation- Smart Lighting,Home Intrusion Detection, Cities-Smart Parking Environment-Weather Monitoring System, Live Projects- LED Running Buttons, Buzzer Interfacing, 7 Segment Display Interfacing

Text Books:

1. Ismail, Y. (2020). IoT for Automated and Smart Applications. CRC Press
2. Bahga, A., & Madisetti, V. (2015). Internet of Things: A Hands-On Approach. Universities Press.
3. Al-Turjman, F. (2019). Intelligence in IoT-Enabled Smart Cities. CRC Press.

Reference Books:

1. Bahga, A., & Madisetti, V. (2015). Internet of Things: A Hands-On Approach. Universities Press.
2.Geddes, M. (2016). Arduino Project Handbook: 25 Practical Projects to Get You Started. No Starch Press
3 Al-Turjman, F., & Imran, M. (2020). IoT Technologies in Smart Cities. IET Press
4.Selected Journal Papers on FANETs, VANETs, IoV, and Smart Cities. Published in reputed journals such as IEEE, Elsevier, Springer, and ACM

Course Code:	UDSEX0491	L	T	P	Credit
Course Name:	Certified Web Developer	3	-	-	3

Course Prerequsites:

Course Description:

This course is designed to equip students with the essential skills and knowledge required to build dynamic and responsive websites. The course covers both front-end and back-end technologies, including HTML, CSS, JavaScript, React.js, Node.js, and MongoDB. Students will gain hands-on experience by building real-world applications, from basic static websites to full-stack web solutions. By the end of the course, participants will be prepared to develop, deploy, and manage modern web applications effectively.

Course Outcomes:	After the completion of the course the student will be able to -	Bloom's Level	Description
CO1	Model responsive and accessible websites using HTML5 and CSS3.	L3	Apply
CO2	Build server-side applications and RESTful APIs using Node.js and Express.js.	L3	Apply
CO3	Develop interactive web pages using JavaScript and DOM manipulation.	L3	Apply
CO4	Build website using learnt concepts.	L6	Create

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

UNIT-I	Introduction to Web Development and HTML5	7 Hours

Web development overview: static vs dynamic websites, Internet, browsers, servers, and HTTP, Introduction to HTML5, Tags, Elements, Forms, Semantic elements (header, footer, article, etc.).

UNIT-II	Cascading Style Sheets (CSS3) and Responsive Design	7 Hours
CSS syntax, selectors, box model, positioning, Styling text, backgrounds, borders, and layouts, Flexbox and CSS Grid.		
UNIT-III	**JavaScript and DOM Manipulation**	**10 Hours**
JavaScript basics: variables, data types, operators, Control structures, functions, arrays, objects, DOM (Document Object Model), Event handling.		
UNIT-IV	**Front-End Framework – React.js**	**7 Hours**
Introduction to component-based architecture, JSX and functional components, React Hooks: useState, use Effect, Conditional rendering and list rendering.		
UNIT-V	**Back-End Development with Node.js and Express.js**	**8 Hours**
Introduction to server-side scripting, Setting up a Node.js server, Working with Express.js, RESTful APIs and CRUD operations, Introduction to authentication (JWT/basic auth).		
UNIT-VI	**Databases and Deployment**	**6 Hours**
Introduction to databases: SQL vs NoSQL, MongoDB basics: collections, documents, queries, Mongoose for MongoDB, Connecting Node.js with MongoDB.		
Text Books:		
1. HTML & CSS: Design and Build Websites – Jon Duckett, JoHn WiLey & SonS, inC, 2011. 2. CSS: The Missing Manual – David Sawyer McFarland, O'Reilly Media, 4th Edition, 2006. 3. Eloquent JavaScript: A Modern Introduction to Programming – Marijn Haverbeke, No starch press, 2018.		
Reference Books:		
1. React – Up & Running by Stoyan Stefanov, O'Reilly Media; 2nd ed. Edition, 2021. 2. Node.js Design Patterns – Mario Casciaro, Packt Publishing; 3rd ed. Edition, 2020. 3. MongoDB: The Definitive Guide - Powerful and Scalable Data Storage, Kristina Chodorow, Shroff/O'Reilly; Third edition, 2020.		

Course Code:	UDSEX0492	L	T	P	Credit
Course Name:	Foundation Course in Machine Learning using Python	3			3

Course Prerequsites:

Linear Algebra, Probability, Basic Python preferred

Course Description:

This course provides a foundational understanding of machine learning, focusing on supervised and unsupervised learning techniques.

Course Outcomes:	After the completion of the course the student will be able to -	BL	Description
CO1	Explain the fundamental concepts and types of machine learning, including supervised and unsupervised learning.	II	Understand
CO2	Apply data preprocessing techniques and implement regression models using appropriate tools.	III	Apply
CO3	Make use of sklearn library for classification and clustering for machine learning models.	III	Apply
CO4	Analyze the performance of machine learning models using evaluation metrics to compare algorithm effectiveness.	IV	Analyze

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

UNIT 1	Introduction to Machine Learning and Mathematical Foundations	7 Hours

This unit introduces types of machine learning—supervised, unsupervised, and reinforcement—along with key applications and workflow.
essential data preprocessing techniques like normalization, encoding, and handling missing values. Mathematical foundations include vectors, matrices, eigenvalues, and basics of probability and statistics.

UNIT 2	Supervised Learning – Introduction to Regression Techniques	8 Hours

Linear regression: hypothesis, cost function, gradient descent, Multiple linear regression, Regularization.

UNIT 3	Supervised Learning – Introduction to Classification Techniques	8 Hours

Logistic Regression, K-Nearest Neighbors (KNN) , Support Vector Machines (SVM), Performance metrics: Confusion matrix, accuracy, precision, recall, F1-score, ROC

UNIT 4	Ensemble Methods	9 Hours

Decision Trees, Bagging Principle -Random Forests, Boosting Principle -AdaBoost, Gradient Boosting, XGBoost,LightGBM

UNIT 5	Hyperparameter Tunning	8 Hours
Cross-validation techniques, Hyperparameter tuning: GridSearchCV, RandomSearch, Bias-Variance trade-off		

UNIT 6	Unsupervised Learning Techniques	5 Hours
Clustering: K-Means, Hierarchical Clustering, Dimensionality reduction: PCA, t-SNE.		

Text Books:

1 Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, O'Reilly Media, 2022.

2 Sebastian Raschka & Vahid Mirjalili, Python Machine Learning, 3rd Edition, Packt Publishing, 2020

Reference Books:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

2. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 4th Edition, 2020.

3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, O'Reilly Media, 3rd Edition, 2022.

E-Learning Material

1. NPTEL Online Course:
[Introduction to Machine Learning by Prof. Sudarshan Iyengar (IIT Ropar)]
https://nptel.ac.in/courses/106/105/106105152

2 Coursera – Machine Learning by Andrew Ng (Stanford University):
https://www.coursera.org/learn/machine-learning

Course Code:	UDSEX0691	L	T	P	Credit
Course Name:	Foundation Couese in Artificial Intelligence Applications	3	-	-	3

Course Prerequsites:

Course Description:

This course provides a comprehensive overview of Artificial Intelligence (AI) and its practical applications across various industries. Designed for beginners, the course covers key AI concepts, maths behinf it and different tools. Students will learn how to apply AI techniques to real-world problems, explore popular AI tools, and gain hands-on

Course Outcomes:	After the completion of the course the student will be able to -	Bloom's Level	Description
CO1	Understand the role of AI in daily life.	L2	Understand
CO2	Explain the machine learning, neural networks and deep learning algorithms.	L2	Understand
CO3	Apply the AI and ML knowledhe to implement it using available tools such as Tensorflow and Keras.	L3	Apply
CO4	Analyze the deep learning algorithms through mathematics.	L4	Analyze

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

UNIT-I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	4 Hours

History of Artificial Intelligence (AI), Five domains of AI, Why AI now?, Limitation of AI.

UNIT-II	MACHINE LEARNING PRIMER	8 Hours

Machine Learning core concepts, scalable algorithms, project workflow, Objective Functions and Regularization, Understanding Objective Function of ML Algorithms, Metrics, Evaluation Methods and Optimizers.

UNIT-III	ADVANCED PYTHON FOR DEEP LEARNING	10 Hours

Python Programming Primer, Installing Python, Programming Basics, Native Data types, Class, Inheritance and Magic Functions, Python Classes, Inheritance Concepts, Magic Functions, Special Functions in Python, Overview, Array, selecting data, Slicing, Iterating.

UNIT-IV	TENSORFLOW 2.0 AND KERAS FOR DEEP LEARNING	8 Hours

TensorFlow 2.0 Basics, TensorFlow core concepts, Tensors, core APIs, Concrete Functions, Datatypes, Control Statements, Polymorphic Functions, Concrete Functions, Datatypes, Control Statements, NumPy, Pandas, Autograph eager execution, tf.function autograph implementation, Keras (TensorFlow 2.0 Built-in API) Overview.

UNIT-V	MATHEMATICS FOR DEEP LEARNING	9 Hours

Linear Algebra, Vectors, Matrices, Linear Transformation, Eigen Vectors, Matrix Operations, Special Matrices, Calculus – Derivatives: Calculus essentials, Derivatives and Partial Derivatives, Chain Rule, Derivatives of special functions, Probability Essentials: Probability basics and notations, Conditional probability.

UNIT-VI	Magnetic Resonance Imaging:	6 Hours

Deep Learning Network Concepts, Core concepts of Deep Learning Networks, Deep Dive into Activation Functions, Building simple Deep Learning Network, Tuning Deep Learning Network.

Text Books:

1. Artificial Intelligence: A Modern Approach, Russell, Stuart J. 1962-, Peter. Norvig and Ernest. Davis. Prentice Hall, 2010.
2. Python Machine Learning. S. Raschka, and V. Mirjalili. Packt Publishing Ltd., Livery Place 35 Livery Street Birmingham B3 2PB, UK, Second edition.

Reference Books:

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, O'Reilly Media, Inc., 2019.

Course Code:	UDSEX0692	L	T	P	Credit
Course Name:	Foundation Couese in Information Security	3	-	-	3

Course Prerequsites:

Course Description:

This course provides a comprehensive introduction to core information security concepts, including the CIA Triad, cryptography, and risk management. Students will learn to identify security threats, implement protective measures, and develop security policies. In this course, learners will explore the key concepts of securing information in a digital world, including the protection of data, networks, and systems against malicious threats and attacks.

Course Outcomes:	After the completion of the course the student will be able to -	Bloom's Level	Description
CO1	Understand Core Information Security Concepts.	L2	Understand
CO2	Identify and Analyze Security Threats and Attacks.	L2	Understand
CO3	Apply Cryptographic Techniques for given scenario.	L3	Apply
CO4	Develop and Enforce Security Policies and Risk Management Plans.	L4	Apply

CO-PO Mapping:

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

Assessment Scheme:

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

Course Contents:

UNIT-I	Introduction to Information Security	7 Hours

Definition and Concepts of Information Security, Confidentiality, Integrity, and Availability (CIA Triad), Types of Security Threats: Physical, Technical, Administrative, Security vs. Privacy, Importance of Information Security in the Digital Age, Overview of Security Policies, Standards, and Procedures.

UNIT-II	Security Threats and Attacks	7 Hours

Types of Cyber Attacks: Malware, Phishing, DoS, DDoS, Man-in-the-Middle (MitM), SQL Injection, and more, Attack Methodology and Phases, Social Engineering and Insider Threats.

UNIT-III	Cryptography and Encryption	8 Hours

Introduction to Cryptography: Symmetric vs. Asymmetric Encryption, Cryptographic Hash Functions and Digital Signatures, Public Key Infrastructure (PKI), SSL/TLS Protocols for Securing Web Traffic.

UNIT-IV	Risk Management and Security Policies	8 Hours

Risk Assessment and Analysis, Risk Mitigation Strategies: Prevention, Detection, and Response, Security Frameworks and Standards (ISO 27001, NIST, etc.), Incident Response Plans.

UNIT-V	Authentication and Access Control	8 Hours

Authentication Methods: Passwords, Biometrics, Multi-Factor Authentication (MFA), Role-based Access Control (RBAC), Least Privilege and Separation of Duties.

UNIT-VI	Emerging Threats and Future of Information Security	7 Hours

Emerging Threats: Ransomware, AI-based Attacks, Quantum Computing, Internet of Things (IoT) Security, Blockchain and Security Implications, Privacy Laws and Regulations (GDPR, CCPA).

Text Books:

1. Principles of Information Security,Michael E. Whitman, Herbert J. Mattord, cengage learning 2002.
2. Computer Security: Principles and Practice, William Stallings and Lawrie Brown, Pearson Education,2008.

Reference Books:

1. Security+ Guide to Network Security Fundamentals, Mark Ciampa, Cengage Learning, 2024.
2. Information Security: Principles and Practice, Mark S. Merkow and James H. Breithaupt, Pearson IT Certification; 2nd edition, 2014.