G H Raisoni College of Engineering and Management

(An Autonomous Institute affiliated to RTM Nagpur University Nagpur)

Department of Artificial Intelligence
B. Tech. in Artificial Intelligence with Multidisciplinary Minor
UG Scheme& Curriculum - 2023
(NEP 2020)

G H Raisoni College of Engineering & Management
(Formerly Known as G H Raisoni Institute of Engineering &Technology, Nagpur)
An Autonomous Institute Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Accredited by NAAC with "A+" Grade
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UG Scheme-2023 (NEP-2020)
B. Tech.(Artificial Intelligence)
Scheme Summary

Semester	Credits	Hours	Marks	Theory Heads	Practical Heads	Total Heads
I	20	27	600	7	6	13
II	20	26	550	6	5	11
III	20	23	550	6	2	8
IV	20	23	600	8	3	11
V	22	27	575	6	4	10
VI	22	28	600	6	5	11
VII	22	24	550	5	3	8
VIII	16	28	375	1	1	2
Total	**162**	**206**	**4400**	**45**	**29**	**74**

Course Category Credits Summary

Semester Basket		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC/ESC	6	8	--	--	--	--	--	--	14
Engineering Science Course		8	4	--	--	--	--	--	--	12
Program Core Course (PCC)	Program Courses	--	2	8	8	10	8	10	--	46
Program Elective Course (PEC)		--	--	--	--	4	8	4	4	20
Multidisciplinary Minor (MD M)	Multidisciplinary courses	--	--	2	2	4	2	4	--	14
Open Elective (OE) Other than a particular program		--	--	4	2	2	--	--	--	8
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	2	2	--	2	--	2	--	--	8
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	2	--	--	2	--	--	--	--	4
Entrepreneurship/Economics/ Management Courses		--	--	2	2	--	--	--	--	4
Indian Knowledge System (IKS)		--	2	--	--	--	--	--	--	2
Value Education Course (VEC)		--	--	2	2	--	--	--	--	4
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--	--	4	4
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	2	--	--	--	--	--	2
Project		--	--	--	--	--	--	4	--	4
Internship/ OJT		--	---	--	--	--	--	--	12	12
Co-curricular Courses (CC)	Liberal Learning Courses	2	2	--	--	--	--	--	--	4
Total Credits (Major)		**20**	**20**	**20**	**20**	**20**	**20**	**22**	**20**	**162**

GH raisoni COLLEGE
Engineering and Management Nagpur

UG Scheme-2023 (NEP-2020)
B. Tech. (Artificial Intelligence)

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-I													
23BTSHL101AI 23BTSHP101AI	Engineering Physics	BSC2	1	1	2	4	3	10	15	50	25	-	100
23BTSHL103AI	Matrices and Differential Calculus	BSC1	2	1	-	3	3	10	15	50	-	-	75
23BTSHL108AI 23BTSHP108AI	Communication Skills	AEC1	1	-	2	3	2	10	15		25	-	50
23BTSHL10XAI	Elective : Indian Knowledge System	IKS	2	-	-	2	2	10	15	50			75
23BTSHP112AI	Liberal Learning Courses-I	CC1	-	-	4	4	2	-	-	-	25	25	50
23BTAIL101 23BTAIP101	Introduction to Artificial Intelligence and Machine Learning.	PCC1	1	-	2	3	2	10	15	50	25	-	100
23BTAIL10X 23BTAIP10X	Elective -I : Vocational and Skill Enhancement	VSEC1	1	-	2	3	2	10	15		25	-	50
23BTITL102AI 23BTITP102AI	Programming for Problem Solving	ESC3	3	-	2	5	4	10	15	50	25	-	100
TOTAL			**11**	**2**	**14**	**27**	**20**	**70**	**105**	**250**	**150**	**25**	**600**

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-II													
23BTSHL102AI 23BTSHP102AI	Environmental Chemistry	BSC5	1	-	2	3	2	10	15	50	25	-	100
23BTSHL104AI	Integral Calculus and Differential Equations	BSC3	2	1	-	3	3	10	15	50	-	-	75
23BTSHL105AI	Linear Algebra and Statistics	BSC4	2	1	-	3	3	10	15	50	-	-	75
23BTSHP113AI	Liberal Learning Courses-II	CC2	-	-	4	4	2	-	-	-	25	25	50
23BTEEL101AI 23BTEEP101AI	Basic Electrical Engineering	ESC1	3	-	2	5	4	10	15	50	25	-	100
23BTECL101AI 23BTECP101AI	Digital Logic Design	ESC2	3	-	2	5	4	10	15	50	25	-	100
23BTAIL10X 23BTAIP10X	Elective –II: Vocational and Skill Enhancement	VSEC2	1	-	2	3	2	10	15		25	-	50
TOTAL			**12**	**2**	**12**	**26**	**20**	**60**	**90**	**250**	**125**	**25**	**550**

ELECTIVES

23BTSHL10XAI -Elective: Indian Knowledge System -

Course	Course Code (L)	Course Code(P)
Elective: IKS-1- Concepts and Applications inEngineering	23BTSHL109AI	Not Applicable
Elective: IKS-2- Social History of Medicine In Colonial India	23BTSHL110AI	Not Applicable
Elective: IKS-3- Modern Indian Architecture	23BTSHL111AI	Not Applicable

AI Board

Course	Course Code (L)	Course Code(P)
Elective -I : Vocational and Skill Enhancement -Data Visualization	23BTAIL102	23BTAIP102
Elective -I : Vocational and Skill Enhancement	23BTAIL103	23BTAIP103
Elective -I : Vocational and Skill Enhancement-	23BTAIL104	23BTAIP104
Elective –II: Vocational and Skill Enhancement-Artificial Intelligence with Python	23BTAIL105	23BTAIP105
Elective –II: Vocational and Skill Enhancement	23BTAIL106	23BTAIP106
Elective –II: Vocational and Skill Enhancement	23BTAIL107	23BTAIP107

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-III													
23BTSHL201AI BSBTSH4TT321AI	Discrete Mathematics and Graph Theory	PCC2	3	1		4	4	10	15	50			75
23BTCSL201AI 23BTCSP201AI BTCE3TT301AI BTCE1PT301AI	Data Structure and Algorithms	PCC3	3	-	2	5	4	10	15	50	25	25	125
23BTCSL202AI MDBTCE2TT302AI	Multidisciplinary Minor I: Computer Architecture	MDM1	2			2	2	10	15	50			75
23BTISL2XXAI OEBTXX4TTXXXAI	Open Elective I	OE1	4			4	4	10	15	50			75
23BTMBL201AI HMBTMB2TT301AI	Engineering Economics and Industrial Management	EEMC 1	2	-	-	2	2	10	15	50	-	-	75
23BTHUL20XAI VEBTSH2TT327AI VEBTSH2TT328AI VEBTSH2TT329AI	Humanities Elective Applied life skills for Progressive Excellence Content Designing and Media Fundamentals Cyber Ethics and Moral Responsibility	VEC1	2	-	-	2	2	10	15	50	-	-	75
23BTAIP210 CPBTAI2PI310	Minor Project	P			4	4	2				50		50
TOTAL			**16**	**1**	**6**	**23**	**20**	**60**	**90**	**300**	**75**	**25**	**550**

Open-Elective-I (III Semester) [NEW CODES]

Course offered by	Course Code	Name of Course	Branches: Who can opt?
Artificial Intelligence	OEBTAI4TT305XX	Data Analysis for Business Intelligence	ETC, EE, Mech, Civil
Civil Engg.	OEBTCV4TT304AI	Environmental Science	AI,CSE,EE,ETC Cyber, DS,IT
CSE	OEBTCE4TT311XX	Introduction to Block Chain Technology	ETC ,EE, Mech, Civil
IT	OEBTIT4TT311XX	Introduction to Scripting Languages	ETC, EE, Mech, Civil
E & TC Engg.	OEBTET4TT304AI	Sensors and its Applications	AI, IT CSE, Cyber, DS, Civil
First Year Engineering	OEBTSH4TT324AI	Applied English Communication Skills	AI, DS, Cyber, Mech, Civil CSE, IT,EE,ETC
First Year Engineering	OEBTSH4TT325AI	Advanced Communication Skills	AI,IT CSE, DS, Cyber, EE, ETC, Mech, Civil
Electrical Engg.	OEBTEL4TT310AI	Non-Conventional energy sources	All branch students except EE Engineering
Mechanical Engg.	OEBTME4TT304AI	Total Quality Management	All branch students except Mech Engineering
Data Science	OEBTDS4TT302XX	Web Designing and Analytics	ETC, EE, Mech, Civil

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-IV													
23BTSHL230AI	Transform and Numerical Method	PCC4	3	1		4	4	10	15	50			75
23BTAIL202 / 23BTAIP202	Machine Learning Algorithms	PCC5	3		2	5	4	10	15	50	25	25	125
23BTITL204AI	Multidisciplinary Minor II-	MDM2	2			2	2	10	15	50			75
23BTXXLXXAI	Open Elective II	OE2	2			2	2	10	15	50			75
23BTAIL207/ 23BTAIP207	Vocational and Skill Enhancement Elective III	VSEC3	1		2	3	2	10	15		25		50
23BTSHL231AI 23BTSHP231AI	Aptitude and Employability skill	AEC2	1		2	3	2	10	15		25		50
23BTMBL202AI	Entrepreneurship Development Practices	EEMC2	2			2	2	10	15	50			75
23BTSHL233AI	Universal Human Values 2: Understanding Harmony	VEC2	2			2	2	10	15	50			75
TOTAL			**16**	**1**	**6**	**23**	**20**	**80**	**120**	**300**	**75**	**25**	**600**

Open-Elective-I (III Semester) [OLD CODES]

Subject Code	Course offered by	Name of Subject	Who can opt?
23BTSHL223	First Year	English for International Aspirants	All branch students
23BTSHL224	First Year	Applied English Communication Skills	All branch students
23BTSHL225	First Year	Advanced Communication Skills	All branch students
23BTCEL203	Civil Engg.Dept	Environmental Science	All branch students except Civil Engineering
23BTCSL211	CSE Dept.	Introduction to Blockchain Technology	ETC,EE,Mech,Civil
23BTEEL210	EE Dept.	Nonconventional Energy Sources	All branch students except EE Engineering
23BTITL211	IT Dept.	Introduction to Scripting Languages	ETC,EEMech,Civil
23BTDSL202	DS Dept.	Web Designing and Analytics	ETC,EEMech,Civil
23BTAIL205	AI Dept.	Data Analysis for Business Intelligence.	ETC,EEMech,Civil

Open-Elective-II (IV Semester)

Subject Code	Course offered by	Name of Subject	Who can opt?
23BTITL221	Dept. of IT	Basics of GAME Programming	ETC, EE, CSE, AI, DS, Mech, Cyber Security, CVE
23BTEEL215	Dept. of EE	Foundation of Electric Vehicle	ETC, CSE, AI, DS, Mech, Civil
23BTECL209	Dept. of E & TC	Principles of Electronic Communication	CSE, AI, DS, Mech, Civil, EE
23BTSHL246	Dept. of First Year Engineering	Applied Mathematics	CSE, AI, DS, Cyber Security, IT, ETC, EE, Mech, Civil
23BTMEL208	Dept. of Mech	Materials for Products Development	ETC, EE, CSE, AI, DS, Cyber, IT, Civil
23BTAIL206	Dept. of AI	Introduction to Neural Networks and Deep Learning	ETC, EE, Mech, Civil

Open-Elective-III (V Semester)

Subject Code	Course offered by	Name of Subject	Who can opt?
23BTAIL312	Artificial Intelligence	Cloud Computing	ETC, EE, Mech, Civil
23BTCEL308	Civil Engg.	Environmental Impact Assessment	AI, CSE, DS, EE ,IT, ETC, Mech, Cyber Security
23BTEEL325	Electrical Engg.	Fundamentals of Electric Vehicle	All branch students Except EE
23BTITL303	Information Technology	Cyber Forensics	All branch students Except IT
23BTMEL311	Mechanical Engg.	Industry 4.0	All branch students Except Mech. Engg.
23BTSHL338	First Year Engineering	Constitution of India	CSE, AI, Cyber Security, DS, Civil, EE, ETC, IT, Mech
23BTSHL338	First Year Engineering	Intellectual Property Rights	All branch students

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-V													
23BTAIL301/ 23BTAIP301	Soft Computing	PCC6	3	-	2	5	4	10	15	50	25	25	125
23BTCSL301AI	Formal language and automata	PCC7	3	-		3	3	10	15	50	-	-	75
23BTCSL304AI	Operating system	PCC8	3	-		3	3	10	15	50	-	-	75
23BTAILXXX	Program Elective I-	PEC1	3	-	2	5	4	10	15	50	25	-	100
23BTCYL307AI 23BTCYP307AI	Multidisciplinary Minor - III	MDM3	3	-	2	5	4	10	15	50	25	-	100
23BTSLXXXAI	Open Elective III	OE3	2	-		2	2	10	15	50	-	-	75
23BTSHP301AI	Research methodology	RM	-	-	4	4	2	-	-	-	25	-	25
TOTAL			**17**		**10**	**27**	**22**	**60**	**90**	**300**	**100**	**25**	**575**

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VI													
23BTAIL304/ 23BTAIP304	Natural Language Processing	PCC9	3		2	5	4	10	15	50	25	25	125
23BTAIL305/ 23BTAIP305	Deep Learning	PCC10	3		2	5	4	10	15	50	25	25	125
23BTXXLXXAI 23BTXXLXXAI	Program Elective II	PEC2	3		2	5	4	10	15	50	25	-	100
23BTXXLXXAI 23BTXXLXXAI	Program Elective III	PEC3	4			4	4	10	15	50	-	-	75
23BTXXLXXAI 23BTXXLXXAI	Multidisciplinary Minor - IV	MDM4	2			2	2	10	15	50	-	-	75
23BTAIL321/ 23BTAIP321	Vocational and Skill Enhancement Elective III	VSEC4	1		2	3	2	10	15	-	25	-	50
23BTSHP302	Research Ethics & Technical Writing	RM	-	-	4	4	2	-	-	-	50	-	50
TOTAL			**16**		**12**	**28**	**22**	**60**	**90**	**250**	**150**	**50**	**600**

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VII													
23BTAIL401	Data Networks	PCC11	3			3	3	10	15	50			75
23BTAIL402/ 23BTAIP402	Responsible AI	PCC12	2		2	4	3	10	15	50	25		100
23BTAIL403/ 23BTAIP403	Generative AI	PCC13	3		2	5	4	10	15	50	25	25	125
23BTXXLXXAI 23BTXXLXXAI	Program Elective IV	PEC4	4			4	4	10	15	50			75
23BTXXLXX 23BTXXLXX	Multidisciplinary Minor	MDM5	4				4	10	15	50			75
23BTAIP460	Project	P			8	8	4				50	50	100
TOTAL			**16**		**12**	**24**	**22**	**50**	**75**	**250**	**100**	**75**	**550**

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VIII													
23BTAIL462	Program Elective V Moocs Based	PEC4	4			4	4	10	15	50			75
23BTAIP461	Internship	I			24	24	12				200	100	300
TOTAL			**4**		**24**	**28**	**16**	**10**	**15**	**50**	**200**	**100**	**375**

Multidisciplinary Minor from Other Department

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-III													
23BTCSL202AI MDBTCE2TT302AI	Computer Architecture	MDM1	2	-	-	2	**2**	10	15	50	-	-	75
SEMESTER-IV													
23BTITL204AI	Software Engineering and Project Management	MDM2	2	-	-	2	**2**	10	15	50	-	-	75
SEMESTER-V													
23BTCYL307AI 23BTCYP307AI	Computer Security	MDM3	3	-	2	5	**4**	10	15	50	25	-	100
23BTCSL302AI 23BTCSP302AI	Integrating DBMS with AI	MDM3	3	-	2	5	**4**	10	15	50	25	-	100
SEMESTER-VI													
23BTCYL313AI	Network Security	MDM4	2	-	2	2	**2**	10	15	50	-	-	75
SEMESTER-VII													
23BTECL 410AI	Introduction to Wireless Sensor Network	MDM5	4	-	-	4	**4**	10	15	50			75

Multidisciplinary Minor offer to Other Department

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-III													
23BTAIL203 MDMBTAI2TT303	Fundamentals of Artificial Intelligence	MDM1	2	-	-	2	2	10	15	50	-	-	75
SEMESTER-IV													
23BTAIL204	Introduction to Machine Learning Algorithms	MDM2	2	-	-	2	2	10	15	50	-	-	75
SEMESTER-V													
23BTAIL311 23BTAIP311	Introduction to Natural Language Processing	MDM3	3	-	2	5	4	10	15	50	25	-	100
SEMESTER-VI													
23BTAIL322	Introduction to AI-Driven Healthcare Applications	MDM4	2	-	2	2	2	10	15	50		-	75
SEMESTER-VII													
23BTAIL409	Introduction to Responsible AI	MDM5	4	-	-	4	4	10	15	50			75

Vocational and Skill Enhancement Courses

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-I													
UNCSL101 /UNCSP101	Computer Programming	VSEC1	1	-	2	3	2	10	15	-	25	-	50
UNITL103/ UNITP103	Introduction to Linux	VSEC1	1	-	2	3	2	10	15	-	25	-	50
UNDIL104/UNDIP104	Data Science Tools	VSEC1	1	-	2	3	2	10	15	-	25	-	50
23BTAIL102/ 23BTAIP102	Data Visualization	VSEC1	1	-	2	3	2	10	15	-	25	-	50
SEMESTER-II													
UNCSL102/ UNCSP102	Foundation of Data Analytics	VSEC2	1	-	2	3	2	10	15	-	25	-	50
UNITL106/ UNITP106	Fundamentals of Ethical Hacking	VSEC2	1	-	2	3	2	10	15	-	25	-	50
23BTAIL105/23BTAIP105	Artificial Intelligence with Python	VSEC2	1	-	2	3	2	10	15	-	25	-	50
UNDIL106/UNDIP106	R programming	VSEC2	1	-	2	3	2	10	15	-	25	-	50
SEMESTER-IV													
UNITL203/ UNITP203	Web Development	VSEC3	1	-	2	3	2	10	15	-	25	-	50
23BTAIL207/23BTAIP207	Data Preprocessing	VSEC3	1	-	2	3	2	10	15	-	25	-	50
UNITL204 /UNITP204	Principles of Object Oriented Programming	VSEC3	1	-	2	3	2	10	15	-	25	-	50
UNDIL203/UNDIP203	Security in IoT	VSEC3	1	-	2	3	2	10	15	-	25	-	50
SEMESTER-VI													
23BTAIL321/23BTAIP321	Introduction to Salesforce	VSEC4	1	-	2	3	2	10	15	-	25	-	50
UNITL308 /UNITP308	Information Coding Technique	VSEC4	1	-	2	3	2	10	15	-	25	-	50
UNAIL308/UNAIP308	R Programming for Statistics and Data Science	VSEC4	1	-	2	3	2	10	15	-	25	-	50

	POOL OF TRACKWISE PROFESSIONAL ELECTIVES				
Track/Elective	**Application Development**	**Machine Learning Engineer**	**Security**	**Computing**	**Data Science**
Track	**Track-I**	**Track-II**	**Track-III**	**Track-IV**	**Track -V**
Program Elective-I (Credits :4) (Th + Pr) (Semester-V)	Recommendation System 23BTAIL306 23BTAIP306	Reinforcement Learning 23BTAIL307 23BTAIP307	Cryptography and Network Security 23BTAIL308 23BTAIP308	Computer Vision 23BTAIL309 23BTAIP309	No SQL Database System 23BTAIL310 23BTAIP310
Program Elective II (Credits :4) (Th + Pr) (Semester-VI)	Practical ML 23BTAIL311 23BTAIP311	Predictive Modeling & Analytics 23BTAIL312 23BTAIP312	Blockchain Technology 23BTAIL313 23BTAIP313	Advance Cloud Computing Services 23BTAIL314 23BTAIP314	Distributed Computing 23BTAIL315 23BTAIP315
Program Elective III (Credits :4) (Th) (Semester-VI)	Virtual and Augmented Reality 23BTAIL316	IOT Architecture & Technologies 23BTAIL317	Digital Forensics 23BTAIL318	Introduction to Robotics 23BTAIL319	Data Mining 23BTAIL320
Program Elective-IV (Credits: 4) Th (Semester-VII)	Mobile Computing 23BTAIL404	Brain Machine Interface 23BTAIL405	Cyber Security 23BTAIL406	Pervasive Computing 23BTAIL407	Information Retrieval 23BTAIL408
Program Elective-V Moocs Based (Credits: 4) Th (Semester- VIII)					

Program Elective- V: MOOCs Based (NPTEL) (Credits: 4) Th (Semester- VII/ VIII)					
Track / Elective	**Application Development**	**Machine Learning Engineer**	**Security**	**Computing**	**Data Science**
ODD SEM					
Program Elective- V: MOOCs Based (Credits: 4) Th (Semester- VII/ VIII)	Pattern Recognition Application https://nptel.ac.in/courses/117105101 (ODD)	Applied Accelerated Artificial Intelligence https://nptel.ac.in/courses/106106238 (ODD)	Secure Computation Part-II https://nptel.ac.in/courses/106108237 (ODD + EVEN)	Second Level Algorithms https://nptel.ac.in/courses/106105704 (ODD)	Introduction to Large Language Models (LLMs) https://nptel.ac.in/courses/106102576 (ODD)
	Software Project Management https://nptel.ac.in/courses/106105218 (ODD)	Artificial Intelligence: Search Methods for Problem Solving nptel.ac.in/courses/106106226 (ODD)	Ethical Hacking https://nptel.ac.in/courses/106105217 (ODD)	Software Testing https://nptel.ac.in/courses/106101163 (ODD)	E-Business Prof. Mamata Jenamani https://nptel.ac.in/courses/110105083 (ODD)
EVEN SEM					
Program Elective -V MOOCs Based (Credits: 4) Th (Semester - VIII)	Animations https://onlinecourses.swayam2.ac.in/cec26_ge03 (EVEN)	Introduction to AI for Management https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs10 (EVEN)	Secure Computation https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs17 (ODD + EVEN)	GPU Architectures & Programming Preview: GPU Architectures and Programming | SWAYAM (EVEN)	Social Network Analysis https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs117 (ODD + EVEN)
	Android Mobile Application Development https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_ge22 (EVEN)	Machine Learning for Soil and Crop Management https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ag05 (EVEN)		Affective Computing https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs61 (EVEN)	Business intelligence and analytics https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_cs65 (EVEN)

Syllabus of III SEMESTER

Course Title: **Discrete Mathematics and Graph Theory**										
Semester	III	Teaching Scheme			Evaluation Scheme				
					Theory			Practical	
Term	ODD	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	BS	1	--	4	10	15	50	--	--
Course Code	23BTSHL201A I BSBTSH4TT321AI								
Teaching Mode	Offline	4		Total	75			--	
Duration of ESE	2.5 hrs				75				

Course Objectives	This course introduces concepts of set theory and graph theory and its application to computer science.
	It also skills to analyze various kindsof sets andgroups of objects meeting the criteria .
	It also introduces combinatorial structures and applies algebraic techniques to combinatorial problems.
Course Outcomes	**CO1**: Know grouping of objects and operation, relation, ordering of objects, concepts of Groups.
	CO2: Classify the algebraic structure for a given mathematical problem.
	CO3: Apply the concept of Boolean algebra in computer science engineering.
	CO4: Solve problems using basic graph theory.
	CO5: Develop algebraic technique to solve combinatorial problems using combinatorial structure.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**	**3**										**3**		
CO2	**3**	**3**										**3**		
CO3	**3**	**3**										**3**		
CO4	**3**	**3**										**3**		
CO5	**3**	**3**										**3**		

Course Contents:

Unit	Contents	Hours
I	**Set Theory** Operations on sets, Laws of algebra of sets, Representation of sets on computer in terms of 0's & 1's. Partition & coveringof a set, ordered pair, Product set, Relation– Different types of relations, Graph of relation, Matrix of relation, Transitive closure of relation, Properties of relations, Compatible relation. Functions, Partial ordering & partially ordered set, Hasse diagram of Poset, Totally ordered set, Peano axioms & Mathematical Induction.	10
II	**Group** Algebra or Algebraic systems like semigroup, monoid and examples. Homomorphism, Isomorphism of semigroup & monoid. Groups, properties of algebraic groups. Permutations groups, Subgroups, Cosets, Lagrange's theorem, properties of cyclic groups, generator of group, kernel of Homorphism, quotient group, Rings, types of rings, Fields, subring, Integral domain.	8
III	**Lattices and Boolean algebra** Lattice as Poset & as algebraic system, Types of lattices, Hassediagrams, Sublattice, direct product of Lattices, Lattice Homomorphism, complement of elements of lattices, Various lattices, composition tables, Lattice, Boolean algebra; Boolean Expressions, Equivalence of Boolean Expression by tables, Simplification of circuit & equivalent circuit by truth tables.	8
IV	**Graph Theory** Graphs and its types, Sub graph, Quotient graph, Euler path, complete path, indegree, outdegree, reachability, cycle, matrix representation of graph. Transitive closure of graph, Adjacency matrix, Trees, Venn diagram, Representationof trees, binary trees, spanning trees, Prim's algorithm.	8
V	**Combinatorics** Counting Theorem and application, multiplication principle of counting, Permutation & Combination with examples, Definition of generatingfunctions and it's examples, proof of simple combinatorial identities. Recursive relations: definitions& examples, explicitly formula for sequence, back tracking to find explicit formula of sequence, Solving recurrence relations. The pigeon hole principle & extended pigeon hole principle and application of pigeon hole principle in solving simple problems.	8

Text Books	1.	Discrete Mathematical structure with application to computer science by Trembley & Manohar (Mc. Graw Hill)
	2.	Discrete Mathematical Structure by Kolmann , Busby & Ross (PHI)
	3.	Discrete mathematics by Lipschutz & Lipson , Schaum's outline, TMH
Reference Books	1.	Discrete Mathematics by Liu
	2.	Discrete Mathematics by John Truss (Addison Wesley, 2000)
	3.	Foundations of Discrete Mathematical by K. D. Joshi (Willey Eastern).

Course Title: **Data Structure and Algorithms**										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3	--	2	4	10	15	50	25	25
Course Code	23BTCSL201AI/ 23BTCSP201AI BTCE3TT301AI BTCE1PT301AI									
Teaching Mode	Offline	5			Total	75			50	
Duration of ESE						125				

Course Objectives	This course introduces basic idea of data structure while making aware of methods and structure used to organize large amount of data.
	It's also aimed at developing skill to implement methods to solve specific problems using basic data structures.
	The course also provides career opportunities in design of data, implementation of data, technique to sort and searching the data.
Course Outcomes	CO1: Analyze various techniques for searching, Sorting and Hashing.
	CO2: Illustrate linear arrays and linked lists, including operations such as insertion, deletion, traversal, sorting, and searching.
	CO3: Demonstrate the array and linked representations of stacks and queues and their applications.
	CO4: Apply trees as non-linear data structure to find solution for given engineering applications.
	CO5: Understand the basics of Graphs as non-linear data structures.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1		3	2	3									1	
CO2		2	3	3									2	
CO3		3	3	3									2	1
CO4		3	3	3									3	2
CO5		3	3	2									3	1

Course Contents:

Unit	Contents	Hours
I	Introduction to Algorithms, Searching and Sorting Introduction to Algorithms, Common operations on data structures, Types of data structures, Abstract Data Type Time and Space Complexity, Step Count Method, Asymptotic Notations. Searching: Linear Search, Binary Search Sorting: Bubble sort, Selection Sort, Merge-Sort, Shell Sort, Radix Sort, Introduction to Hashing	9
II	Arrays and Linked Lists Arrays: Introduction, Linear Arrays, Arrays as ADT, Representation of Linear array in Memory, Traversing Linear Arrays, Insertion and deletion in arrays. Linked List: Introduction, Representation of Linked Lists in Memory, Traversing a Linked List, Searchinga Linked List, Memory Allocation; Garbage Collection, Types of linked lists, Insertion and Deletion in Singly Linked List, Insertion and Deletion in Doubly Linked List, Insertion and Deletion in Circular Linked List	9
III	Stacks, Queue and Recursion Stacks-Introduction to Stacks ,Array Representation of Stacks ,Linked Representation of Stacks, Stack as ADT, Various operations on stacks using arrays and linked lists, Application of Stacks : Polish Notations, Recursion, Towers of Hanoi Queue: Introduction to Queues, Array Representation of Queues, Linked Representation of Queues, Queues as ADT, Circular Queues, Deques, Priority Queues, Applications of Queues	9
IV	Trees and Binary Trees General and Binary Trees, Representation of binary tree in memory, Operations on Binary Trees, Binary Tree Traversals, Threaded Binary Trees, Binary Search Trees ,various operations in Binary Search Trees, AVL Search Trees, Insertion in an AVL Search Tree, Deletion in an AVLSearch Tree, m-way Search Trees, B-Trees-Insertion and deletion in B-Tree, B+Trees-Insertion and deletion in B+Tree	10
V	Graphs and their Applications: Introduction, Graph Theory Terminology, Representation of Graphs,Operations on Graphs, Traversing a Graph, Posets , Topological Sorting, Spanning Trees, Minimum Spanning Trees	8

Text Books	1.	AVAho, J Hopcroft, JD Ullman, Data Structures and Algorithms, Addison-Wesley, 1983.
	2.	THCormen, CF Leiserson, RL Rivest, C Stein, Introduction to Algorithms, 3rd Ed., MIT Press, 2009.
	3.	Sahni, S., "Data Structures, Algorithms, and Applications in C++", WCB/McGraw-Hill.
E--Books	1.	https://apps2.mdp.ac.id/perpustakaan/ebook/Karya%20Umum/Dsa.pdf
Reference Books	1.	Data Structures & Algorithms, 1e, Alfred V.Aho, Jeffery D. Ullman , Person.
	2.	MT Goodrich, R Tamassia, DM Mount, Data Structures and Algorithms in Java, 5th Ed., Wiley, 2010. (Equivalent book in C also exists.)
	3.	Wirth, N., "Algorithms and Data Structures", Prentice-Hall of India.
On-line TL Material	1.	https://nptel.ac.in/courses/106/102/106102064/
	2.	http://cse01-iiith.vlabs.ac.in/
	3.	https://ds2-iiith.vlabs.ac.in/data-structures-2/

Course Title: **Computer Architecture MD-I**										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MDM1	2	--		2	10	15	50	-	-
Course Code	23BTCSL202AI MDBTCE2TT302AI									
Teaching Mode	Offline	2			Total	75				
Duration of ESE										

Course Objectives	To understand the design principles of digital computing systems
	To provide essential understanding of different subsystems of modern computer system and design aspects these subsystems3
	To provide overview on performance enhancement methods in instruction execution
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: To describe the basic components and design of a computer system
	CO2: To examine the issues involved in the instruction execution and various stages of instruction life stage
	CO3: To apply the concept of various memories and interfacing technologies
	CO4: To analyze the different parallel processing technique
	CO5: To design different high performance computing architecture

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO0	PO1	PO2	PSO1	PSO2
CO1	1	–	–	–	–	–	–	–	--	–	–	--	3	–
CO2	–	2	–	–	–	–	–	–	--	–	–	--	2	–
CO3	–	3	–	–	–	–	–	–	--	–	–	--	2	–
CO4	–	–	3	–	–	–	–	–	--	–	–	--	3	–
CO5	–	–	3	–	–	–	–	–	--	–	–	--	–	3

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Overview and history of computer architecture, CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU:–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, Instruction set architecture CISC, RISC. **Case study:** –instruction sets of common CPUs, performance matrices for calculation of processingin Computer	5
II	**Computer Arithmetic:** Fixed point Addition, Subtraction, Multiplication and Division. Floating Point Arithmetic, High-performance arithmetic, Booth's algorithm: Division and Multiplication, Data representation methods. **IEEE standard:** single and double precision format and examples, ALU	5
III	**Memory Architecture:** Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory, Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices, Segmentation, TLB, DMA	5
IV	**An Overview of Pipelining:** Basic concepts of Pipelining, Pipelined Datapath, and Control. **Data Hazards:** Forwarding versus Stalling, Control Hazards, Exceptions, Arithmetic and Instruction Pipeline, throughput and speedup, pipeline hazards.	5
V	**Processor Architecture:** hardwired and micro-programmed design approaches, Case study - design of a simple hypothetical CPU. Multicore processors architecture, Introduction toGraphics Processing Units, Clusters and Warehouse scale computers, Advanced topics & its application.	5

Text Books	1.	Computer Organization and Architecture by Carl Hamacher 4th Edition
	2.	Advance computer Architecture by Kai Hwang under Tata McGraw Hill Publications
	3.	Introduction to Parallel Processing: Algorithms & Architectures, Behrooz Parhami in Springer Shop
EBooks	1.	Computer Architecture and Organization by William Stalling http://home.ustc.edu.cn/~leedsong/reference_books_tools/Computer%20 Org anization%20and%20Architecture%2010th%20-%20William%20Stallings.pdf
Reference Books	1.	Introduction to Parallel Processing by P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare By PHI Publications
	2.	Fundamentals of Parallel Processing by Jordan Harry, Alaghband Gita, PHI Publication
	3	Parallel Computers – Architecture and Programming by V. Rajaraman And C. Siva Ram Murthy.
	4.	Introduction to Parallel Programming by Steven Brawer
On-line TL Material	1.	NPTL https://nptel.ac.in/courses/106/105/106105163/

Course Title: Applied life skills for Progressive Excellence										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Odd	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	H	2 Hrs.	--	--	2	10	15	50	--	--
Course Code	23BTSHL227 VEBTSH2TT327AI									
Teaching Mode	Offline	2 Hrs.			Total	75			--	
Duration of ESE	2 Hrs.					75				

Course Objectives	To develop understanding of the fundamentals of life skills in students.
	To improve self-awareness and develop ways to face demands and challenges of life.
	To provide social-psychological and emotional foundations for the understanding of life skills.
	To foster social responsibility in students and enhance their positive and healthy behaviour.
	To carve the students with the opportunity to become active members of their community and has a lasting, positive impact on society at large.
Course Outcomes	**After the completion of the course, students shall be equipped with**
	CO1: The basic life skills towards self and Community as a whole and its varied approaches.
	CO2: The exposure to Self-awareness and face challenges based on life situations.
	CO3: A better understanding of lifeskills with social-psychological and emotional foundations.
	CO4: Social responsibility and exhibit enhancement in their positive and healthy behaviour.
	CO5: A deep sense of active membership of their community and a lasting, positive impact on

Mapping of Course Outcomes with Program Outcomes:

Course Outcome	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1						**2**	**1**								
CO2								**1**	**2**			**2**			
CO3						**2**			**1**						
CO4						**1**	**1**	**2**		**1**					
CO5						**2**	**1**			**1**		**1**			

Course Contents:

Unit	Contents	Hours
1	**Life skills for Individuals:** Self- Realization and managing self in different social context- Self- Direction -Introspection- Attitudes & Behavior- Expectation Management and capability Approach- Justifications Vs. Reasons-Learn to Struggle and Bounce Back	**8**
2	**Life skills for Relationships:** Pro-social Behavior and Aggression- Handling Parenting- Jealousy Negotiation and Refusal Skills - Networking with a purpose-Balancing Negative Human Traits – Confess and Confront-Developing Positive relationships- Conflict Management	**8**
3	**Life Skills for Youth** Peer Pressure- Substance abuse and Alcoholism- Depression and consequence handling- Suicide and skills to avoid ideation-Preparedness for life disasters- Thinking Skills- Approach towards Practical Living	**7**
4	**Deconstructing Life skills as a whole:** Emotion and Coping: Identifying and Managing Emotions/ Techniques to deal with Emotions – Risk and Resilience- Perspective & Challenges- Stress Management- Decision Making- Accepting Criticism	**7**
5	**Life skills for Society:** Community Service Volunteering- Evading Social Exclusion-Human Trafficking- Women and Social inclusion-Service Learning- Responsible Citizenship	**5**

Text Books	1.	Life skills by Dr. Usha Jain and Dr. Rajiv Kumar Jain Publisher: Vayu Education of India in 2014
	2.	Life skills for Teenagers by Dr. Rinita Jain Publisher: Notion Press in 2014
Reference Books	1.	The first book of Life Skills by Larry James Publisher: Embassy Books in 2006
	2.	Fundamentals of Management and Life Skills by Sunil B Rao, Manjunatha M K , Buela D, Sheema Shaheen by Vision Book House in 2020
E-Learning	1.	Conover Resources- Life Skills

Sr. No.	Name of Activities
1	Group Discussions
2	Role Plays
3	Case Studies
4	Group Presentations

Course Title: Content Designing and Media Fundamentals										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Odd	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	H	2 Hrs.	--	--	2	10	15	50	--	--
Course Code	23BTSHL228 VEBTSH2TT328AI									
Teaching Mode	Offline	2 Hrs.			Total	75				
Duration of ESE	2 Hrs.					75				

Course Objectives	To introduce students to the basics of Content Writing, the writing styles with relevant techniques
	To nourish their creative content writing with appropriate methods and practices
	To develop an overall understanding of digital marketing / online marketing platforms
	To demonstrate the emerging trends in digital marketing & the use of digital marketing tools.
	To introduce students to the Social Media related content writing and also to critically assess the choice of visual aids
Course Outcomes	**After the completion of the course, students shall be equipped with**
	CO1: The skills to implement the concepts of Content Writing in their writing styles
	CO2: The knowledge of various styles and techniques of writing and editing
	CO3: The understanding of various online platforms and exploring the digital marketing strategies
	CO4: The evolving styles in digital marketing and its associated tools
	CO5: The prime choice of visual aids and the in par content writing via Social Media

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcome	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PSO 2	PSO 3
CO1									**1**	**2**					
CO2									**1**	**3**					
CO3										**2**	**1**				
CO4										**2**	**1**				
CO5									**1**	**2**	**1**				

Course Contents:

Unit	Contents	Hours
1	**The Fundamentals of Content Writing:** The concept of content writingand its significance- Types of Content Writing- Principles and Process of Content Writing- Traits of a content writer- Print and Web content Writing	**8**
2	**The Content Writing Theory:** The Method: Brief/ Conceive/Research/Structure/Format – Editing & Proof reading- Writing styles- Corporate Communication: B2B/B2C/Press Release/Newsletters-Formal & Informal Language	**9**
3	**Basics of Digital Marketing:** Introduction to Digital Marketing- Website planning and Creation- Search Engine Optimization- Social Media Marketing- Web Analytics- Web Marketing and Remarketing- Design Essentials	**8**
4	**Social Media and Visual Aids:** Basics of Social Media and its related content writing- Public relations- Infographics- Importance and relevance- Images and Screenshots- Videos, Memes, Gifs- Product demonstration	**5**
5	**Plagiarism in Content Writing:** What is Plagiarism- Importance of plagiarism free content writing- Plagiarism detection tools- Techniques to avoid plagiarism	**5**

Text Books	1.	Content Writing Step-By-Step by Joseph Robinson published in 2020-KDP Print US
	2.	Content Writing Handbook by Kounal Gupta published in 2021 – Henry Harvin
Reference Books	1.	The No-Fluff Guide to Writing Web Content by Alina Bradford Published in 2019 - KDP Print US
	2.	Blog Writing: The Content Creation Blueprint by Anthony James Published in 2018- KDP Print US
E-Learning	1.	C IS FOR CONTENT by Fuzia

Sr. No.	Name of Activities
1	Content Brainstorming and Designing
2	Media and Visual Aids and Presentations
3	Writing Styles for Different Content Scenarios
4	Presentation on Free Digital platforms

Course Title: Cyber Ethics and Moral Responsibility										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Odd	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	H	2 Hrs.	--	--	2	10	15	50	--	--
Course Code	23BTSHL229 VEBTSH2TT329AI									
Teaching Mode	Offline	2 Hrs.			Total	75				
Duration of ESE	2 Hrs.					75				

Course Objectives	Define cyber ethics and Morality with how classic ethical frameworks relate to it.
	Apply critical thought to a wide variety of topics pertaining to cyber ethics.
	Clearly articulate arguments both for and against various cyber ethical cases and bullying.
	Demonstrate the ability to include ethical considerations in their decision-making.
	Examine the scope of intellectual property issues and the available protection measures.
Course Outcomes	**After the completion of the course, students shall be equipped with**
	CO1: Cyber Ethics and Morality with its related frameworks.
	CO2: Critical thinking in a varied cyber ethics topics.
	CO3: Articulate arguments and arrive clarity for and against cyber ethical cases. Being vocal and firm on the concern of Cyber bullying.
	CO4: Decision making skills by considering ethical scenarios and its relevant consequences.
	CO5: A better understanding of intellectual property issues and the protective measures.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcome	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PSO 2	PSO 3
CO1						**1**		**3**	**1**			**1**			
CO2								**1**							
CO3								**3**		**2**					
CO4						**1**	**1**	**2**							
CO5							**1**		**1**						

Course Contents:

Unit	Contents	Hours
1	**Introduction to the course:** Introduction to Cyber Ethics and Morality- The needof Cyber Ethics in current era- Ethical Concepts and Theories- Netiquettes-Developing Ethical Analytical skills and Values	**7**
2	**Ethical Perspectives as a User:** Freedom of Expression-Criminal Liability vs. Accountability- Code of Conduct- Moral Responsibility and Trust- Content Reliability- Decision Making and Reasoning Skills -Online Communities and its usages- Free speech and content control- Plagiarism and Email spam- Cyber-bullying	**12**
3	**Regulating Internet Privacy:** Personal Information on the Internet- Consumer Privacy on the Internet- Professional Ethics- Surveillance and Cyberspace – The Digital Divide- Emerging and converging technologies- Regulating commerce in cyberspace	**7**
4	**Intellectual Property:** Respecting Intellectual Property online- The domain of intellectual Property- Justifications and critiques- Trends of Intellectual property rights	**4**
5	**Cyber Ethics as a practice with case studies**	**5**

Text Books	1.	Cyber Ethics 4.0- Serving Humanity with values edited by Global Ethics.net in 2018
	2.	Raising Humans in a Digital World by Diana Graber- An Imprint of Hapercollins in 2019
Reference Books	1.	Cyber ethics: Social & Moral Issues in the Computer Age edited by Robert M Baird, Reagan Ramsower-Stuart E Rosenbaum in 2000
E-Learning	1.	Cyber Ethics for students and Youth-Education Beaureau- Online Site with Resources

Sr. No.	Name of Activities
1	Group Discussions on real time Scenarios
2	Role Plays
3	Case Studies
4	Group Presentations

SEMES TER – III:

Engineering Economic and Industrial Management														
Sub. Code	Name of the Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme						
								Theory			Practical		Total	
			Th	Tu	Pr	Total		TAE	CAE	ESE	Int.	Ext.		
23BTMBL201AI HMBTMB2TT301AI	Engineering Economic and Industrial Management	H	2	-	-	2	2	10	15	50	-	-	75	
Course Objectives	Understanding of basic knowledge of Economics and its application.													
	Understanding of Management as discipline and its practices.													
	Strengthening knowledge of management in the functional area of Marketing and Finance.													
Course Outcomes	C01-Remember the basic concepts of Micro Economics and its applications.													
	C02-understand the basic concepts of Macro Economics and its applications.													
	C03-Analyzing the functions of Management and its application.													
	C04-Design Marketing strategies by understanding different marketing concepts													
	C05-Apply the basic concept of Human Resource Management.													

Course Contents:

Unit	Contents	Hours
I	Micro Economics- Features and scope, Demand- Law of demand, assumptions and exceptions, Utility and Indifference curves, Elasticity of demand, Factors of Production, Market and Market Structures: Price and output determination under perfect competition.	7
II	Macro Economics- Features and scope, National Income, circular flow of national income, Functions of central and commercial banks, Inflation, Deflation, Stagflation, Monetary & Fiscal policies of the government.	6
III	Definition, nature and scope of Management, Functions of management - Planning, Organizing, Directing, Controlling, Communication.	5
IV	Marketing management- concepts of marketing, Marketing Mix, Service Marketing, Product Life Cycle, New Product Development, Pricing strategies, Channels of distribution, Promotion Mix	7
V	HRM – Concept, Manpower planning, Recruitment and selection, performance appraisal – Ranking Method, Rating scale method, 360 degree appraisal, Behaviorally Anchored Rating Scale (BARS).	5

Text Books	Modern Economics Theory, by K.K. Dewett, S. Chand & company ltd., 3rd Edition, 2006
	Principles of Management, by P CTripathi & P N Reddy, Mc Graw Hill Education, 6th Edition.
	Principles of Marketing, by Philip Kotler & Gary Armstrong, Rearson Education, 11th Edition
	Managerial Economics by D. N. Dwivedi, 8th Edition, vikas publication

Department of Artificial Intelligence

Syllabus

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-IV													
23BTSHL230AI	Transform and Numerical Method	PCC4	3	1		4	4	10	15	50			75
23BTAIL202 / 23BTAIP202	Machine Learning Algorithms	PCC5	3		2	5	4	10	15	50	25	25	125
23BTITL204AI	Multidisciplinary Minor II-	MDM2	2			2	2	10	15	50			75
23BTXXLXXAI	Open Elective II	OE2	2			2	2	10	15	50			75
23BTAIL205/ 23BTAIP205	Vocational and Skill Enhancement Elective III	VSEC3	1		2	3	2	10	15		25		50
23BTSHL231AI 23BTSHP231AI	Aptitude and Employability skill	AEC2	1		2	3	2	10	15		25		50
23BTMBL202AI	Entrepreneurship Development Practices	EEMC2	2			2	2	10	15	50			75
23BTSHL233AI	UniversalHuman Values 2: Understanding Harmony	VEC2	2			2	2	10	15	50			75
TOTAL			**16**	**1**	**6**	**23**	**20**	**80**	**120**	**300**	**75**	**25**	**600**

Department of Artificial Intelligence

Syllabus of Semester IV

Course Title: **Transforms and Numerical Methods**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC4	3	1	--	4	10	15	50	--	--
Course Code	23BTSHL230AI									
Teaching Mode	Offline	4			Total	75			--	
Duration of ESE	2hrs					75				

Course Objectives	1.The objectives of this course is to teach students to comprehend the transform method to solve differential and difference equations.
	2.Learn Numerical methods to solve algebraic, transcendental, simultaneous and ordinary differential equations.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand the mathematical descriptions in Laplace Transform
	CO2: Understand the mathematical descriptions in Z- transform.
	CO3: Understand numerical techniques to solve variousalgebraic and transcendental equations
	CO4: Apply the knowledge of numerical techniques to solve ordinary differential equations

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	--	1	--	--	--	--	--	--	3	3	3
CO2	3	3	2	--	1	--	--	--	--	--	--	3	3	3
CO3	3	3	2	--	1	--	--	--	--	--	--	3	3	3
CO4	3	3	2	--	1	--	--	--	--	--	--	3	3	3
CO5	3	3	2	--	1	--	--	--	--	--	--	3	3	3

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Course Contents:

Unit	Contents	Hours
I	**Laplace Transforms:** Laplace transform: definition and their simple properties, transform of derivatives and integrals, Evaluation of integrals by Laplace transform, Inverse Laplace transform and its properties, Convolution theorem, Laplace transforms of periodic function and unit step function. Solutions of mathematical models (ODE & PDE) using Laplace Transform. Solution of simultaneous ordinary differential equations by Laplace Transform method.	12
II	**Z-Transforms:** Definition, properties of Z- Transforms, Inverse Z- Transform and relation between Z transform and Laplace Transform. Convolution Theorem, Application of Z-Transform to solve difference equations with constant coefficients.	12
III	**Numerical Methods-I:** Error analysis, Solutions of algebraic and transcendental equations. Bisection method, False position method, Newton-Raphson methodand their convergences. Solution of system of linear equations by Gauss Seidel method, Crout's method, Gauss Jordan method, Jacobi's Method	12
IV	**Numerical Methods-II:** Solution of ordinary differential equationby Taylor series method, Runge-Kutta fourth order method, Euler modified method, Picard's Method, Milne's Predictor corrector method. Solution of Simultaneous and higher order differential equations.	12

Text Books	1.	Higher Engineering Mathematics, Grewal B.S.: Khanna Publishers; 2013 Forty Third
	2.	Advanced Engineering Mathematics, Jain, R.K. and Iyengar, S.R.K.
EBooks	1.	http://www.math.ust.hk/~machas/numerical-methods.pdf
Reference Books	1.	Advanced Engineering Mathematics, Kreyszig, E. John Wiley & Sons; 2000, Eight
	2.	Advanced Engineering Mathematics, Jain, R.K. and Iyengar, S.R.K,2007,Third
	3.	Numerical Methods, Dr. P Kandasamy, S.Chand Publishers Edition forty third.
	4.	Introduction to Numerical Analysis, S. Baskar and S. Sivaji Ganesh, 2013

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Course Title: **Machine Learning Algorithms**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	Int	Ext
Course Category	PCC5									
Course Code	23BTAIL202/ 23BTAIP202	3 Hr.	NA	2 Hrs.	4	10	15	50	25	25
Teaching Mode	OFFLINE	5 Hrs			Total	75			50	
Duration of ESE	NA					125				

Course Objectives	1. Understand the basics of machine learning algorithms.
	2. Understand natureof the problem and apply suitable machine learning algorithm
	3. Implement Machine Learning Algorithms on various datasets
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand the fundamentals of machine learning techniques.
	CO2: Apply a wide variety of supervised machine learning algorithms to solve the given problem.
	CO3: Analyze the different modelling techniquesand evaluate the performance of the machine learning model.
	CO4: Evaluate popular Machine Learning algorithms like SVM, KNN, PAC, VC to solve the given problems.
	CO5: Implement unsupervised learning algorithms to solve the given problem and evaluate the performance of the Machine Learning Models.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	1	**-**	**-**	**2**	**2**	**2**
CO2	**3**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**–**	**2**	**3**
CO3	**3**	**-**	**3**	**2**	**-**	**2**	**-**	**-**	1	**-**	**-**	**2**	**2**	**2**
CO4	**3**	1	**3**	**3**	**-**	1	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**
CO5	**2**	**-**	**3**	**2**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**3**	**2**

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Course Contents:

Unit	Contents	Hours
I	**Introduction to machine learning:** Need for machine learning, basic terminologies used in machine learning, Types of machine learning- Supervised Learning, Unsupervised Learning, Reinforcement Learning, challenges in machine learning, machine learning process, applications of machine learning. **Basics of Learning Theory:** Concept Learning, Hypothesis, Hypothesis Space, Bias, Variance, Well-posed learning problem.	6
II	**Supervised Learning:** Understanding Data: Types of data, Data collection, Data preprocessing, Descriptive statistics. **Regression:** Introduction to regression and regression analysis, Types of errors, cost function, Linear regression, Logistic regression, Gradient Descent **Decision Tree learning:** fundamentals of decision tree learning model, Entropy, Information gain, Building decision tree	8
III	**Modelling and Evaluation:** Predictive models, Descriptive models. Underfitting and over fitting, Pruning, bias-variance tradeoff, cross validation, Model performance evaluation method and techniques. PCA Model and ML Model Inference **Probabilistic learning:** Fundamentals of probability-based learning, Bayes theorem, classification using Bayesian learning.	8
IV	**Popular ML Algorithms:** Support Vector Machine, K-Nearest Neighbor Algorithm, Computational learning theory, PAC learning model, VC Dimension, Ensemble learning	6
V	**Unsupervised Learning:** Introduction to clustering approaches, types of clustering, clustering techniques, Association rules, K-Means algorithm, DBSCAN algorithm, Gaussian mixture model	6

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Sr. No.	Name of Experiments / Mini Projects/ Case Studies	COs
1	Write python program to demonstrate the use of various libraries for machine learning.	CO1
2	For a given set of data write a program to implement **Linear Regression and Logistic regression** algorithm to create a model and evaluate the model.	CO2
3	Write a program to demonstrate the working of the **Decision Tree** based **classification**. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	CO2
4	Write a program to implement the **Naïve Bayesian classifier** for a sample training data set. Compute the accuracy of the classifier, considering few test data sets.	CO3
5	Write a program to implement **Support Vector Machine** for a sample training data set. Compute the accuracy of the classifier, considering few test data sets.	CO4
6	Write a program to implement the **K-Means** Algorithm for a sample training data set. Compute the accuracy of the model, considering few test data sets.	CO5
7	Write a program to implement the **DBSCAN** Algorithm for a sample training data set. Compute the accuracy of the model, considering few test data sets.	CO5
Open Ended Experiments / New Experiments		
8	Medical Image Segmentation	
Details of online Laboratory Resource Material Instruction / Operating Manuals		
1.	Introduction to Fundamentals of Fuzzy Logic and Basic Operations URL: http://vlabs.iitkgp.ernet.in/scte/	
2.	Introduction and implementation to Color Image Processing URL: http://cse19-iiith.vlabs.ac.in/objective.php?exp=colour	
3.	Understating and Implantation of Mean and Covariance URL: http://vlabs.iitb.ac.in/vlab/labscse.html	

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Text Books	1.	Mitchell Tom, Machine Learning. McGraw Hill, 1997.
	2.	S Shridhar, M Vijayalaxmi, Machine Learning, Oxford University Press, 2021
	3.	Saikat Dutt, S Chandramouli, Amit Kumar Das, Machine Learning, Pearson, 2019
E-Books	1.	Understanding Machine Learning: From Theory to Algorithms, By Shai Shalev-Shwartz and Shai Ben-David URL: https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/index.html
	2.	Bayesian Reasoning and Machine Learning By David Barber URL: http://web4.cs.ucl.ac.uk/staff/D.Barber/textbook/091117.pdf
Reference Books	1.	Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning Data Mining, Inference, and Prediction
	2.	Richard O. Duda, Peter E. Hart, David G. Stork. Pattern classification, Wiley, New York, 2001.
	3.	Machine Learning: The Art and Science of Algorithms that Make Sense of Data (1st Edition) – Peter Falch
	4.	Introduction to machine learning, EthemAlpaydin. —2nd ed., The MIT Press, Cambridge, Massachusetts, London, England.
On line TL Material	1	NPTEL: Introduction to Machine Learning by Prof. Sudeshna Sarkar, IIT Kharagpur. URL: https://onlinecourses.nptel.ac.in/noc21_cs85/preview,
	2	NPTEL: Essential Mathematics for Machine Learning By Prof. Sanjeev Kumar, Prof. S. K. Gupta, IIT Roorkee URL: https://onlinecourses.nptel.ac.in/noc21_ma 38/
	3	DataCamp: Machine Learning for Everyone URL: https://www.datacamp.com/courses/machine-learning-for-everyon

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Multidisciplinary Minor-II

Course Title: **SOFTWARE ENGINEERING AND PROJECT MANAGEMENT MD-II**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MD M-II	2Hrs	--	--	2	10	15	50	--	--
Course Code	23BTITL204AI									
Teaching Mode	Offline					75				
Duration of ESE	2.5 Hrs	2 Hrs			Total	75				

Course Objectives	The student should be made to: 1. Understand the phases in a software project
	2. Understand fundamental concepts of requirements engineering and Analysis Modeling.
	3. Understand the major considerations for enterprise integration and deployment.
	4.Learn various testing and maintenance measures
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Identify the key activities in managing a software project
	CO2: Compare different process models and design techniques.
	CO3: Understand the concepts of requirements engineering and Analysis.
	CO4: Apply quality management and project management procedure for software design and deployment.
	CO5: Remember various software testing and planning approaches.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	3	-	-	-	-	-	-	-	3	-	-	-
CO3	2	3	3	2	1	-	-	-	-	-	3	-	3	2
CO4	2	3	3	-	-	-	-	-	-	-	3	-	3	3
CO5	3	-	3	1	-	-	-	-	-	-	3	-	-	3

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Course Contents:

Unit	Contents	Hours
I	**SOFTWARE PROCESS** Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models, Agile models, Software Project Management, Project Scheduling – Scheduling, Earned Value Analysis.	7
II	**REQUIREMENTS ANALYSIS AND SPECIFICATION** Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary	7
III	**SOFTWARE DESIGN** Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design – Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.	7
IV	**PROJECT MANAGEMENT** Estimation – FP Based, LOC Based, Make/Buy Decision, COCOMO II – Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection, RMMM – Scheduling and Tracking –	7
V	**TESTING** Software testing fundamentals-Internal and external views of Testing-white box testing – basis path testing-control structure testing-black box testing Debugging	7

Text Books	1.	Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, McGraw-Hill International Edition, 2010.
	2.	Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.
E--Books	1.	Foundations of Software Engineering by Kevin Amaratunga
	2.	The New Software Engineering by Sue Conger
Reference Books	1.	Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning Private Limited, 2009.
	2.	Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India,2010.
online TL Material	1.	Certification Courses available: https://nptel.ac.in/downloads/106105087/
	2.	Free Courses available: https://swayam.gov.in/course/236-software-enginnering

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Vocational and Skill Enhancement Elective III

Course Title: **Skill Enhancement-II (Data Preprocessing)**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	VSEC3	1	--	2 Hrs.	2	10	15	-	25	
Course Code	23BTAIL207/ 23BTAIP207									
Teaching Mode	Offline				Total	25			25	
Duration of ESE	--					50				

Course Objectives	1. To understand the role and necessity of data pre-processing
	2. To identify and comprehend the various data quality issues.
	3. To learn the applicability of the techniques in data pre-processing.
	4. To relate the pre-processing techniques to real-world applications.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand data using Statistical tools and techniques
	CO2: Apply appropriate techniques for Data Cleaning
	CO3: Analyze Feature Scaling, Data Labeling techniques
	CO4: Evaluate Visualization of data through graph plots.
	CO5: Implement the data pre-processing techniques on real world datasets.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	--	--	3	--	--	--	--	--	--	--	--	1
CO2	--	3	--	--	3	--	--	--	--	--	--	--	3	--
CO3	--	3	2	--	3	--	--	--	--	--	--	--	--	2
CO4	--	3		--	3	--	--	--	--	--	--	--	--	--
CO5	--	3	3	--	3	--	--	--	3		2	3	--	--

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Course Contents:

Unit	Contents	Hours
I	Introduction, Definitions, need of data preprocessing, understanding data preprocessing, Libraries used for Data preprocessing	4
II	Step and type of Data preprocessing, missing, noise data, data integration, data transformation	4
III	Data Reductions, Dimensionality Reduction, Clustering, data Sampling, Data Discretization	6
IV	Categorical Data, Feature Scaling, encoding categorical features, Normalization and its type, Binarization, Data Labeling, Data Feature Selection.	5
V	Principal Component Analysis (PCA), **t**-distributed stochastic neighbor embedding (t-SNE) in Python with scikit-learn.	5

Text Books	1.	Gerardus Blokdyk, Data pre-processing The Ultimate Step-By-Step Guide,
	2.	M. Shron, O'Reilly, Thinking with Data: How to Turn Information into Insights, Publisher: O'Reilly Media, 2014
	3.	T. Fawcett and F. Provost, Data Science for Business: What you Need to Know about Data Mining and Data Analytic Thinking, Publisher: O'Reilly Media, 2013
E-Books	1.	Salvador García, Julián Luengo, Francisco Herrera, Data Preprocessing in Data Mining, Volume 72, Springer http://users.ece.utexas.edu/~ethomaz/courses/dm/papers/da ta-preprocessing-book.pdf
	2.	Winter School on "Data Mining Techniques and Tools for Knowledge Discovery in Agricultural Datasets" http://apps.iasri.res.in/ebook/win_school_aa/notes/Data_Preprocessing.pdf
Reference Books	1.	Ralph Kimball, Margy Ross, The Data Warehouse Toolkit, 3rd edition, Publisher: Wiley, 2013
	2.	J. Han, M. Kamber and J.Pei, Morgan Kaufmann, Data Mining, Concepts and Techniques, Publisher: Elsevier, 2006
	3.	Ramesh Sharda, Dursun Delen, Efraim Turban, Business Intelligence and Analytics: Systems for Decision Support, Publisher: Pearson/Prentice Hall, 2014
on line TL Material	1.	http://www.prolearninghub.com/courses/data-warehouse-concepts-design-data-integration/

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List of Practicals

Sr. No.	Name of Practicals
1	Importing Numpy libraries and perform operations
2	Creating data frame and loading dataset and perform operations.
3	Handling missing data value in dataset.
4	Identify and handle outliers in your dataset
5	Execute feature scaling on given dataset.
6	Perform encoding on given dataset.
7	Implement principal component analysis algorithm
8	Perform training and testing on given datasets
9	Implement t-distributed stochastic neighbor embedding (t-SNE) in Python with scikit-learn.
Open Ended Experiments / New Experiments	
10	A] Open Ended Practical: Preprocess a dataset, apply following techniques • Importing the libraries • Import the dataset • Taking care of the missing data • Encoding categorical data • Splitting the dataset into the training and test sets • Feature scaling
11	Virtual Lab: https://python-iitk.vlabs.ac.in/List%20of%20experiments.html

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Course Title: Aptitude and Employability Skills										
Semester	**IV**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			Practical	
Term	II	L	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	AEC2	1	-	2	3	10	15	-	25	--
Course Code	**23BTSHL231** AI/CS/CY/DS/IT/EC/EE/ME/CE **23BTSHP231** AI/CS/CY/DS/IT/EC/EE/ME/CE									
Teaching Mode	Offline				**Total**	25			25	
Duration of ESE	NA					**50**				

Course Objectives	The Curriculum aims to equip students in order to apply quantitative reasoning and Mathematical analysis methodologies to understand and solve problems.
	To attain conceptual clarity to comprehend reasoning questions in a simple way and arrive at decisions at a logical manner.
	To introduce them with the current market scenarios and equip the students with the essential skills for employability
	To demonstrate self-sufficiency to be highly employable and assimilate how to prepare for personal interview
	To build self-confidence facing any interview and consolidate job and career readiness
Course Outcomes	**CO1:** Students shall draw conclusions or make decisions based on analysis and critique of quantitative information. This leads them to effectively justify the conclusion and execute their plans.
	CO2: Students shall solve real life problems requiring interpretation and comparison of various probabilities to ascertain the best outcomes expected.
	CO3: Students shall exhibit their ability to set clear and realistic professional objective and enabling them to make well informed choices and commercially equipped according to market trends (Resume Building)
	CO4: Students shall be equipped on the application of organizing, planning and execution Skills(Personal Interview)
	CO5: Students shall be well versed to map their personality tied with different job opportunities. (Market Research & Identifying skill gap)

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	**3**	**3**												
CO2	**3**	**3**												
CO3				**2**							**2**	2		
C04										**3**				
CO5									**3**	**3**				

Course Contents:

Unit	Contents
I	**Direction**: Introduction to direction nomenclature, Distance covered, Shortest possible distance by pythagoras theorem, Concept of Shadow -**Analogy**: All mathematical analogies-**Seating Arrangement**: Circular and Linear arrangement–**Syllogism**: Deductive reasoning, categorial syllogism, Some, All, few and Venn diagrams
II	**Data sufficiency**: Questions and statements -**Coding and Decoding**: Coding, Decoding & Patterns -**Number Series**: In place of alphabetsthe required number to be filled and addition and subtraction carried out accordingly – **Cryptarithmetic**: In place of alphabetsthe required number to be filled and addition and subtraction carried out accordingly
III	**Orientation- Researching Joband Company- Emerging Market Trends:** Experience sharing of Major Campus interviews, Skill Requirements, Current Market trends, Researching the Job and company
IV	**Personal and company commercial:** Guidelines for preparinga 30- 90 second self Introduction .Questions to think about in developinga commercial- Understand " What to avoid" in a commercial - **Self Selling Proficiency**: What to say and do, How to demonstrate commercial awareness in an interview ,Post Interview activity, Telephone etiquette in a phone Interview **Resume Building :**Guidelines on framingresume and cover letter Checklist to ensure completeness , Sample resumes and cover letter references Basic Guidelines on Video Resumean its difference with conventional
V	**Personal Interview- Group Discussion**: Preparation tips on GD and Extempore: Dos' and Donts', Presentation on PI Preparation and FAQs -Role Plays/ Mock Interview with Technical Faculty and Mock Interview by Faculty **Assessment and feedback series:**

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Text Books	1.	Aggarwal, R. S. (2010). A Modern Approach to Verbal & Non-Verbal Reasoning (Revised ed.). S. Chand Publishing. ISBN: 978-8121924986.
	2	Panikar, S., & Sharma, P. (2021). *Communication skills for budding professionals* (2nd ed.). Global Education Ltd
Reference Books	1.	Sharma, A., & Kumar, M. (2018). Quantitative Aptitude for Competitive Examinations. Pearson Education. ISBN: 978-9353061742.
	2.	Nair, M., & Mulay, T. (2024). *The golden book on employability: Get hired...stay hired* (1st ed.). Global Education Ltd.

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Course Title: **Universal Human Values 2: Understanding Harmony**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	VEC2	2	--	--	2	10	15	50	--	--
Course Code	23BTSHL233 AI/CS/CY/DS/ IT/EC/EE/ME/ CE									
Teaching Mode	Offline	3			Total	75			--	
Duration of ESE	2 Hrs.					75				

Course Objectives	Development of a holistic perspective based on self - exploration about themselves (human being), family, society and nature/existence
	Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
	Strengthening of self-reflection and development of commitment and courage to act.
Course Outcomes	1. Students are expected to become more aware of themselves.
	2. Students are expected to become more aware of their surroundings (family, society, nature).
	3. Students should become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
	4. Students would have better critical ability, they would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
	5. Students would be able to apply what they have learnt to their own self in different day-to-day settings in real life.

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1						**2**		**3**	**1**			**2**			
CO2			**3**			**2**		**2**		**2**		**2**			
CO3			**3**			**3**	**3**	**2**							
CO4			**2**			**2**	**2**	**2**							
CO5			**1**			**1**	**1**	**2**				**3**			

Course Contents:

Unit	Contents	Hours
I	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education:** Purpose and motivation for the course, Self-Exploration, Contin uo u s Happiness and Prosperity, Right understanding relationship and physica l facility, Understanding happiness and prosperity correctly, Method to fulfill the above human aspirations.	8
II	**Understanding Harmony in the Human Being - Harmony in Myself!** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understand ing the needs of Self ('I') and 'Body', Understand ing the Body as an instrument of 'I', Understan ding the characteristics and activities of 'I' and harmony in 'I', Understan ding the harmony of I with the Body.	8
III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding values in human-human relationship, Understanding the meaning of Trust, Understanding the meaning of Respect, Understan d in g the harmony in the society, Visualizing a universal harmonious order in society.	8
IV	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature, Understanding Existence a s Co-ex istence, Holistic perception of harmony.	8

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Text Book	1.	Human values and Professonal Ethics by R R Gaur,R Sangal,G P Bagaria, Excel Books, New Delhi,2010
Reference Books	1.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999
	2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi 2004.
	3.	The story of my experiments with truth-by Mohandas Karamchand Gandhi
	4	Small is beautiful-E.F Schumacher
	5	Slow is beautiful-Cecile Andrews

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Course Title: **Entrepreneurship Development Practices**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EEMC2	2 Hrs.	--	--	2	10	15	50	--	--
Course Code	23BTMBL202AI									
Teaching Mode	Offline	2 Hrs.			Total	75			--	
Duration of ESE	2 Hrs.					75				

Course Objectives	To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.
	To explain and formulate the Problem statement of startup
	To perceive fundamentals of business control strategy in industrial and technological Problems.
Course Outcomes	**After the completion of the course, students shall be equipped with**
	CO1: Identify the problem statement with business and Startup potentials.
	CO2: Identify specific customer segment for the intended solution
	CO3: Make Lean Canvas for their startup model.
	CO4: Make Business plan presentation and pitch Business Plan
	CO5: Identify the challenges and threats in Entrepreneurship.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Programme Outcomes						Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5		PSO 1	PSO 2	PSO3
CO1	3	2	2	3	3		2	1	-
CO2	3	1	2	2	3		2	2	-
CO3	3	1	1	2	1		1	2	-
CO4	3	2	2	1	2		2	2	-
CO5	2	2	2	1	2		2	2	

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Course Contents:

Unit	Contents	Hours
1	**Introduction to Entrepreneurship:** Stages involved in Entrepreneurship Developments, TRL Levels, Ideation, Design thinking, business strategies.	4
2	**Product Development Framework:** Stagers involved in New Product Development in Entrepreneurship, Emphasize, Problem statement Definition, Ideate, Prototypes & Testing.	5
3	**Business Canvas Model:** Introduction to Business Canvas: Model, Customer segments, Value proposition, Revenue streams, Societal and environmental benefits, Channels, Customer relationships, Key activities, Key resources, Key partners & Cost structure	4
4	**Types of Companies in Entrepreneurship & Legal Compliances:** Types of companies, Proprietary firm, partnership, LLP, Pvt ltd, Public Limited etc, Legal compliances in Entrepreneurship.	4
5	**Discussion & Case studies in Entrepreneurship:** Discussion of recent successful startups as case studies, Presentation of case studies with new design concept business model with proper Canvas Model. Discussion of Entrepreneurship Threats & Challenges in New Startups.	5

Text Books	1.	Hisrich R D, Peters M P, "Entrepreneurship" 11th Edition, Tata McGraw-Hill, 2018.
	2	Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
	2.	Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011
Reference Books	1.	Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005
	2.	EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986
E-Learning	1.	NPTEL Course, 'Entrepreneurship essentials', by Prof. Manoj Kumar Mandal, IIT Kharagpur, Link: https://nptel.ac.in/courses/127105007/
	2	NPTEL Course, 'Entrepreneurship, by Prof. C Bhaktvatsalya Rao, , IIT Madras Link: https://nptel.ac.in/courses/110106141
	3	StartupIndia Learning Program sponsored by Upgrad and Governement of India, Link https://startupindia.upgrad.com/login?redirect=startupindia.upgrad. com/v/dashboard& (Free)

Course Title: Data Analysis for Business Intelligence										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	OE1	4	-	-	4	10	15	50	-	-
Course Code	23BTAIL205									
Teaching Mode	Offline	2 Hrs			Total	75			-	
Duration of ESE	2 Hrs					75				

Course Objectives	To learn Data Collection & Pre-Processing.
	To learn the basic rudiments of business intelligence system
	Be exposed with different data analysis tools and techniques
Course Outcomes	Upon successful completion of this course, student will be able to:
	C01: Understand Data Collection & Pre-Processing
	C02: Apply the fundamentals of business intelligence & interpret the data of business intelligence.
	C03: Analyze the data using knowledge of exploratory Data Analysis.
	C04: Evaluate Machine Learning techniques for Business
	C05: Design a real world problem using Data Visualization & Tableau

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes													
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PS O2
CO1	2	3	3									2	2	
CO2	3	3	3	3								2	2	
CO3	3	3	3	3	2	2					3	2	2	
CO4	3	3	3	3	3	3					3	3	3	3
CO5	3	3	3	3	3	3					3	3	3	3

Course Contents:

Unit	Contents	Hours
I	**Data Collection & Pre-Processing:** Understanding the Dataset, Python package for data science, Importing and Exporting Data in Python, Basic Insights from Datasets, Identify and Handle Missing Values Data Formatting, Data Normalization Sets, Binning, Indicator variables.	5
II	**Introduction to Business Intelligence**: evolution of BI, BI value chain, introduction to business analytics, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities.	5
III	**Exploratory Data Analysis:** Descriptive Statistics, Basic of Grouping, Correlation. Univariate and Multivariate Data Analysis.	5
IV	**MachineLearningforBusiness:** Machine learning and data use cases, Machine learning types, Business requirements and model design.	5
V	**Data Visualization**: Loading Data in pandas, Plotting Data with matplotlib Different Types of Plots. **Introduction to Tableau**: Building and Customizing Visualizations AnalyzingDatainTableau: Preparing for Analysis, Exploring Visualizations Mapping Analysis, Groups, Sets, and Parameters.	5

Text Books	1.	Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th Edition, Pearson 2013.
Reference Books	1.	Fundamentals of Business Analytics, R N Prasad and S Acharya, Wiley India, 2011.
	2.	David Loshin Morgan, Kaufman, "Business Intelligence: The Savvy Manager"s Guide", Second Edition, 2012
Online Material	1	https://courses.cognitiveclass.ai/courses/course-v1:CognitiveClass
	2	https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-mg24/#:~:text=Course%20abstract&text=This%20course%20seeks%20to%20present,%2C%20predictive%2C%20and%20prescriptive%20analytics.
		https://nptel.ac.in/courses/110/106/110106072/

Department of Artificial Intelligence

Course Title: **Soft Computing**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC6	3 Hrs	-	2Hrs	4	10	15	50	25	25
Course Code	23BTAIL301 23BTAIP301									
Teaching Mode	Offline	5 Hrs			Total	75			50	
Duration of ESE	2.5 Hrs					125				

Course Objectives	1. Understand Soft Computing concepts, technologies, and applications
	2. Understand the underlying principle of soft computing with its usage in various application. .
	3. Understand different soft computing tools to solve real life problems.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
	CO2: Apply and Evaluate defuzzification techniques and fuzzy logic controllers to design and optimize real-world fuzzy control systems.
	CO3: Solving single and multi-objective optimization problems using Evolutionary algorithms
	CO4: Implement various Neural Network Architectures for solving complex problems
	CO5: Develop application on different soft computing techniques like Fuzzy, GA and Neural network

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	--	2	2	2	--	--	--	--	--	--	--	--	--	--
CO2	--	--	3	3	--	--	--	--	--	--	--	--	--	3
CO3	--	--	3	3	--	--	--	--	--	--	--	--	--	3
CO4	--	--	3	3	--	--	--	--	--	--	--	--	--	--
CO5	--	--	3	3	3	--	--	--	--	--	--	3	--	3

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Course Contents:

Unit	Contents	Hours
I	Introduction to Soft Computing, Introduction to Fuzzy logic,Fuzzy membership functions, Operations on Fuzzy sets, Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences	6
II	Defuzzyfication Techniques-I, Defuzzyfication Techniques-II, Fuzzy logic controller-I, Fuzzy logic controller-II	6
III	Solving optimization problems, Concept of GA, GA Operators: Encoding, GA Operators: Selection-I, GA Operators: Selection-II, GA Operators: Crossover-I, GA Operators: Crossover-II, GA Operators: Mutation	6
IV	Introduction to EC-I, Introduction to EC-II, MOEA Approaches: Non-Pareto, MOEA Approaches: Pareto-I, MOEA Approaches: Pareto-II	6
V	Introduction to Artificial Neural Networks, Learning rules and various activation functions, Single layer Perceptron , Back Propagation networks, Architecture of Back propagation(BP)Networks, Back propagation Learning, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.	6

Text Books	1.	Principles of Soft Computing by S. N. Sivanandam and S. N. Deepa book to be added in Soft computing Syllabus.
	2.	R. Rajasekaran and G. A and Vijayalakshmi Pa, *Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications*, Prentice Hall of India
	3.	D. E. Goldberg, *Genetic Algorithms in Search, Optimisation, and Machine Learning*, Addison-Wesley
	4.	M Amirthavalli, Fuzzy Logic and Neural Networks, Scitech Publications
E-Books	1.	Timothy J Ross, Fuzzy Logic with Engineering Applications https://www.academia.edu/5333146/Fuzzy_Logic_with_Engineering_Applications_Third_Edition
	2.	Mitchell Melanie, An Introduction to Genetic Algorithms, https://www.boente.eti.br/fuzzy/ebook-fuzzy-mitchell.pdf
Reference Books	1.	Jacek M. Zurada, *Artificial Neural Systems*, PWS Publishing, Boston, 1992 (ISBN 0-314-93391-3)
	2.	"Fuzzy Logic with Engineering Applications" by Timothy J Ross
	3.	Evolutionary Computation: A Unified Approach by Kenneth A. DeJong, MIT Press, 2006, ISBN: 0262041944
On line TL Material	1	https://nptel.ac.in/courses/106/105/106105173/

Department of Artificial Intelligence

Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Implement different fuzzy set operations
2	Implementation of different fuzzy membership functions
3	Implementation of Fuzzy Logic Controller
4	Implementation of GA using binary encoding for KNAPSACK problem
5	Implementation of various selection technique
6	Implementation of crossover techniques for binary coded GA
7	Implementation of mutation techniques for binary coded GA
8	Implementation of Perceptron Model
9	Implementation of Backpropagation Algorithm
Open Ended Experiments / New Experiments	
1	Implementation of Multilayer feedforward Network on any dataset of your choice
Details of online Laboratory Resource Material Instruction / Operating Manuals	
1.	Soft Computing Tools Lab URL: http://vlabs.iitkgp.ernet.in/scte/

Department of Artificial Intelligence

Course Title: **FORMAL LANGUAGES AND AUTOMATA**										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC6	3 Hrs			3	10	15	50	NA	NA
Course Code	UNCSL301									
Teaching Mode	Offline	3 Hrs			Total	75				
Duration of ESE	2 Hrs 30 mins					75				

Course Objectives	To introduce the fundamental concepts of formal languages, grammars and automata theory.
	Classify machines by their power to recognize languages and use finite state machines to solve problems in computing.
	Use of Turing Machine and Pushdown Automata in Formal Language.
Course Outcomes	**CO1:** Understand the abstract machines and their power to recognize the valid Languages.
	CO2: Apply the knowledge of Automata Theory, Grammars & Regular Expressions for solving various problems
	CO3: Design context free grammars for formal languages.
	CO4: Analyze automata and their computational power to recognize languages.
	CO5: Solve the problems based on Turing Machine.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes:													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3		-	-	1	1		-	-	-	-	1	2	
CO2	-	3		3	2	2		-	-	-	-		3	3
CO3	-	3		3	2	-	-	-	-	-	-	1	3	3
CO4	-		3		2	1	-	-	-	-	-	-	3	
CO5	-		3		2	2	-	-	1	-	-	-	3	

Course Contents:

Unit	Contents	Hours
I	Introduction Basic Mathematical Notation and techniques: Finite State systems Basic Definitions Finite Automaton DFA & NDFA Finite Automaton with €-moves, Regular Languages, Regular Expression Equivalence of NFA and DFA Equivalence of NDFA"s with and without €-moves Equivalence of finite Automaton.	7

II	Regular Expressions: Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Properties of Regular Languages Pumping Lemma for Regular Languages, Applications of the Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages.	7
III	Context-Free Grammars: Chomsky hierarchy of languages. Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Sentential Forms, Parse Tress, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages.	7
IV	Push Down Automata: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.	7
V	Turing Machine: Definitions of Turing machines Models ,Computable languages and functions, Techniques for Turing machine construction, Multi head and Multi tape Turing Machines, The Halting problem.	7

Text Books	1.	Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
	2.	Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage Learning.
E--Books	1.	"Formal languages and automata theory" by K V N Sunitha; N Kalyani, Publisher: Chennai : Pearson, [2015] ©2015
Reference Books	1.	Introduction to Languages and The Theory of Computation, John C Martin, TMH.
	2	Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
	3	A Text book on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
	4.	Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan, Rama R, Pearson.
on line TL Material	1.	NPTEL Course Formal Language and Automata, IIT Guwahati https://nptel.ac.in/courses/111/103/111103016/

Course Title: **OPERATING SYSTEM**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC7	3 Hrs	NA	2 Hrs	4	10	15	50	25	25
Course Code	**23BTCSL304AI**									
Teaching Mode	Offline	5 Hrs			Total	75			50	
Duration of ESE	2.30 Hrs					125				

Course Objectives	Introduces general idea, structure and functions of operating system
	Making students aware of basic mechanisms used to handle processes, memory, storage devices and files.
	Recent trends in the operating system
Course Outcomes	**CO1**: Understand basic structure and purpose of operating system.
	CO2: Apply the concepts of process and illustrate various CPU scheduling algorithms.
	CO3: Analyze the concepts of inter process communication.
	CO4: Evaluate Deadlock & File System security mechanisms in operating systems.
	CO5: Compare different memory management techniques with advantages and disadvantages.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	--	--	2	2	--	--	--	--	--	--	2	--	2
CO2	1	3	3	2	--	--	--	--	--	--	--	--	3	--	3
CO3	1	--	3	3	--	--	--	--	--	--	--	--	--	3	--
CO4	2	--	--	--	3	--	--	--	--	--	--	--	2	--	22
CO5	--	2	--	--	2	3	--	--	--	--	--	--	2	--	

Course Contents:

Unit	Contents	Hours
I	**Introduction About OS:** Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, system design and implementation.	7
II	**Process & Scheduling** Process concept, process control block, Types of scheduler- FCFS, SJF, LJF, Priority Scheduling, Round Robin, SRTF,LRTF, context switch, threads, multithreading model, goals of scheduling and different scheduling algorithms,	7
III	**Process management and synchronization**: Concurrency conditions, Critical section problem, software and hardware solution, semaphores, conditional critical regions and monitors, classical inter process communication problems	7
IV	**Deadlock & File System:** definitions, Prevention, Avoidance, detection and Recovery, Goals of Protection, access matrix, Deadlock implementation, File concept, Access methods space allocation strategies, disk arm scheduling strategies.	7
V	**Memory Management**: Contiguous allocation, Relocation, Paging, Segmentation, Segmentation with paging, demand paging, Virtual Memory Concepts, page faults and instruction restart, page replacement algorithms, working sets, Locality of reference, Thrashing, Garbage Collection.	7

Text Books	1.	Operating System concepts – Silberchatz; Galvin, Addison Wesley, 6thEdn.
	2.	Modern Operating Systems – Tanenbaum, Pearson Edn. 2nd edn
	3.	Operating Systems: Internals and Design Principles -- William Stallings
E--Books		https://ebooks.lpude.in/computer_application/mca/term_1/DCAP403_OPERATING_SYSTEM.pdf
Reference Books	1.	Operating Systems – S R Sathe, Macmillan Publishers, India, 2008
	2.	Operating System –Milan Milenkovik, McGraw-Hill, 1987
	3.	Operating Systems - 3 rd Edition by Gary Nutt, Pearson Education.
On-line TL Material	1.	https://nptel.ac.in/courses/106/108/106108101/

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	POOL OF TRACKWISE PROFESSIONAL ELECTIVES				
Track/Elective	**Application Development**	**Machine Learning Engineer**	**Security**	**Computing**	**Data Science**
Track	**Track-I**	**Track-II**	**Track-III**	**Track-IV**	**Track -V**
Professional Elective-I (Credits :4) (Th + Pr) (Semester- V)	Recommendation System 23BTAIL306 23BTAIP306	Reinforcement Learning 23BTAIL307 23BTAIP307	Cryptography and Network Security 23BTAIL308 23BTAIP308	Computer Vision 23BTAIL309 23BTAIP309	NO SQL Database System 23BTAIL310 23BTAIP310

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Course Title: Recommendation System										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective-I	3	-	-	3	10	15	50	25	-
Course Code	23BTAIL306 /23BTAIP306									
Teaching Mode	Online	3			Total	75				
Duration of ESE	3 Hrs.					100				

Course Objectives	To understand working of an recommender systems that automate a variety of choice-making strategies with the goal of providing affordable solutions.
	To understand developing recommender for personal choices in working class tier.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand and apply mathematics required for design a recommendation System.
	CO2: Demonstrate collaborative filtering techniques and use it wisely in a recommendation System.
	CO3: Analyze different types of Content-based recommendation System and its use in real time applications.
	CO4: Decide the appropriate knowledge-based recommendation System depending on the requirement and its usage.
	CO5: Evaluate the performance of recommender systems based on various Metrics and design the recommender systems.

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	2	-	-	-	-	-	--	--	1	-
CO2	2	3	2	2	2	-	-	-	-	-	--	--	1	-
CO3	2	2	3	3	2	-	-	-	-	-	3	3	2	2
CO4	2	2	3	2	2	1	1	-	-	-	3	3	2	2
CO5	3	2	3	2	2	1	1	-	-	-	3	3	2	2

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Unit	Contents	Hours
I	**Introduction:** Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.	7
II	**Collaborative Filtering:** User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems.	9
III	**Content-based recommendation:** High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms	9
IV	**Knowledge based recommendation:** Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.	8
V	**Evaluation:**Types of evaluation for recommender systems. Evaluation design. Prediction metrics and ranking metrics. **Recommendations in Networks:** Recommendation tasks in networks. Ranking algorithms. Neighbourhood's methods. Heterogeneous network methods. **Learning to Rank**: Pairwise Rank Learning, Listwise Rank Learning, Comparison with Rank-Learning Methods in Other Domains.	9

Text Books	1.	Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press.
	2.	Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer
	3.	C.C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
Reference Books		Manouselis N., Drachsler H., Verbert K., Duval E., RecommenderSystems For Learning, Springer (2013), 1st ed.
	1.	1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction,Cambridge University Press(2011), 1st ed. 2.
	2.	2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer
	3.	3. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer
E-Books	1.	http://pzs.dstu.dp.ua/DataMining/recom/bibl/1aggarwal_c_c_recommender_systems_the_textbook.pdf
	2.	https://www.cse.iitk.ac.in/users/nsrivast/HCC/Recommender_systems_handbook.pdf
On-line TL Material	1.	https://www.coursera.org/learn/basic-recommender-systems
	2.	https://canvas.umn.edu/courses/135116.

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Recommendation System(UAIP451)

List of Practical

Exp. No.	Experiment
1	Write a program to implement Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices.
2	Write a program to use User based collaborative filtering method.
3	Write a program to use Item based collaborative filtering method.
4	Write a program to apply association rule mining techniques
5	Write a program to apply content-based recommendation methods
6	Write a program to implement Probability Theorem based recommendation methods
7	Write a program to implement Ranking algorithms for recommendation systems
8	Write a program to evaluate the recommendation system using various metrics.
9	Design and implement Social Network based recommendation system
	Open ended practical with case study on Recommendation System
10	Students/Learners are instructed to study the Following research paper andsubmit report of the same. (**Recommender System for NetFlix**) Recommendation System for Netflix (vu.nl) https://www.cs.vu.nl/~sbhulai/papers/paper-fernandez.pdf

Department of Artificial Intelligence

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Department of Artificial Intelligence

Course Title: **Reinforcement Learning (Elective I/V)**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC 2	3	--	2	4	10	15	50	25	--
Course Code	23BTAIL307/ 23BTAIP307									
Teaching Mode	Offline	5 Hrs.			Total	75			25	
Duration of ESE	2.5 Hrs.					100				

Course Objectives	1. Understand to the basic concepts of reinforcement learning.
	2. Understand the link between reinforcement learning and Machine learning.
	3. Understand how the reinforcement learning mathematical basis are used.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand the mathematics behind reinforcement learning.
	CO2: Describe the various models used in for reinforcement learning & Machine learning.
	CO3: Apply reinforcement learning models to real time application.
	CO4: Evaluate and compare the available reinforcement learning algorithm for improvements.
	CO5: Implement Reinforcement Learning Algorithms for solving real world problems

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Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	--	--	--	--	--	--	--	--	--	--	--	--
CO2	--	3	3	2	--	--	--	--	--	--	--	--	3	2
CO3	--	--	--	--	--	--	3	3	--	--	--	--	--	--
CO4	--	2	3	3	--	--	--	--	--	--	--	3	3	3
CO5	--	--	--	--	--	--	2	3	--	--	--	2	--	--

Course Contents:

Unit	Contents	Hours
I	**Introduction**: Overview: Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning. Introduction to RL, RL framework and applications, Introduction to immediate RL, Bandit optimality, Value function-based methods.	8
II	**Markov Decision Process**: Markov Decision Process: Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.	10
III	**Prediction and Control by Dynamic Programming:** Overview of dynamic programming for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators.	8

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IV	**Advanced Topics in Reinforcement Learning:** Eligibility traces and function approximation methods Least squares methods, Fitted Q-iteration, Deep Q-Networks (DQN), Policy gradient methods, A3C, PPO, Hierarchical reinforcement learning and Partially Observable MDPs (POMDPs)	8
V	**Case Study-Based Projects:** Practical applications and case studies in reinforcement learning, Project-based learning and real-world problem-solving	6

Text Books	1.	Reinforcement Learning: An Introduction, Richard S. Sutton and Andrew G. Barto, The MIT Press Cambridge, Massachusetts London, England.
	2.	An Introduction to Deep Reinforcement Learning, Vincent François-Lavet, Peter Henderson, Riashat Islam, Marc G. Bellemare and Joelle Pineau, Foundations and Trends in Machine Learning: Vol. 11, No. 3-4. DOI: 10.1561/2200000071.
E-Books	1.	https://www.andrew.cmu.edu/course/10-703/textbook/BartoSutton.pdf.
Online Course	1.	https://onlinecourses.nptel.ac.in/noc19_cs55/preview.
	2.	https://nptel.ac.in/courses/106106143.
Reference Books	1.	Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach." Pearson Education Limited, 2016.
	2.	Hands-On Reinforcement Learning with Python: Master reinforcement and deep reinforcement learning using OpenAI Gym and TensorFlow.
	3.	Reinforcement Learning: An Introduction (Adaptive Computation And Machine Learning Series.
	4.	Awesome reinforcement learning for cyber security.

Department of Artificial Intelligence

Use Large and real time dataset for experiments.

Sr. No.	Name of Experiments	COs
1	Install and configure RL libraries (OpenAI Gym, TensorFlow/PyTorch, Stable Baselines).	CO1
2	Write a program to create a simple environment and agent interaction loop.	CO1
3	Define a simple grid world environment as an MDP. Implement the state transition dynamics and reward structure	CO2
4	Implement the policy evaluation algorithm for a given policy in a small MDP.	CO2
5	Write a program to implement policy iteration and value iteration. Compare the convergence of both methods on the grid world environment.	CO3
6	Implement the Multi Arm Bandit Problem	CO3
7	Implement the game – Crossing a Maze using RL	CO4
8	Implement TIC-TA-TOE using RL.	CO4
9	Design an RL algorithm to solve the Knapsack problem.	CO5
10	Practical based on virtual lab/open ended using Open AI Gym for RL Algorithms	CO5

Department of Artificial Intelligence

Course Title: Cryptography and Network Security										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C22	3 Hrs	NA	2 Hrs	4	10	15	50	25	--
Course Code	23BTAIL308/ 23BTAIP308									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

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Course Objectives	• To understand Cryptography Theories, Algorithms and Systems.
	• To understand necessary Approaches and Techniques to build protection mechanisms.
Course Outcomes	At the end of the course, the student should be able to:
	CO1:Understand the fundamentals of networks security, security architecture, threats and vulnerabilities
	CO2: Apply the different cryptographic operations of symmetric cryptographic algorithms.
	CO3: Analyze the different cryptographic operations of public key cryptography.
	CO4: Evaluate various Authentication schemes to simulate different applications.
	CO5: Ability to recognize and implement various Security practices and System security standards.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2											2	
CO2	2	3	3	3	3						2	2	2	3
CO3	2	3	2	3	3						2	2		3
CO4	2	2	3	3	3	1	1				2	2		3
CO5	3	3	3	3	3	1	1				2	2	2	3

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Course Contents:

UNIT	CONTENTS	HOURS
I	**UNIT I: INTRODUCTION** Security trends – Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies – Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography-Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.	**6**
II	**UNIT II: MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY:** Algebraic structures – Modular arithmetic- Euclid‟s algorithm- Congruence and matrices -Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES Advanced Encryption Standard – RC4 –Key distribution.	**7**
III	**UNIT III: PUBLIC KEY CRYPTOGRAPHY MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY:** Primes – Primality Testing –Factorization – Euler‟s totient function, Fermat‟s and Euler‟s Theorem – Chinese Remainder Theorem – Exponentiation and logarithm – ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.	7
IV	**UNIT IV: MESSAGE AUTHENTICATION AND INTEGRITY** Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications – Kerberos, X.509.	7
V	**UNIT V: SECURITY PRACTICE AND SYSTEM SECURITY** Electronic Mail security – PGP, S/MIME – IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls. Various Adversarial attacks and AI based security techniques.	7

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Textbooks	**TEXT BOOK**: 1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.
Reference Books	**REFERENCES:** 1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd 2. BehrouzA.Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007. 3. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2

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List of Practical:

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List of Practical:

Sr. No.	Name of Practical
1	Perform encryption and decryption using Caesar cipher.
2	Perform encryption and decryption using Play Fair Cipher.
3	Perform encryption and decryption using Rail Fence Technique. (Row Transposition Techniques)
4	Implement Polyalphabetic cipher encryption-decryption.
5	Implement Hill cipher encryption-decryption
6	Implement Simple DES.
7	Implement Diffie–Hellman Key Exchange.
8	Program to generate SHA-1 hash.
9	Implement RSA encryption-decryption algorithm.
10	Implement Digital signature algorithm
	Practical Beyond Syllabus
11	Perform various encryption-decryption techniques with cryptool.
12	Study and use the Wireshark for the various network protocols.

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ourse Title: **Computer Vision (Program Elective I/V)**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category		4	--	--	4	10	15	50	25	--
Course Code	23BTAIL309/ 23BTAIP309									
Teaching Mode	OFFLINE	4 Hrs.			Total	75			--	
Duration of ESE	2.5 Hrs.					100				

Course Objectives	1. To introduce traditional Computer Vision, image processing techniques, image filtering, feature detection, segmentation, and object recognition to analyze and manipulate visual data.
	2. To introduce camera calibration, 3D geometry, and depth estimation to accurately model and interpret spatial information from images and their applications to Computer Vision
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Ability to identify and recall fundamental concepts, terms, and theories in image processing and computer vision.
	CO2: Apply various Feature Detection and Segmentation Techniques.
	CO3: Able to understand Camera Calibration and its parameters.
	CO4: Ability to recognize and implement Motion Tracking and Object Recognition.
	CO5: Ability to understand the application of Computer Vision Techniques in Real-world Problems.

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Mapping f Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	--	**3**	**3**	**3**	**2**	--	--	--	--	--	--	--	**1**	
CO2	--	**3**	**3**	**2**	--	--	--	--	--	--	--	--	**2**	**2**
CO3	--	**3**	**3**	--	--	--	--	--	--	--	--	--	--	**2**
CO4	--	**3**	**3**	--	--	--	--	--	--	--	--	--	--	--
CO5	**2**	**3**	**3**	--	--	--	--	--	--	--	--	--	--	--

Course Contents:

Unit	Contents	Hours
I	**Introduction:** History, Image Formation, Image Representation, Linear Filtering, Image in Frequency Domain, Image Sampling, Image Processing & Feature Extraction, Correlation, Convolution.	8
II	**Visual Features & Representations**: Edge, Blobs, Corner Detection; Scale Space and Scale Selection; SIFT, SURF; HoG, LBP, etc. Visual Matching - Bag-of-words, VLAD; RANSAC, Hough transform; Pyramid Matching; Optical Flow. **Morphological Operations. Segmentation:** Active contours, split & merge, watershed, region splitting, region merging, graph-based segmentation, mean shift and model finding, Normalized cut.	9
III	**Geometric Techniques in Computer Vision:** Camera calibration; camera models; intrinsic and extrinsic parameters; radial lens distortion; direct parameter calibration; camera parameters from projection matrices; orthographic, weak perspective, affine, and perspective camera models.	8
IV	**Motion representation:** the motion field of rigid objects; motion parallax; optical flow, the image brightness constancy equation, affine flow; differential techniques; feature-based techniques; regularization and robust estimation.	9
	Motion tracking: Statistical filtering; iterated estimation; observability and linear systems; the Kalman filter.	
V	**Object recognition and shape representation:** Deep neural architecture and applications, appearance-based methods, invariants, image Eigen spaces.	8

***TAE's should be on code based assignment.**

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Text Books	1.	Computer Vision: Algorithms and Applications, R. Szeliski, Springer, 2011.
	2.	Introductory techniques for 3D computer vision, E. Trucco and A. Verri, Prentice Hall, 1998. 3. Forsyth and Ponce, —Computer Vision – A Modern Approach‖, Second Edition, Prentice Hall, 2011.
	3.	Forsyth and Ponce, —Computer Vision – A Modern Approach‖, Second Edition, Prentice Hall, 2011.
E-Books	1.	Deep Learning by Ian Goodfellow and Yoshua Bengio and Aaron Courville https://www.deeplearningbook.org/
	2.	Computer Vision: A Modern Approach (Second Edition) by David Forsyth and Jean Ponce- http://luthuli.cs.uiuc.edu/~daf/CV2E-site/cv2eindex.html
Online Course	1	https://www.geeksforgeeks.org/computer-vision/
	2.	https://www.v7labs.com/blog/what-is-computer-vision
	3.	https://nptel.ac.in/courses/108103174
Reference Books	1.	Multiple View Geometry in Computer Vision: R. Hartley and A. Zisserman
	2.	Modern Deep Learning and Advanced Computer Vision, A Perspective Approach, Dr.P.S.Jagadeesh Kumar, Prof. Thomas Binford, Dr.J. Ruby, J. Lepika.
	3.	Multiple View Geometry in Computer Vision: R. Hartley and A. Zisserman, Reference Books Cambridge University Press.

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List of Practical:

Sr. No.	Name of Practical
1	Implement Linear Filtering & Image Sampling.
2	Implement any Feature Extraction technique
3	Implement Correlation, Convolution.
4	Implement Edge, Blobs & Corner Detection
5	Implement Visual Matching - Bag- of-words technique.
6	Implement Hough transform
7	Implement active contours, split & merge, watershed, region splitting, region merging, graph-based segmentation, mean shift and model finding, Normalized cut.
8	Implement any one classification technique
9	Implement Motion representation & Tracking
10	Implement Vision Transformers
	Practical Beyond Syllabus
11	Case study of Face and person recognition
12	Case study of Image Restoration

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Course Title: NO SQL DATABASE SYSTEM										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective-I	3Hrs	-	2Hrs	4	10	15	50	25	---
Course Code	23BTAIL310/ 23BTAIP310									
Teaching Mode	Offline	5Hrs			Total	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	1. Learn about the most advanced Database Management Systems on the large volume of unstructured data generated through social media and many other platforms
	2. To make candidates familiarize with No SQL Technology and give some hands-on on one of the most popular No SQL database Mongo DB.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand the functionalities of No SQL-DB as a document database.
	CO2: Identify the different types of indexes in No SQL-DB for query execution.
	CO3: Analyze the different Aggregation commands in No SQL-DB
	CO4: Evaluate and manage Replication in No SQL-DB.
	CO5: Implement Backup and restore operations.

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Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes & Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	2	3	3	-	-	2	-	-	3	3	2	2
CO2	3	3	2	3	3	2	-	-	-	-	3	2	2	2
CO3	3	3	2	3	3	2	-	-	-	-	3	2	2	2
CO4	3	3	2	3	3	2	-	-	-	-	3	2	2	2
CO5	3	3	2	3	3	2	-	2	-	-	3	2	2	2

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Course Contents:

Unit	Contents	Hours
I	**Introduction to No SQL and Mongo DB:** Need of a database, Different types of database, Relational vs. Nonrelational database, Installation of Mongodb, NoSQL Databases, NoSQL features, Different types of NoSQL databases, Introduction to MongoDB, MongoDB architecture, Data modelling in MongoDB, Advantages of MongoDB over RDBMS, Mongo Shell, Configuration file in MongoDB, Graph based database	6
II	**Indexing** JSON File format for storing documents, Introduction to Documents, Collections, Database Commands in Mongodb, Inserting and Saving Documents Inserting multiple documents, Updating Documents Removing Documents, Document Replacement, Operator and Modifiers, Indexing in MongoDB, Single index Finding index, Multikey index.	8
III	**Aggregation** Aggregation Framework, Pipeline Operations- $match, $sort, $group, Pipeline Operations-,$project, $unwind ,$limit, $skip, MapReduce, Aggregation commands	6
IV	**Replication:** Replication, Advantages of replication, Implementation of replication, Managing Configuration File in MongoDB, Setting up replica set in MongoDB, Replication configuration, Checking the Configuration, Change replication configuration, Replication status, Remove members, Adding new port in replica set, Terminologies used in replication, Help on replication, Adding arbitrator, Stepping down a member	6
V	**Backup and restore:** Export and import of data, Importing from JSON file, Choosing the right database , Database era, Taking decisions on database, , Strengths and weakness of database , Free and open source database	6

Text	1.	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Author: Sadalage, P. & Fowler, Publication: Pearson Education.

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Books	2.	PramodSadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley Professional, 2012.
	3	Dan McCreary and Ann Kelly, Making Sense of NoSQL, Manning Publications, 2013.
Reference Books	1.	Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement by Eric Redmond and Jim R.
	2.	ShashankTiwari, Professional NoSQL, Wrox Press, Wiley, 2011, ISBN: 978-0-470-94224-6
	3.	Gaurav Vaish, Getting Started with NoSQL, Packt Publishing, 2013.
	4.	Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Ed, O'Reilly Media 2018.
Online TL Material	1.	https://nptel.ac.in/courses/106104135 2 3
	2.	https://www.coursera.org/learn/nosql-databases
	3	https://www.edx.org/course/introduction-to-nosql-data-solutions

List of Practical:

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Practical No	Name of Practical	CO Mapped	Mapping with PO and PSO
1	Introduction to Nosql-DB and Installation of MongoDB NoSQL Database.	CO1	PO1, PO3, PO5, PO6, PSO1, PSO2
2	Build the Queries in No-SQL DB (MongoDB) to study operations to Insert, Query, Update, and Delete records (CRUD Operations).	CO1	PO1, PO2, PO3, PO4, PO5, PO6, PO11, PSO1, PSO2
3	Build Queries in No-SQL DB (MongoDB) to create and show Database and apply some Queries to Get Specified Output using AND & OR in Nosql-DB, limit and sort records.	CO1	PO1, PO2, PO3, PO4, PO5, PO6, PO11, PSO1, PSO2
4	Implement queries in No-SQL DB (MongoDB) to study Indexing in Nosql DB (Indexing and Advanced Indexing)	CO2	PO1, PO2, PO3, PO4, PO5, PO6, PO11, PSO1, PSO2
5	Implement Aggregation in Nosql DB (MongoDB) (Aggregation and Map Reduce Functions)	CO3	PO1, PO2, PO3, PO4, PO5, PO6, PO11, PSO1, PSO2
6	To study and implement Replication and Sharding in Nosql-DB (MongoDB)	CO4	PO1, PO2, PO3, PO4, PO5, PO6, PO11, PSO1, PSO2
7	Implement advanced concepts in MongoDB: geospatial Queries, aggregation pipeline, and operators	CO2, CO3	PO1, PO2, PO3, PO4, PO5, PO6, PO11, PSO1, PSO2
8	Build a Project with No-SQL DB using MongoDB	CO2, CO3, CO4, CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO11, PO12, PSO1, PSO2

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MDM: III Syllabus

Course Title: **Introduction to Natural Language Processing**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MDM3	3 Hrs	--	2 Hrs	4	10	15	50	25	
Course Code	23BTAIL311 23BTAIP311									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	3 Hrs					100				

Course Objectives	1. Introduce fundamental NLP concepts and techniques. 2. Apply advanced NLP models like word embeddings and parsing 3. Explore NLP applications such as sentiment analysis and BERT
Course Outcomes	Upon successful completion of this course, student will be able to: CO1: Understand the basics of NLP apply text processing and spelling correction techniques. CO2: Analyze and apply various language modeling techniques. CO3: Evaluate word embeddings, vector space models, and syntax parsing techniques. CO4: Demonstrate semantic analysis techniques. CO5: Implement NLP operations and applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcome

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

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Course Contents:

Unit	Contents	Hours
I	**UNIT I: Introduction to NLP:** Introduction to NLP (Application, component, phases, steps, Ambiguity), Text Processing & NLP Pipeline. **Spelling Correction:** Spelling correction techniques using Edit Distance.	5
II	**UNIT II: Language Modeling:** Types of Language Modeling & N GRAM. **Sequential Models for Tagging** – POS tagging and its types, NER Tagging. Application for Tagging.	6
III	**UNIT III: Basics:** Word Embedding: Word2Vec & Glove. **Introduction to Syntax:** Syntax Parsing, Parsing types, Constituent Parsing & Dependency Parsing.	8
IV	**UNIT IV: Introduction to Semantic Analysis**: Distributional Semantics, Sentence Framing & Lexical Semantics. **Topic Model:** Introduction to Latent Dirichlet Allocation & Entity Linking.	7
V	**UNIT V: NLP Operations:** Information Extraction, Relation Extraction, Text Summarization, Text Classification, Audio & Speech Processing. **Applications of NLP:** Text Classification & Sentiment Analysis	8

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Books	1.	Speech and Language Processing: An Introduction to Natural Language Processing by Dan Jurafsky and James Martin, 3rd Edition , Pearson Publication
	2.	Natural Language Processing with Python: Analysing Text with the Natural Language Toolkit by Steven Bird, Ewan Klein, Edward Loper, O'Reilly Publication
	3.	Foundations of Statistical Natural Language Processing, Chris Manning and Hinrich Schütz, MIT Press, Cambridge
	4.	C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:,1999
E--Books	1.	Applied Natural Language Processing, by Dr. Ramasesan R, CMI Publication. URL: https://drive.google.com/file/d/1UuSzMRvYnpg6cnnhJZmN6CidUEq_XYcN/view
	2.	Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit URL: https://www.nltk.org/book/
Reference Books	1.	Natural Language Understanding, Second Edition,by Allen James, Lebanon, Indian Publication
	2.	Foundations of Statistical Natural Language Processing, Manning, Christopher and Heinrich, Schutze, MIT Press, 1999
	3.	Statistical Language Learning, Charniack, Eugene, MIT Press
Online TL Material	1.	NPTEL: Natural Language Processing URL: https://nptel.ac.in/courses/106/105/106105158/
	2.	NPTEL: Applied Natural Language Processing URL: https://nptel.ac.in/courses/106/106/106106211/
	3.	DataCamp : Natural Language Processing in Python URL: https://www.datacamp.com/tracks/natural-language-processing-in-python

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Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Program should be based on Natural Language Understanding (Lexical Ambiguity, Syntactical Ambiguity, Referential Ambiguity)
2	Program should be based on basic text processing operation on text document.
3	Program should be based on Errors Detection and Corrections
4	Program should be based on Implement N-gram Language model
5	Program should be based on Part-of-Speech (POS) tagging and NER
6	Program should be based on word embedding using Word2Vec/Glove/fastText
7	Program should be based on LSA and Topic model.
8	Program should be based on Parsing (Dependency and Constituency)
9	Program should be based on Text Classification
10	Program should be based on Natural Language Generation
11	Program should be based on HMM/CRF on sequence tagging task
Open Ended Experiments / New Experiments	
1	Develop any one NLP application Sentiment Analysis • Chatbot • Text Summarization Track • Machine Translation • Question/Answering
2	Study and understand the BERT Model
3	Study and understand LLaMA Model
Details of on line Laboratory Resource Material Instruction / Operating Manuals	
1.	N-Grams Smoothing Virtual Lab URL: https://nlp-iiith.vlabs.ac.in/
2.	Summarize a chunk of text to a summary of a user's preference URL: http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/The_Big_Bang_Nerds/labs/exp1/index.html
3.	Online Lab at GitHub URL: https://github.com/virtual-labs/natural-language-processing-iiith

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Course Title: **CLOUD COMPUTING**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	OE3	2	NA		2	10	15	50	NA	NA
Course Code	23BTAIL312									
Teaching Mode	OFFLINE	2 Hrs			Total	75				
Duration of ESE	NA					75				

Course Objectives	To understand Cloud Computing concepts, technologies, architecture and applications
	To understand the underlying principle of cloud virtualization, cloud storage, data management and data visualization
	To understand different cloud programming platforms and tools to develop and deploy applications on cloud
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand cloud computing concepts using popular cloud platforms
	CO2: Demonstrate various cloud programming models and apply them to solve problems on the cloud.
	CO3: Analyze Data Management in Cloud Computing and Resource Management in Cloud)
	CO4: Evaluate Cloud Security and Risk Management
	CO5: Develop cloud computing solutions for an enterprise

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	--	3	--	--	--	--	2	--	--	--	--	--	3	--
CO2	1	--	--	--	3	--	--	--	--	--	--	--	3	--
CO3	--	--	3	--	--	--	--	--	--	--	--	--	3	--
CO4	--	--	--	3	--	--	--	--	--	--	--	--	--	2
CO5	--	--	--	--	3	--	--	--	--	--	--	--	--	2

Course Contents:

Unit	Contents	Hours
I	Introduction to Cloud Computing and Virtualization: Virtualization Concepts, Cloud Computing Fundamental: Overview of Computing Paradigm, Evolution of cloud computing, Defining cloud computing, Components of a computing cloud, Essential Characteristics of Cloud Computing, Cloud Taxonomy. Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service (SaaS), Hardware-as-a-service: (HaaS), Oriented Architecture (SOA)	5
II	Cloud Computing Architecture and Service Management in Cloud: Computing Cloud architectural principles, Role of Web services, Benefits and challenges to Cloud architecture, Cloud Service Models, cloud computing vendors. Cloud Services, Management, Performance and scalability of services, tools and technologies used to manage cloud services deployment	6
III	Data Management in Cloud Computing and Resource Management in Cloud)	4
IV	Cloud Security and Risk Management: Cloud Security: Understanding cloud based security issues and threats, Data security and Storage, Identity& Access Management, Risk Management in cloud, Governance and Enterprise Risk Management.	5
V	Open Source and Commercial Clouds: Openstack, AWS, Google Cloud, Microsoft Azure, Cloud Simulator and IoT Cloud Framework, Research trend in Cloud Computing, Fog Computing,	4

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Text Books	1.	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
	2.	Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
E--Books	1.	CLOUD COMPUTING Principles and Paradigms Link: http://dhoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf
Reference Books	1.	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
	2.	Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010
Online TL Material	1.	https://nptel.ac.in/courses/106/105/106105167/

Course Title: Research Methodology										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Odd	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	RM	-.	-	4 Hrs	2	-	-	-	25	-
Course Code	23BTSHP301									
Teaching Mode	Offline	4Hrs			Total				25	
uration of ESE	-					25				

Course Objectives	1. To understand the role of research methodology in Engineering.
	2. To understand data collection methods and basic instrumentation.
	3. To learn various statistical tools for data analysis.
	4. To develop the ability to apply statistical tools and techniques.
	5. To provide knowledge on sampling design.
Course Outcomes	CO1: Understand the role of research methodology in Engineering
	CO2: Apply appropriate techniques for data collection
	CO3: Analyze collected data using editing, classification, coding, and quantitative methods
	CO4: Apply statistical methods for data analysis
	CO5: Evaluate sampling designs and apply suitable sampling techniques

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		3		3											
CO2		3		3	1										
CO3		3	3	3	2										
CO4				3	1										
CO5		3		3							2				

Course Contents:

Unit	Contents	Hours
I	**Introduction to Research**: Definition of research, Characteristics of research, Types of research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Overview of research methodology in various areas, Introduction to problem solving, basic research terminology such as proof, hypothesis, lemma etc., Role of Information and Communication Technology(ICT) in research.	6
II	**Data Collection:** Primary Data: Meaning, Importance & limitations.,, Observation , Questionnaire, Interview, Interview Scheduled Social Survey, Case Study Secondary Data: Meaning, Importance& limitations. Sources Secondary Data.	6
III	**Data Analysis And Use Of Quantitative Method**: Editing, Classification and Coding. Categorization, Tabulation, Tables, Graphs, Illustrations. Use of quantitative method in research.	6
IV	**Data Analysis And Use Of Statistical Method:** Statistical Techniques: Measures of Central tendency, Dispersion, Skewness, Kurtosis & Moments, Correlation, Regression. Theory of Attributes & Association, chi squareTest & Distribution.	6
V	**Sampling Design:** Census and sample survey, Characteristics of good sample design, Implications of sample design, Sampling Techniques, Probability or random sampling, Non-probability sampling	6

Text Books	1	Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", SAGE Publications Ltd., 2011.
	2	C.R. Kothari ,"Research Methodology: Methods and Trends", New Age International,2004
	3	Gupta S.C, Fundamentals of Statistics, Himalaya Publication House, Bombay Rajaram V. (1996),
E--Books	1	Wayoc C. Booth : The Craft of Research
	2	David Willinson : Research Tools Kits : A Complete Guide to Practitioner Research
Reference Books	1	Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction" JUTA and Company Ltd, 2004.
on line TL Material	1	http:// www.shodhaganga.inflibnet.ac.in
	2	http:// www.inflibnet.ac.in.
	3	http:// www.zotero.org

Sr. No.	Name of Experiments / Mini Projects/ Case Studies (Any 8)
1	Report writing explaining importance of research.(CO1)
2	To collect data using two different methods. (CO2)
3	Performing literature review, identifying gaps (CO3)
4	Design simple sampling method for survey(CO3)
5	Raw data coding and classification(CO3)
6	Formulation of hypothesis based on collected data (CO3)
7	Using bar graphs, pie charts for interpreting findings(CO4)
8	Project proposal that includes problem identification.(CO5)
9	Ethical consideration in research methodology.(CO5)

Rubrics

For 25 internal marks

Attendance	Submission	Final Oral presentation/Viva Voce	Total Marks
5	1	10	25

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Course Title: Natural Language Processing										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory				
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC9	3	-	2	5	4	10	15	50	25
Course Code	23BTAIL304/ 23BTAIP304									
Teaching Mode	Offline	5 Hrs			Total	75			50	
Duration of ESE	2.5 Hrs.					125				

Course Objectives	1. Introduce fundamental NLP concepts and techniques.
	2. Apply advanced NLP models like word embeddings and parsing
	3. Explore NLP applications such as sentiment analysis and BERT
Course Outcomes	**Upon successful completion of this course, student will be able to:**
	CO1: Understand the basics of NLP apply text processing and spelling correction techniques.
	CO2: Apply and Demonstrate various language modeling techniques.
	CO3: Analyze word embeddings, vector space models, and syntax parsing techniques.
	CO4: Evaluate semantic analysis techniques.
	CO5: Implement NLP operations and applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO8	PO9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

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Course Contents:

Unit	Contents	Hours
I	**Introduction to NLP:** Basics of NLP (Application, component, phases, steps, Ambiguity), Text Processing, NLP Pipeline. **Spelling Correction:** Spelling correction techniques.	6
II	**Language Modeling:** Types of Language Modeling, N GRAM, Advance smoothing for language modeling with its techniques. **Sequential Models for Tagging** – POS tagging and its types, Maximum Entropy Models, HMM, Conditional Random Fields.	8
III	**Basics:** Bag of word, Word2Vec, Word/Sentence/Text embedding, Tf/IDF, Count vector, Vector space Model, Glove, fastText, Sentence embedding Technique (Doc2Vec) **Introduction to Syntax:** Syntax Parsing, Parsing types, Constituent Parsing, Dependency Parsing, Maximum Spanning Tree, Context Free Grammar.	8
IV	**Introduction to Semantic Analysis**: Distributional Semantics, Sentence Framing, Lexical Semantics, Lexical Semantics with WordNet, Word Sense Disambiguation, Information Retrieval. **Topic Model:** Latent Dirichlet Allocation, Entity Linking. **Language Generation and Discourse Analysis:** Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure.	8
V	**NLP Operations & Applications:** Information Extraction, Relation Extraction, Text Summarization, Text Classification, Sentiment Analysis, Aspect Based Sentiment Analysis and Opinion Mining, Audio & Speech Processing. Introduction to Transformers and GPT. **Ethical Aspects of NLP:** Misinformation and Fake Content Generation, Privacy Concerns in Text Data, Hate Speech and Offensive Language Detection, Transparency and Explainability.	8

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Books	1.	Speech and Language Processing: An Introduction to Natural Language Processing by Dan Jurafsky and James Martin, 3rd Edition , Pearson Publication
	2.	Natural Language Processing with Python: Analysing Text with the Natural Language Toolkit by Steven Bird, Ewan Klein, Edward Loper, O'Reilly Publication
	3.	Foundations of Statistical Natural Language Processing, Chris Manning and Hinrich Schütz, MIT Press, Cambridge
	4.	C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:,1999
E--Books	1.	Applied Natural Language Processing, by Dr. Ramasesan R, CMI Publication. URL: https://drive.google.com/file/d/1UuSzMRvYnpg6cnnhJZmN6CidUEq_XYcN/view
	2.	Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit URL: https://www.nltk.org/book/
Reference Books	1.	Natural Language Understanding, Second Edition,by Allen James, Lebanon, Indian Publication
	2.	Foundations of Statistical Natural Language Processing, Manning, Christopher and Heinrich, Schutze, MIT Press, 1999
	3.	Statistical Language Learning, Charniack, Eugene, MIT Press
On line TL Material	1.	NPTE: Natural Language Processing URL: https://nptel.ac.in/courses/106/105/106105158/
	2.	NPTEL: Applied Natural Language Processing URL: https://nptel.ac.in/courses/106/106/106106211/
	3.	DataCamp : Natural Language Processing in Python URL: https://www.datacamp.com/tracks/natural-language-processing-in-python

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Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Program should be based on Natural Language Understanding (Lexical Ambiguity, Syntactical Ambiguity, Referential Ambiguity)
2	Program should be based on basic text processing operation on text document.
3	Program should be based on Errors Detection and Corrections
4	Program should be based on Implement N-gram Language model
5	Program should be based on Part-of-Speech (POS) tagging and NER
6	Program should be based on word embedding using Word2Vec/Glove/fastText
7	Program should be based on LSA and Topic model.
8	Program should be based on Parsing (Dependency and Constituency)
9	Program should be based on Text Classification
10	Program should be based on Natural Language Generation
11	Program should be based on HMM/CRF on sequence tagging task
Open Ended Experiments / New Experiments	
1	Develop any one NLP application Sentiment Analysis • Chatbot • Text Summarization Track • Machine Translation • Question/Answering
2	Study and understand the BERT Model
3	Study and understand LLaMA Model
Details of online Laboratory Resource Material Instruction / Operating Manuals	
1.	N-Grams Smoothing Virtual Lab URL: https://nlp-iiith.vlabs.ac.in/
2.	Summarize a chunk of text to a summary of a user's preference URL: http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/The_Big_Bang_Nerds/labs/exp1/index.html
3.	Online Lab at GitHub URL: https://github.com/virtual-labs/natural-language-processing-iiith

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Course Title: Deep Learning										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory				
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC10	3	--	2	4	10	15	50	25	25
Course Code	23BTAIL305/ 23BTAIP305									
Teaching Mode	Offline	5 Hrs.			Total	75			50	
Duration of ESE	2.5 Hrs.					125				

Course Objectives	To understand the mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text and data.
	To apply Deep learning Techniques to various engineering and social applications.
Course Outcomes	**Upon successful completion of this course, students will be able to:**
	CO1: Understand and master basic knowledge, theories and methods in artificial neural networks.
	CO2: To apply various deep learning architectures.
	CO3: To analyze the models using deep learning algorithms
	CO4: To evaluate and tune model parameters for different deep learning techniques.
	CO5: To implement and validate deep learning models.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO8	PO9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	History of Deep Learning, Deep Learning Success Stories, Thresholding Logic, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs.	6
II	**Optimizer & Its Basic:** Representation Power of Feed forward Neural Networks Feed Forward Neural Networks, Back propagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Ada Grad, RMS Prop, Adam	8
III	**Optimization for Training Deep Models:** Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second Order Methods, Optimization Strategies and Meta-Algorithms	8
IV	**Regularization for Deep Learning:** Parameter norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised learning, Multi-task learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, tangent Prop and Manifold, Tangent Classifier	8
V	Convolution Neural Networks, LeNet, AlexNet, ZF-Net, GoogleNet, ResNet Learning Vectorial Representations of Words, Recurrent Neural Networks, LSTM, Transfer Learning Model, Pretrained model: VGG, EfficientNet, YOLO/ RCNN, BERT, GPT., Introduction to GAN.	5

Text Books	1.	Patrick Henry Winston, Artificial Intelligence, Addition-Wesley,1992
	2.	Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville .
	3.	Elaine Rich, kevin knight, Shivshnakar Nair, artificial Intelligence, McGraw Hill
E-book	1	Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach 3rd Edition , Prentice Hall,2009
Online	1	http://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs42/

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List of Practical's

Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Perform And Implement Perception Model
2	Perform And Implement Back Propagation Neural Network
3	Perform And Implement Feed Forward Neural Network for any real time dataset
4	Perform And Implement Feed Forward Neural Network for any real time dataset with Different Optimizer
5	Perform And Implement Noise Reduction Using Auto Encoder
6	Perform And Implement Image Compression Using Auto Encoder
7	Perform And Implement ECG Signal Classification Using CNN With Different Optimizer
8	Perform And Implement Brain Tumor Classification Using CNN
9	Perform And Implement Pre-trained Model(VGG16) for Real Time Classification
10	Perform And Implement For Real Time Image Classification

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	POOL OF TRACKWISE PROFESSIONAL ELECTIVES				
Track/Elective	**Application Development**	**Machine Learning Engineer**	**Security**	**Computing**	**Data Science**
Track	**Track-I**	**Track-II**	**Track-III**	**Track-IV**	**Track -V**
Program Elective-I (Credits :4) (Th + Pr) (Semester-V)	Recommendation System 23BTAIL306 23BTAIP306	Reinforcement Learning 23BTAIL307 23BTAIP307	Cryptography and Network Security 23BTAIL308 23BTAIP308	Computer Vision 23BTAIL309 23BTAIP309	No SQL Database System 23BTAIL310 23BTAIP310
Program Elective II (Credits :4) (Th + Pr) (Semester-VI)	Practical ML 23BTAIL311 23BTAIP311	Predictive Modeling & Analytics 23BTAIL312 23BTAIP312	Blockchain Technology 23BTAIL313 23BTAIP313	Advance Cloud Computing Services 23BTAIL314 23BTAIP314	Distributed Computing 23BTAIL315 23BTAIP315
Program Elective III (Credits :4) (Th) (Semester-VI)	Virtual and Augmented Reality 23BTAIL316	IOT Architecture & Technologies 23BTAIL317	Digital Forensics 23BTAIL318	Introduction to Robotics 23BTAIL319	Data Mining 23BTAIL320
Program Elective-IV (Credits: 4) Th (Semester-VII)	Mobile Computing 23BTAIL404	Brain Machine Interface 23BTAIL405	Cyber Security 23BTAIL406	Pervasive Computing 23BTAIL407	Information Retrieval 23BTAIL408
Program Elective-V Moocs Based (Credits: 4) Th (Semester- VIII)					

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Course Title: Practical ML										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3	-	1	4	10	15	50	25	-
Course Code	23BTAIL311 23BTAIP311									
Teaching Mode	Offline	4			Total	75				
Duration of ESE	3 Hrs.					100				

Course Objectives	To equip students with hands-on knowledge and practical skills required to develop Machine Learning and Deep Learning models using **Keras, PyTorch, and TensorFlow** for intelligent computing tasks across multidisciplinary domains.
	To prepare students to professionally and ethically apply ML techniques to real-life applications in healthcare, education, automation, and smart systems, enhancing stakeholder satisfaction.
Course Outcomes	Course outcomes: Upon completion of the subject, students will be able to
	CO1: **Understand** Keras, PyTorch and TensorFlow fundamentals
	CO2: **Apply** data loading and preprocessing techniques using Keras, PyTorch and TensorFlow.
	CO3: **Analyze** and implement prediction, classification, and sequence models using Keras, PyTorch and TensorFlow.
	CO4: **Evaluate** feature handling, serialization formats (Protocol Buffers, TorchScript), and model interpretability techniques across Keras, PyTorch and TensorFlow frameworks.
	CO5: **Build** machine learning and deep learning models for real-world applications using Keras, PyTorch, and TensorFlow.

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcome	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	1	2							3	3	1
CO2	3	3	3	2	3							2	3	2
CO3	3	3	3	3	2							2	3	2
CO4	3	3	2	3	3			1	1	2		2	3	3
CO5	3	3	3	3	3			1		2		3	3	3

Unit	Contents	Hours
I	**Introduction to Keras, PyTorch & TensorFlow:** Introduction to deep learning frameworks: TensorFlow 2.x, Keras, and PyTorch.Understanding tensors: creation, basic operations, reshaping, and broadcasting in TensorFlow and PyTorch.Working with GPU tensors and device placement.Execution models: TensorFlow eager execution and PyTorch dynamic computation.Core model components: layers, activation functions, and loss functions.Model-building approaches: Sequential API and Functional API,Training workflows:Training with model.fit() in Keras,Custom training using TensorFlow GradientTape,PyTorch training loop (forward → loss → backward → optimizer step).Saving and loading models in TensorFlow, Keras, and PyTorch. (Practical tools: Using Google Colab/Jupyter notebooks and TensorBoard for visualization)	**8**
II	**Data Loading & Preprocessing**: TensorFlow Data API: batching, shuffling, mapping, prefetching. Keras preprocessing layers. PyTorch Dataset and DataLoader. Data augmentation for images and text. TFRecord format and TorchVision datasets. Converting data for use with deep learning models. Working with structured, image, and sequence data.	**7**
III	**Prediction and Sequence Models** Sequence modeling fundamentals. Preparing univariate & multivariate time series Windowing strategies: trailing vs centered. RNN, LSTM, GRU, CNN models for sequences. Implementing sequence models using Keras, TensorFlow, and PyTorch Evaluation metrics: MAE, MSE, accuracy. Handling sequence bias and data leakage	**7**
IV	**Feature Handling & Serialization** Protocol Buffers in TensorFlow.TensorFlow Example and Sequence Example. Feature Columns and preprocessing layers. Categorical feature handling: One-hot, embeddings. : saving & loading PyTorch models. Model serialization and interoperability overview. Intro to model interpretability (Grad-CAM, saliency	**7**

	maps)	
V	**Advanced Concepts & Deployment** Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) and Feedforward Networks. Transfer Learning using TF Hub and TorchVision models.TF Transform and TensorFlow Datasets (TFDS). ONNX for cross-framework mode conversion. Basic deployment concepts: TensorFlow Lite, TorchServe,Model optimization basics	7

Text Books	1	Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron
	2	Machine Learning with Tensor Flow Nishant Shukla With Kenneth Fricklas
Reference Books	1	*Advanced Deep Learning with TensorFlow 2 and Keras* – Rowel Atienza
	2	*Programming PyTorch for Deep Learning – Ian Pointer*
	3	*PyTorch Recipes – Pradeepta Mishra*
	4	Pro Deep Learning with TensorFlow A Mathematical Approach to Advanced Artificial Intelligence in Python
	5	Learn TensorFlow 2.0, Implement Machine Learning and Deep Learning Models with Python
e-Books	1	https://www.tensorflow.org/text/tutorials/text_generation

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List of Practical:

Sr. No	Name of the Experiments	CO
1	Setting up TensorFlow, Keras, and PyTorch environments.	1
2	Performing object detection using pre-trained models (TF Hub / TorchVision)	1
3	Data loading & normalization using TF Data API and Torch DataLoader.	2
4	Image augmentation using Keras and TorchVision transforms.	2
5	Building an RNN/LSTM time-series model in Keras and PyTorch.	3
6	Evaluating time-series models using MAE and visualizing results.	3
7	Creating Protocol Buffer messages & loading serialized TF data.	4
8	Encoding categorical features using embeddings (TF & PyTorch)	4
9	Building a CNN using all three frameworks (Keras, TF, PyTorch).	5
Open Ended Experiments/New Experiments		
10	To create image classification and pose detection models using Teachable Machine and then convert and use these models in Google Colab for image and pose classification tasks.	5

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Course Title: Predictive Modeling and Analytics										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	TH	TU	PR	CREDITS	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	4 Hrs	-	-	4	10	15	50	25	NA
Course Code	23BTAIL312 23BTAIP312									
Teaching Mode	Offline	4Hrs			Total	75			--	
Duration of ESE	3 Hrs.					100				

Course Objectives	1.Introduces general idea and information about Predictive Modeling &
	2. Making students aware about basic knowledge of Predictive Modeling & Analytics
	3. Study recent tools in the Data Analytics
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1.Understand and apply the basic concepts of Predictive Modeling &
	CO2. Apply concepts of Linear Regression with practical examples
	CO3. Illustrate the basic concepts Logistic Regression and Logistic Model
	CO4: Analyze Decision Trees and Unstructured data analysis.
	CO5: Implement forecasting using software tools MS Excel, SPSS .

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Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes & Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents

Unit	Contents	Hours
I	**UNIT I: Introduction** Introduction to Analytics, Analytics in Decision Making Game changers & Innovators, Predictive Analytics, Experts view on Analytics Simple Linear Regression (SLR).Multiple regression, Multiple outputs, Subset selection, Ridge regression, Lasso regression, Linear Discriminant Analysis.	8
II	**Additive Models, Trees, and Boosting** Generalized additive models, Regression and classification trees, Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting, Examples (Spam data, California housing, New Zealand fish, Demographic data).	8
III	**UNIT III: Decision Trees and Unstructured data analysis** Introduction to Decision Trees, CHI-Square Automatic Interaction Detectors (CHAID), Classification and Regression Tree (CART), Analysis of Unstructured data, Naive Bayes algorithm	8
IV	**UNIT IV: Forecasting and Time series Analysis** Forecasting, Time Series Analysis, Additive & Multiplicative models, Exponential smoothing techniques, Forecasting Accuracy, Auto-regressive and Moving average models, Demo using SPSS	8
V	**UNIT V: Advanced Topic and Big Data for Predictive Analytics** Bias-Varience Trade –off in Predictive Analytics, Imbalanced Data Problem in Predictive Analytics, Explain ability of Machine Learning Models for Predictive Analytics.The Vs That Define Big Data, Big Data and Stream Analytics, Data Stream Mining	8

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Text Books	1.	Modeling Techniques in Predictive Analytics: Business Problems Book by Thomas W. Miller
	2.	Predictive Analytics: The Power to Predict Who Will Click, Buy, Book by Eric Siegel
	3.	Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning-Data Mining, Inference, and Prediction, Second Edition, Springer Verlag.
E-Books	1.	Predictive Analytics: Data Mining, Machine Learning and Data Science for Practitioners, 2nd Edition By DursunDelen
	2.	Reporting, Predictive Analytics and Everything in Between, By Brett Stupakevich, David Sweenorand Shane Swiderek
	3	Predictive Analytics Using R Book by Jeffrey Strickland
Reference Books	1.	The Path to Predictive Analytics and Machine Learningby Conor Doherty, Steven Camina, Kevin White, Gary Orenstein.
	2.	Learning Predictive Analytics with Pythonby Ashish Kumar
Online TL Material	1.	https://towardsdatascience.com/machine-learning/home
	2.	https://onlinecourses.swayam2.ac.in/imb20_mg19/preview

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Predictive Modelling & Analysis
List of Practical:

Sr. No.	Name of Assignment
1	Apply Data preprocessing methods on student and labor datasets Implement data cube for data warehouse on 3-dimensional data.
2	Develop k-means and MST based clustering techniques, Develop the methodology for assessment of clusters for given dataset.
3	Implement binning visualizations for any real time dataset, Implement linear regression techniques.
4	Visualize the clusters for any synthetic dataset, Implement the program for converting the clusters into histograms.
5	Implement Decision Tree: (Download Dataset for PlayTennis) 1. Use the Gini as impurity paramter and construct a Decision Tree 2. Construct a Decision Tree using Information Gain as impurity parameter. 3. Construct a Decision Tree using Misclassification Error as impurity parameter 4. Predict and compare the result of above 3 tree the value of PlayTennis for Outlook = sunny, Temp = cool, Humidity = high, Wind = strong 5. Compare your result with the inbuild library available for - Decision Tree - Random Forest

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Course Title: Block Chain Technology										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3	-	1	4	10	15	50	25	-
Course Code	23BTAIL313 23BTAIP313									
Teaching Mode	Offline	4			Total	75				
Duration of ESE	3 Hrs.					100				

Course Objectives	To understand the use and importance of Blockchain Technology
	To understand use for Blockchain Technology in our domain
Course Outcomes	CO1: Understand emerging abstract models for Block chain Technology.
	CO2: Apply the different algorithm for Implementation of Consensus.
	CO3: Demonstrate the functional/operational aspectsof cryptocurrency Ecosystem
	CO4: Analyze major research challenges and technical gaps existing between Theory and practice in Crypto currency domain
	CO5: Evaluate more research challenges in this domain

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	Cryptographic basics for cryptocurrency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography	12
II	The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS)	08
III	Bitcoin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of Properties of Bitcoin.	08
IV	Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts	08
V	(Trends and Topics) - Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves - Zcash.	12

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Text Books	1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
Reference Books	1	Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015
	2	J.A.Garay et al, The bitcoin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOl 9057, (VOLII), pp 281-310
	3	R.Pass et al, Analysis of Blockchain protocol in Asynchronous networks , EUROCRYPT 2017, (eprint.iacr.org/2016/454) .
On-line TL Material		https://nptel.ac.in/courses/106/104/106104220/

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List of Practical

Exp. No.	Experiment
1	Introduction to Block-chain Technology and Block structure
2	Implement the use of the Variable, Operators in Solidity:
3	Implement the use of the Strings, Arrays, Enums, Structs, Mappings in Solidity.
4	Implement Functions, Function Modifiers, View functions, Pure Functions, Fallback Function, and Function Overloading in Solidity
5	Write a program to demonstrate mining of Ether.
6	Create a lottery contract where participants can enter, and one winner is randomly chosen.
7	Implement a simple ERC-20 token contract.
8	Create a simple bank contract where users can deposit, withdraw, and check their balances.
9	Install and configure Hardhat.
10	Write and deploy a basic smart contract, test it using Hardhat's local Ethereum environment.
Open Ended Practical	
1.	Open Ended Practical: Ganache
2.	Open Ended Practical: Metamask
3.	Open Ended Practical: Web3js

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Course Title: Advanced Cloud Computing Services										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3	-	1	4	10	15	50	25	-
Course Code	23BTAIL314 23BTAIP314									
Teaching Mode	Offline	4			Total	75				
Duration of ESE	3 Hrs.					100				

Course Objectives	1. To understand Cloud Computing concepts, technologies, architecture, and applications.
	2. To understand the underlying principles of cloud virtualization, cloud storage, data management, and data visualization.
	3. To understand different cloud programming platforms and tools to develop and deploy applications on the cloud.
Course Outcomes	Upon successful completion of this course, students will be able to:
	CO1: Understand core cloud computing concepts, service models, deployment models, and major cloud platforms.
	CO2: Apply cloud programming paradigms, virtualization principles, and CloudSim tools to design and implement simulated cloud solutions.
	CO3: Analyze and deploy compute services in cloud environments to satisfy application performance and scalability requirements.
	CO4: Evaluate cloud storage and database services for scalable and reliable data management in cloud platforms.
	CO5: Develop and analyze cloud-based analytics and machine learning workflows using cloud services and tools.

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	--	2	2	--	--	--	--	1	--	--	--	--	--
CO2	--	2	3	3	1	--	--	1	2	2	--	--	--	3
CO3	--	1	3	3	2	--	--	--	2	--	--	--	--	3
CO4	--	2	3	3	2	1	--	--	2	--	--	--	--	--
CO5	--	3	3	3	3	1	1	--	2	--	1	3	--	3

Course Contents:

Unit	Contents	Hours
I	**Introduction to Cloud Computing**: Virtualization Concepts,Overview of Computing Paradigms, Taxonomy, Evolution of Cloud Computing, Definition, Components, Essential Characteristics, Cloud Service Models, Cloud Deployment models, Cloud Computing Architecture, Benefits and Challenges of Cloud Computing. Creating an AWS /Microsoft Azure /Google Account, Exploring its Web Services.	7
II	**Cloud Simulation & Research Algorithms** Introduction to Cloud Simulators, CloudSim Architecture & Working, Performance Evaluation using CloudSim, Algorithm for Cloud Simulation. Cloud Performance Measurement Parameters (Latency, Throughput, Utilization, SLA, Energy Consumption) Basics of VMWare: Concepts, Features, and Advantages.	6
III	**Compute:** Amazon Elastic Compute Cloud (EC2), Amazon Lambda, VPC(Virtual Private Cloud), and Lightsail. Azure Instance types, Azure Functions (Serverless Computing). Google Compute Engine (GCE), Google App Engine.	7
IV	**Storage & Database** Amazon Simple Storage Service (S3), Amazon Elastic Block Store (EBS). Azure Blob Storage,Azure SQL Database. Cloud Storage (Buckets): Cloud Firestore, Cloud Bigtable. Database Introduction, Amazon DynamoDB, Amazon Redshift.	7
V	**Analytics** Amazon Elastic MapReduce (EMR), Amazon Kinesis, AWS SageMaker: Introduction, ML Workflow using SageMaker. Azure Machine Learning StudioTraining & Deployment Pipelines, Dataproc (Hadoop/Spark on GCP)	

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Text Books	1.	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
	2.	Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
	3.	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
E-Books	1.	CLOUD COMPUTING Principles and Paradigms Link: http://dhoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf
Reference Books	1.	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
	2.	Cloud Security: A Comprehensive Guide to Secure Cloud Computing,
On line TL Material	1	https://onlinecourses.nptel.ac.in/noc21_cs14/preview

Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Introduction to Cloud Computing & Account Creation (AWS / Azure / Google Cloud).
2	Creating Virtual Machines using VMware Workstation.
3	Create virtual machines by virtualizing a physical machine on another machine.
4	Build your first Web App with Microsoft Azure/AWS
5	Create a data center in Cloud Analyst.
6	Create an EC2 Instance in AWS by using Windows or Linux(Compute Service).
7	Creating an S3 Bucket and Connecting it to EC2(Storage)
8	Creating Tab and call lists in Salesforce using List views
9	Create a permission set in Salesforce
Open-Ended Experiments / New Experiments	
1	Create Bank app with use of Cloud .

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Course Title: Distributed Computing										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3	-	1	4	10	15	50	25	-
Course Code	23BTAIL315 23BTAIP315									
Teaching Mode	Offline	4			Total	75				
Duration of ESE	3 Hrs.					100				

Course Objectives:
1.To provide hardware and software issues in modern distributed systems.
2. To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
3. To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.
Couse Outcomes: After completing this course, students will be able to
CO1: Understand the principles and desired properties of distributed systems on which the internet and other distributed systems are based.
CO2: Apply the basic theoretical concepts and algorithms of distributed systems in problem solving.
CO3: Analyze the inherent difficulties that arise due to distributed-ness of computing resources
CO4: Evaluate Distributed mutual exclusion algorithms
CO5: Illustrate Inter-process communication

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Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	--	2	2	--	--	--	--	1	--	--	--	--	--
CO2	--	2	3	3	1	--	--	1	2	2	--	--	--	3
CO3	--	1	3	3	2	--	--	--	2	--	--	--	--	3
CO4	--	2	3	3	2	1	--	--	2	--	--	--	--	--
CO5	--	3	3	3	3	1	1	--	2	--	1	3	--	3

Course Contents	Hrs.
UNIT I: Introduction	**9**
Basic of distributed Computing System, CICS architecture, RISC architecture, Multi core Computer networking: ISO/OSI Model, Evolution of OS.	
UNIT II: DCS design	**7**
Objectives of DCS design, Transparencies, Important problems of DCS, Load scheduling and balancing techniques.	
UNIT III: Distributed Co-ordination	**6**
Introduction of Distributed Co-ordination, Temporal ordering of events, Lamport's logical clocks Vector clocks; Physical clocks ordering message, detection of Global state.	
UNIT IV: Process synchronization	**6**
Basic review of Process synchronization, Distributed mutual exclusion algorithms, Performance matrix, Deadlocks in distributed systems.	
UNIT V: Inter-process communication	**8**
Introduction, Message passing communication, Remote procedure call Transaction communication Group communication; Broadcast atomic protocols.	

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Text Books	1.	Distributed Systems Concepts and Design, G. Coulouris, J. Dollimore, Addison Wesley
	2.	Advanced Operating Systems, M. Singhal, N.G. Shivarathri, McGraw Hill
Reference Books	1.	Distributed Operating Systems and Algorithms, Randy Chow, T. Johnson, Addison Wesley
	2.	Distributed Operating Systems, A.S. Tanenbaum, Prentice Hall
	3.	Principles of Distributed Database Systems, M. Tamer Ozsu, Patrick Valduriez, Prentice Hall International
on line TL Material	1.	https://nptel.ac.in/courses/106106107

Distributed Computing

List of Practical:

Sr. No.	Name of Assignment
1	Program to implement non token based algorithm for Mutual Exclusion
2	Program to implement Lamport's Logical Clock
3	Program to implement edge chasing distributed deadlock detection algorithm.
4	Program to implement locking algorithm.
5	Program to implement Remote Method Invocation.
6	Program to implement Remote Procedure Call.
7	Program to implement Chat Server.
8	Program to implement termination detection

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Elective-III

Course Title: Virtual and Augmented Reality										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective-III PEC3	4	-	-	4	10	15	50	-	-
Course Code	23BTAIL316									
Teaching Mode	Offline	4			Total	75				
Duration of ESE	3 Hrs.					75				

Course Objectives	To establish and cultivate a broad and comprehensive understanding of this rapidly evolving and commercially viable field of Computer Science
	To describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.
Course Outcomes	On completion of this course, the student will be able to:
	CO1: Understand fundamental computer vision, computer graphics and human-computer interaction techniques related to VR/AR
	CO2: Apply the concept of geometric modeling in Virtual environment.
	CO3: Illustrate the differentiation of VR/AR technology.
	CO4: Analyze the concepts of Augmented reality
	CO5: Implement Virtual/Augmented Reality applications.

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

UNIT	CONTENTS	HOURS
I	**Introduction to Virtual Reality:** Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality, Virtual environment representation requirement.	7
II	**Computer Graphics And Geometric Modeling:** Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modeling, 3D clipping, Illumination models, Reflection models, Shading algorithms. Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.	7
III	**Virtual Environment:** Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems. Animating the Virtual Environment: Introduction, Thedynamics of numbers, Linearand Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle	7

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	system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.	
IV	**Augmented Reality:** Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.	7
V	**Visual Perception: Rendering, Motion & Tracking** Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information. Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection ,Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies	8

Text Books	1	Grigore C. Burdea, Philippe Coiffet , Virtual RealityTechnology, Wiley 2016
	2	Alan B. Craig, Understanding Augmented Reality, Conceptsand Applications, Morgan Kaufmann, 2013.
	3	Anand R., "Augmented and Virtual Reality", KhannaPublishing House, Delhi.
Reference Books	1	John Vince, "Virtual Reality Systems ", Pearson EducationAsia, 2007.
	2	Virtual Reality, Steven M. LaValle, Cambridge University Press, 201
	3	Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
e-Books	1	http://lavalle.pl/vr/book.html
On-line TL Material	1	https://nptel.ac.in/courses/106/106/106106138/
	2	https://www.coursera.org/learn/introduction-virtual-reality

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Course Title: IOT Architecture & Technologies										
Semester	**VI**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**EVEN**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**Elective-III PEC3**	**4**	**-**	**-**	**4**	**10**	**15**	**50**	**-**	**-**
Course Code	**23BTAIL317**									
Teaching Mode	**Offline**	**4**			**Total**	**75**				
Duration of ESE	**3 Hrs.**					**75**				

Course Objectives	To understand the IoT system typically comprises of smart sensor nodes to collect data Either real-time or offline, data communication over a network and the back-end datamanagement & processing to extract intelligent information.
	To understand the typical use cases of IoT are wearables, smart homes, smart vehicles, traffic prediction & control, weather monitoring & forecasting, indoor location-based services, health monitoring of machines & structures, augmented/virtual reality etc
Course Outcomes	On completion of this course, the student will be able to:
	CO1: To understand various building blocks and working of state-of-the-art IoT systems
	CO2: To apply the engineering fundamentals, blended with good industrial practices, which lead to the first-time success of the design and development of sensor node.
	CO3: Illustrate the smart sensor node with emphasis on design, requirement, data ,Interfacing and capabilities.
	CO4: Analyze the and gain enough insights to conceive and build IoT systems on their own.
	CO5: Evaluate various IOT Frame Work such as Windows, Microsoft Azure

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	Introduction to IOT: What Is the Internet of Things (IoT), Current Business Trends in IOT, Benefits of IOT, Barriers of IOT, Case Study & IoT Architecture.	10
II	IoT Sensors and Actuators and Types of Sensor & their Significance.	8
III	IOT Communication Layer: Communication Technology, Raspberry PI, Wireless & Bluetooth, IoT protocols: MQTT/MQTTS, ALLJOYN and Hands on End to End IoT Session, Introduction to 5G Technology.	10
IV	Cloud: Introduction to Cloud Computing, Introduction to Amazon Web Servers & AWS IOT Implementations.	10
V	IOT Framework: Introduction to IOT Framework, Types of Framework available in Market - Windows, Microsoft Azure	10

Text Books	1	Internet of Things: A Hands-on Approach, By Arshdeep Bahga and Vijay Madisetti
	2	Introduction to Embedded Systems: A Cyber-Physical Systems Approach, By Edward Ashford Lee and Sanjit Arunkumar Seshia
	3	Introduction to Computation and Programming using Python, by John Guttag
Reference Books	1	Python documentation: https://www.python.org/doc/
	2	Android developer: https://developer.android.com/training/index.html
On-line TL Material		https://nptel.ac.in/courses/106/105/106105166/

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Course Title: Digital Forensics										
Semester	**VI**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**EVEN**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**Elective-III PEC3**	**4**	**-**	**-**	**4**	**10**	**15**	**50**	**-**	**-**
Course Code	**23BTAIL318**									
Teaching Mode	**Offline**	**4**			**Total**	**75**				
Duration of ESE	**3 Hrs.**					**75**				

Course Objectives	To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.
	To understand how to examine digital evidences such as the data acquisition, identification analysis.
Course Outcomes	On completion of this course, the student will be able to:
	CO1: Understand the origins of forensic science.
	CO2: Apply digital forensics investigation.
	CO3: Illustrate the findings from digital forensic investigations.
	CO4: Analyze the Performance recovery of digital evidence from various digital devices using a variety of software utilities.
	CO5: Implement forensic analysis tools to recover important evidence for identifying computer crime. To be well-trained as next-generation computer crime investigators.

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	3	3	--	--	--	--	--	--	--	--	--	1	2
CO2	1	3	3	3	3	3	--	--	--	--	--	--	1	2
CO3	1	2	2	2	3	2	--	--	--	--	3	3	2	3
CO4	1	2	2	3	3	3	1	--	--	--	3	3	2	3
CO5	2	2	2	3	3	3	1	--	--	--	3	3	2	3

Course Contents:

UNIT	CONTENTS	HOURS
I	**Computer forensics fundamentals**: Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.	6
II	**Understanding Computing Investigations** – Procedure for corporate High-Tech investigations, understanding data recovery workstation and software, conducting and investigations.	7
III	**Data acquisition**- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.	7
IV	**Processing crimes and incident scenes**, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.	7
V	**Current computer forensics tools**- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.	7

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Textbooks	**1.** Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002. **2.** Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.
Reference Books	Vacca, J, *Computer Forensics, Computer Crime Scene Investigation*, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

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Course Title: Introduction to Robotics										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective-III PEC3	4	-	-	4	10	15	50	-	-
Course Code	23BTAIL319									
Teaching Mode	Offline	4			Total	75				
Duration of ESE	3 Hrs.					75				

Course Objectives	Student will be able to 1. Study the concepts of Artificial Intelligence in robotics.
	2. Learn the methods of solving problems by robotics using Artificial Intelligence
	3. Understand the concepts of Expert Systems and Machine learning in robotics.
Course Outcomes	1. Understand problems that are amenable to solution by AI methods
	2. Illustrate a given problem in the language/framework of different AI methods.
	3. Analyze the learning methods adopted in AI
	4. Design and perform an empirical evaluation of different algorithms on a problem formalization.
	5. Implement the applications of AI in Robotic Applications

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Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO8	PO9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	**Introduction:** History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents	6
II	**Problem Solving:** Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning–knowledge representation – first order logic	6
III	**Planning:** Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planningand acting in real world. **Reasoning:** Uncertainty – Probabilistic reasoning–Filtering and prediction– Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.	10
IV	**Learning:** Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, and perception.	7
V	**AI In Robotics:** Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.	7

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Text Books	1.	Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India, 2016.
	2.	Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems",. Harlow: AddisonWesley, 2002
Reference Books	1.	David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992
	2.	Huimin Lu, Xing Lu, "Artificial Intelligence and Robotics", Springer, 2017.
	3.	Francis.X.Govers, "Artificial Intelligence for Robotics", Packt Publishing, 2018.
On-line TL Material	1.	https://nptel.ac.in/courses/107/106/107106090/

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Course Title: Data Mining										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective-III PEC3	4	-	-	4	10	15	50	-	-
Course Code	23BTAIL320									
Teaching Mode	Offline	4			Total	75				
Duration of ESE	3 Hrs.					75				

Course Objectives	To identify the scope and essentiality of Data Mining.
	To analyze data, choose relevant models and algorithms for respective applications.
	3.To develop research interest towards advances in data mining
Course Outcomes	On completion of this course, the student will be able to:
	CO1: Understand Data and Data Mining Principles
	CO2: Apply the frequent pattern mining methods, such as Apriori, ECLAT, and FP growth.
	CO3: Illustrate the different data mining techniques for classification and prediction.
	CO4: Analyze the popular algorithms for cluster analysis.
	CO5: Implement appropriate data mining algorithms to solve real world problems

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	-	3	2	--	--	--	--	--	--	--	--	2	--	--
CO2	2	3	3	2	2	--	--	--	--	--	--	2	--	--
CO3	2	3	3	3	3	--	--	--	--	--	3	2	3	2
CO4	2	3	3	3	3	1	1	--	--	--	3	2	3	2
CO5	3	3	3	3	3	1	1	--	--	--	3	2	3	3

Course Contents:

UNIT	CONTENTS	HOURS
I	Introduction to data mining: What is Data Mining? What is the Data Mining Process? Basic Data Mining Tasks, Problem Identification, Data Mining Metrics, Data Cleaning (pre-processing, feature selection, data reduction, feature encoding, noise and missing values, etc.), Key Issues, Opportunities for Data Mining.	6
II	Mining frequent patterns, associations and correlations: Basic concepts, efficientand scalable frequent item set mining algorithms, mining various kinds of association rules – multilevel and multidimensional, association rule mining versus correlation analysis, constraint-based association mining.	6
III	Classification and prediction: Definition, decision tree induction, Bayesian classification, rule-based classification, classification by backpropagation and support vector machines, associative classification, lazy learners, prediction, accuracy and error measures.	8
IV	Cluster analysis: Definition, clustering algorithms - partitioning, hierarchical, density based, grid based and model based; Clustering high dimensional data, constraint-based cluster analysis, outlier analysis – density based and distance based	8
V	Data mining on complex data and applications: Algorithms for mining of spatial data, multimedia data, text data; Data mining applications, social impacts of datamining, trends in data mining.	8

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Text books	1.	Han, J. and Kamber, M., "Data Mining - Concepts and Techniques", 3rd Ed., Morgan Kaufmann Series.
	2.	Ali, A. B. M. S. and Wasimi, S. A., "Data Mining - Methods and Techniques", Cengage Publishers
E-Book	1.	Mining the Social Web Data Mining Facebook Twitter LinkedIn Instagramby Matthew A. Russell & Mikhail Klassen https://www.pdfdrive.com/mining-the-social-web-data-mining-facebook-twitter-linkedin-instagram-e185781408.html
Reference Books	1.	Tan, P.N., Steinbach, M. and Kumar, V., "Introduction to Data Mining", Addison Wesley – Pearson.
	2.	Pujari, A. K., "Data Mining Techniques", 4th Ed., Sangam Books.
Online TL Material	1.	https://nptel.ac.in/courses/106/105/106105174/

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Course Title: **Introduction to Salesforce**										
Semester	**VI**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	VSEC4	1 Hr	--	2 Hrs.	2	10	15	--	25	
Course Code	23BTAIL321 23BTAIP321									
Teaching Mode	Offline	3Hrs			Total	--			25	
Duration of ESE	--					50				

Course Objectives	1. Understand the foundational concepts of the Force.com platform, its architecture, and the tools available for app development.
	2. Configure and secure user access to data, ensuring that only authorized users can access sensitive information while maintaining a flexible, scalable environment.
	3. Configure and secure user access to data, ensuring that only authorized users can access sensitive information while maintaining a flexible, scalable environment.
Course Outcomes	Upon successful completion of this course, student will be able to:
	1. Understand Features of Salesforce CRM
	,2. Apply the Advanced Features in Salesforce CRM for development of software
	3 Analyze modules using Salesforce CRM
	4. Evaluate the security concepts, Automated Business Process and Approval Process of Salesforce CRM.
	5. Create Business Processes in Salesforce

Department of Artificial Intelligence

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	**Introduction to Sales Cloud:** Introduction sales objects, Leads, Account, Contacts, Opportunity, Product, Price books, Quote Multitenant Architecture,	3
II	Introduction to Apps, Tabs, Setup Detail Pages and Related Lists, Introduction to Fields, Advanced Fields, Data Validation, , Introduction to Picklists, Field Dependencies, Dependent Picklist, Custom Formula Fields, Dynamic Default Values, Validation Rules.	3
III	Introduction to Page Layout, Relationship Custom Fields, Record Highlights, Introduction to Search Layouts, Introduction to Roll-Up Summary Fields, Many-to-Many Relationship, Lookup Relationship.	3
IV	**Security** Model In Salesforce: Introduction to Field-Level Security, Controlling Access to Records, Set OrgWide Defaults, Introduction to Hierarchies, Comparing Roles, Profiles, and Permission Sets ,Role Introduction of Sharing Rules, Define a Public Group ,Define Sharing Rules, Introduction to Manual Sharing, Manual Sharing Rule, Displaying FieldValues and Page Layouts According to Profile, Overriding Sharing with Object Permissions, Delegated Administration Groups.	3
V	**Automating Business Processes:** Introduction to Process Builder, Process Builder: A Closer Look Creating a Process That Updates Field Values, Introduction to Queues, Introduction to Scheduled Actions, Email Alerts, Introduction to Email Templates, Introduction to Approvals, Planning for Approval Processes	3

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Text Books	1.	Phil Choi, Chris McGuire Caroline Roth Force.com Platform Fundamentals An Introduction to Custom Application Development in the Cloud salesforce.com
	2.	Wes Nolte, Jeff Douglas Salesforce Handbook Paperback – 20 Mar 2011 Publisher: Lulu.com
E-Books	1.	"Salesforce for Beginners" by James H. Johnson
	2.	"Salesforce for Dummies" by Liz Kao & Jon Paz
Reference Books	1.	Paul Goodey Salesforce CRM: The Definitive Admin Handbook Paperback – Second Edition Packt Publishing Limited
online TL Material	1.	https://trailhead.salesforce.com/content/learn/modules/platform_dev_basics

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List of Practicals

Sr. No	Name of Practical	CO's
1.	Introduction to Salesforce & Org Setup	CO1
2.	Demonstrate the Standard and Custom Objects	CO1
3.	Demonstrate the Page Layout Model	CO2
4.	Demonstrate the Master Detail and Lookup Relationship	CO3
5.	Demonstrate the OWD, Object and Record Level Securities	CO4
6.	Demonstrate the Profiles, Roles and Permission Sets	CO4
7.	Demonstrate the Sharing and Manual Sharing Rules	CO4
8.	Demonstrate Field Level Securities	CO4
9.	Demonstrate Record-Level Security.	CO4
10	Demonstrate the Approval Process and Process Builder.	CO5

G H Raisoni College of Engineering and Management

(An Autonomous Institute affiliated to RTM Nagpur University Nagpur)

Department of Artificial Intelligence
B. Tech. in Artificial Intelligence with Multidisciplinary Minor
UG Scheme & Curriculum - 2023
(NEP 2020)

G H Raisoni College of Engineering & Management
(Formerly Known as G H Raisoni Institute of Engineering &Technology, Nagpur)
An Autonomous Institute Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
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Course Title: **Data Networks**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC	3		--	3	10	15	50	--	--
Course Code	23BTAIL401									
Teaching Mode	Offline	3			Total	75			--	
Duration of ESE	2.5 hrs					75				

Course Objectives	1.To understand the computer network architectures.
	2.To make aware of design and performance perspective of network architectures.
	3.To discuss current trends in communication
Course Outcomes	CO1: Understand the need for OSI reference model in computer networking
	CO2: Apply the various transmission medium used in physical layer
	CO3: Analyze different Elementary protocols for communication and Identify IEEE standards employed in computer networking
	CO4: Evaluate various Routing Algorithm and Protocols
	CO5: Design techniques involved in developing transport and application layer of Computer networking.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	**Unit-I: Introduction** The use of computer networks. Network hardware. LAN's, Man's, WAN's, internet works, Network software, protocol hierarchies, design issues for layers, interfaces and services, Connectionless oriented and connectionless services, service primitives, relationship of Services to protocols, the OSI reference model, TCP/IP reference model, comparison of OSI And TCP/IP reference model.	8
II	**Unit-II: Physical Layer** The theoretical basis for data communication-Fourier analysis, bandwidth- limited signals, Maximum data rate of a channel, transmission media- magnetic media, and twisted pair coaxial Cable, fiber optics. Wireless transmission, microwave transmission. Multiplexing, switching, Narrow and ISDN - services, architecture, interface, perspective on N-ISDN, broadband ISDN & ATM-virtual circuits versus circuit switching, transmission in ATM networks, ATM Switches.	8
III	**Unit-Ill: Data Link Layer** Design issues - services provided to the network Layer, framing, error control, flow control, Error correcting & detecting codes, elementary data link protocols, simplex stop and wait Simplex protocols for noisy channel, sliding window protocols-one bit protocol, go back Protocol, selective repeat protocol. The medium access sub layer - static and dynamic channel Allocation in LANs and MANs, Multiple access protocols - ALOHA. CSMA,collision free Protocols, limited contention protocols, IEEE 802.11 wireless LAN protocols, IEEE Standards 802 for LAN and MANs- 802.3 & Ethernet, token bus. Token ring,	8
IV	**Unit-IV: The Network Layer** Design issues, services provided to the transport layer, internal organization, comparison of Virtual circuit and datagram subnets, routing algorithms. Optimality principle, shortest path Routing, flooding, flow-based routing, distance vector routing, link state routing, hierarchical Routing, broadcast multicast routing, congestion control algorithms, general principles Prevention policies, traffic shaping. flow specifications, congestion control in virtual circuit Subnets. Choke packets, load shedding, jitter control. IPprotocol, IP address. Subnets, internet Control protocols, OSPF. BGP	8
V	**Unit V: Transport and Application Layer** Transport and Application Layer - services provided to the upper layer, Quality of Service, Transport service primitives, elements of transport protocols, addressing, establishing a Connection, releasing a connection, flow control & buffering, multiplexing, crash recovery	8

Text Books	1	Computer Networks, Andrew S.Tanenbaum, David J.Wetherall, Sixth Edition, Pearson
	2	Data Communication and Networking, Behrouz A. Forouzam, McGraw Hill
	3	An Engineering Approach to Computer Networks-S.Keshav,Pearson Education
E-Books	1	Fayez Gebali, Analysis of Computer and Communication Networks, First Edition, Springer
	2	An Introduction to Computer Networks, Peter L Dordal, Department of Computer Science, Loyola University Chicago(http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf)
	3.	TCP/IP Network Administration, Craig Hunt

Reference Books	1.	Jean Walrand, PravinVaraiya, High-Performance Communication Networks (The Morgan Kaufmann Series in Networking), MorganKaufmann Publishers
	2.	V. S. Bagad, I. A. Dhotre, Computer Communication Networks, Third Edition, Technical Publications, Illustrated
	3.	Norman Abramson, Franklin F. Kuo, Computer-communication networks, Fourth Edition, Prentice-Hall, 1973, Illustrated
online TL Material	1.	Coursera – —Data communication Network Services‖ by Cisco
	2.	NPTEL – —Data Communication‖ by IIT Kharagpur

Course Title: **Responsible AI**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC	3		--	3	10	15	50	25	--
Course Code	23BTAIL402/ 23BTAIP402									
Teaching Mode	Offline	3			Total	75			25	
Duration of ESE	2.5 hrs					100				

Course Objectives	**Fairness**: Ensuring AI systems treat all individuals and groups fairly, avoiding biases that could lead to discrimination.
	Transparency: Making AI systems understandable and explainable, allowing users to understand how decisions are made.
	Accountability in the context of AI means putting in place a system of checks and balances to guarantee that someone will always be in charge of the choices and results.
	Privacy and Security AI systems work with **private and classified data**.
	Reliability: Preparing AI systems to function consistently as anticipated in any situation is the goal of the reliability aspect.
Course Outcomes	**CO1:** Understand the fundamental concepts of Responsible AI, including autonomy, adaptability, and interaction.
	CO2: Apply various models and tools for interpreting AI systems, including LIME, SHAP, and ELI5.
	CO3: Analyze ethical reasoning approaches to AI system design and implementation, considering the ethical status of AI systems and relevant guidelines like GDPR and HIPAA.
	CO4: Evaluate methods and metrics for identifying and mitigating bias in AI systems, using case studies such as the COMPAS case.
	CO5: Design strategies for improving fairness and standardization in AI, focusing on data pipelines and ethical AI deployment.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

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Course Contents:

Unit	Contents	Hours
I	**UNIT I: Introduction** Introduction to Responsible AI. Background of Responsible AI, Autonomy, Adaptability, Interaction.	**6**
II	**Introduction to Explainable AI**, Transparency, Interpretability in Intelligent Systems, Models for Interpreting AI Systems, Explaining decisions of AI Systems, Evaluating Interpretability and Explanation. Application of Explainable AI. Tools of explainable AI. Applications of Explainable AI , LIME, SHAP, ELI5, GRADCAM, HEATMAP, Example on Structured and Unstructured data (Image and Text). **Taking Responsibility**: Introduction, Responsible Research and Innovation, The ART of AI- Accountability, Responsibility & Transparency, Design for Values.	**12**
III	**UNIT III: Ethics in Responsible AI** Can AI Systems Be Ethical: Introduction, introduction to ethical action, ethical reasoning approaches by AI Designing Artificial Moral Agents, ethical deliberation implementation guide, ethical behavior levels, Level of ethical behavior. Ensuring Responsible AI in Practice: Introduction, Governance for Responsible AI ,Codes of Conduct, Inclusion and Diversity, The AI Narrative, AI and Society, The Ethical Status of AI Systems , GDPR, HIPAA Guideline, Ethical	**10**
IV	**UNIT IV: Bias & Fairness in AI** Bias and its type, fairness, metrics for bias, COMPAS case study, code walk through of bias matrices. **Reproducibility and Standardization in AI-** Standard MLOPs Pipelines, Data catalog, Model Registry, Data and concept Drift, Demo of end-to-end pipeline, Accountability	**6**
V	**UNIT V: Privacy preserving AI techniques** Privacy, Securing Federated Learning with Differential Privacy, Homomorphic Encryption Understanding techniques of privacy Preserving ML, Introduction to Horizontal and Vertical Federated Learning, Discussion on Security, and trust While Implementing Federated Learning	**6**

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Text Books	**1.**	Virginia Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer Nature Switzerland AG 2019, ISBN 978-3-030-30370-9
	2.	Bernd Carsten Stahl, Artificial Intelligence for a Better Future An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies, Springer Nature, ISBN 978-3-030-69977-2
	3.	Practical Explainable AI using python By Pradeep Mishra.
Reference Books	**1.**	Steven John Thompson, Machine Law, Ethics, and Morality in the Age of Artificial Intelligence, IGI Global, ISBN 9781799867982
	2.	Joachim von Braun, Margaret S. Archer Gregory M. Reichberg, Marcelo Sánchez Sorondo, Robotics, AI, and Humanity, Springer Nature Switzerland AGISBN 978-3-030-54172-9
	3	Responsible Machine Learning by Patrick Hall
online TL Material	**1.**	https://www.microsoft.com/en-us/ai/responsible-ai?activetab=pivot1%3aprimaryr6

Department of Artificial Intelligence

Responsible AI

Sr. No	Name of Experiments / Mini Projects/ Case Studies
1	Explain the output of machine learning classifier using LIME.
2	Explain the output of machine learning classifier using SHAP.
3	Explain the output of machine learning classifier using ELI5.
4	Explain the output of machine learning classifier using GRADCAM.
5	Explain the output of data model using HEATMAP.
6	Scaling the data set using Standardization.
7	Preprocessing the data set using OneHot Encoding
8	Upload the .csv data file to perform various operationIBM Cloud Object Storage using AI.
9.	Implementation and Testing of Bias in System on given dataset
10	Implementation and use of MLflow API in python for various problems statements
Open Ended Experiments / New Experiments	
	Use explainable AI technique and MLOPs in project of your choice.

Department of Artificial Intelligence

Syllabus of VII SEMESTER

Course Title: **Generative AI**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category		3	-	2	4	10	15	50	25	25
Course Code	23BTAIL403/ 23BTAIP403									
Teaching Mode	Offline	4			Total	75			50	
Duration of ESE	3 hrs					125				

Course Objectives	• To apply theoretical understanding to solving problems using Generative AI models
	• To explore Generative AI models like GANs, VAEs, and Transformers.
	• To Implement GPT architecture for text generation and dialogue systems.
	• To discuss current trends and future directions in Generative AI research.
	• To Apply Generative AI techniques to image, text, speech, and vision applications.
Course Outcomes	**CO1**: Understand the fundamental concepts of Generative AI, neural networks, and GAN architectures, large language models' architecture and pre-training techniques
	CO2: Apply the GPT model and BERT model for natural language processing tasks.
	CO3: Analyze Retrieval-Augmented Generation
	CO4: Build autonomous AI agents using frameworks like LangGraph and LangSmith.
	CO5: Implement Image generation with Generative AI.

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**1**	**3**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**3**	**1**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**3**	**2**	**3**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**3**	**1**	**3**	**2**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**2**	**3**	**2**	**2**

Course Contents:

Unit	Contents	Hours
I	**INTRODUCTION**: Introduction to advanced architectures, Introduction to Generative AI Models: Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Diffusion models (Stable Diffusion). Transformers, Attention Mechanism in detail Long Short-Term Memory Networks (LSTMs). Generative AI Applications.	6
II	Introduction to **Large Language Models (LLMs):** Study of GPT architecture and variants. Applications of GPT models in text generation and dialogue systems. Understanding BERT architecture and pre-training objectives. Fine-tuning BERT for downstream NLP tasks. Model fine-tuning techniques (LoRA, PEFT). **Prompt Engineering:** Techniques for zero-shot, few-shot prompting, and mitigating hallucinations.	10
III	**Retrieval-Augmented Generation (RAG):** Connect LLMs to proprietary data using Vector Databases (e.g., Pinecone, ChromaDB) and frameworks like LangChain.	6
IV	**AI Agents & Orchestration:** Build autonomous AI agents using frameworks like LangGraph and LangSmith. **APIs & Integrations:** Interact with proprietary models using OpenAI, Anthropic, or Azure OpenAI	8
V	**Application: Image Generation with Generative AI:** Introduction to Image Generation, LSTM-based and Transformer-based Generation, Evaluation and Fine-Tuning. Case Based Learning, Medical imaging enhancement**:** Use generative models to denoise or enhance MRI/CT scans for research purposes. **Responsible AI:** Importance of ethical and unbiased algorithms in Responsible Generative AI systems, Challenges and limitations of current approaches. Emerging trends and future directions in Generative AI.	8

Department of Artificial Intelligence

Text Books	1.	“Generative AI for everyone: Understanding the essentials and applications of this breakthrough technology". Altaf Rehmani .
	2.	"Introduction to Generative AI”, Numa Dhamani, Kindle Edition, 2024.
	3.	Generative AI in Practice: 100+ Amazing Ways Generative Artificial Intelligence is Changing Business and Society, Bernard Marr
	4.	"Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal.
Reference Books	1.	"Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, TensorFlow, and Keras" by Josh Kalin.
	2.	“Generative AI in Software Development: Beyond the Limitations of Traditional Coding” Jesse Sprinter, 2024.
e-sources		https://elearn.nptel.ac.in/shop/iit-workshops/completed/leveraging-generative-ai-for-teaching-programming-course s/?v=c86ee0d9d7ed
		https://onlinecourses.swayam2.ac.in/e-learning/preview/imb24_mg116
		https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-language-models/?v=c86ee0d9d7ed

Department of Artificial Intelligence

PRACTICAL LIST

1. **Text summarization** Build a model that condenses long articles or research papers into concise summaries.
2. **Chatbot development** Create a conversational agent using LLMs for customer support or campus FAQs.
3. **Code generation** Train or fine-tune a model to generate Python/Java snippets from natural language prompts.
4. **Image synthesis** Use diffusion models (like Stable Diffusion) to generate realistic or artistic images.
5. **Data augmentation** Generate synthetic datasets to improve ML model training, especially for imbalanced data.
6. **Style transfer** Apply artistic styles to images (e.g., turning a photo into a Van Gogh-style painting).
7. **Text-to-speech** Build a system that converts written text into natural-sounding speech.
8. **Story generation** Implement a creative writing assistant that generates short stories or poetry.
9. **Medical imaging enhancement** Use generative models to denoise or enhance MRI/CT scans for research purposes.
10. **Music generation** Experiment with AI tools that compose melodies or background scores.

	POOL OF TRACKWISE PROFESSIONAL ELECTIVES				
Track/Elective	**Application Development**	**Machine Learning Engineer**	**Security**	**Computing**	**Data Science**
Track	**Track-I**	**Track-II**	**Track-III**	**Track-IV**	**Track -V**
Program Elective-I (Credits :4) (Th + Pr) (Semester-V)	Recommendation System 23BTAIL306 23BTAIP306	Reinforcement Learning 23BTAIL307 23BTAIP307	Cryptography and Network Security 23BTAIL308 23BTAIP308	Computer Vision 23BTAIL309 23BTAIP309	No SQL Database System 23BTAIL310 23BTAIP310
Program Elective II (Credits :4) (Th + Pr) (Semester-VI)	Practical ML 23BTAIL311 23BTAIP311	Predictive Modeling & Analytics 23BTAIL312 23BTAIP312	Blockchain Technology 23BTAIL313 23BTAIP313	Advance Cloud Computing Services 23BTAIL314 23BTAIP314	Distributed Computing 23BTAIL315 23BTAIP315
Program Elective III (Credits :4) (Th) (Semester-VI)	Virtual and Augmented Reality 23BTAIL316	IOT Architecture & Technologies 23BTAIL317	Digital Forensics 23BTAIL318	Introduction to Robotics 23BTAIL319	Data Mining 23BTAIL320
Program Elective-IV (Credits: 4) Th (Semester-VII)	Mobile Computing 23BTAIL404	Brain Machine Interface 23BTAIL405	Cyber Security 23BTAIL406	Pervasive Computing 23BTAIL407	Information Retrieval 23BTAIL408
Program Elective-V Moocs Based (Credits: 4) Th (Semester- VIII)					

Syllabus of VII SEMESTER: Program Elective-IV

Course Title: Mobile Computing

Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC4	3	1	--	4	10	15	50	--	--
Course Code	23BTAIL404									
Teaching Mode	Offline	4			Total	75			--	
Duration of ESE	2.5 hrs					75				

Course Objectives	1. To introduce an advanced element of learning in the field of wireless communication.
	2. To learn about the concepts and principles of mobile computing.
	3. To understand concept of mobile adhoc network.
Course Outcomes	CO1: Understand the history of wireless communication, its applications and advantages over wired network
	CO2: Apply specialized medium access control for wireless network such as SDMA, FDMA, TDMA, CDMA.
	CO3: Analyze technical requirement of GSM, its network structure and protocols.
	CO4: Evaluate network layer protocols, its applications, properties and various routing algorithms.
	CO5: Create wireless application protocols, its architecture, working of all protocol layers, along with Bluetooth, Wireless LAN and J2ME

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	History of Wireless Communication, Applications of Wireless Communication, A simplified Reference Model, A second generation 2G services systems, and radio link, channel types, antennas and its types. Advantages of Wireless Network over Wired Network.	7
II	Introduction to Cellular system, (Wireless) Medium Access Control: Motivation for a specialized MAC Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Comparison of DMA/FDMA/TDMA/CDMA. Comparison of Mobile OS with Desktop OS.	7
III	Introduction to GSM system, GSM background, GSM operational and technical requirements. cell layout and frequency planning, mobile station, base station systems, switching sub systems, home locations register (HLR), Visiting Location Register (VLR), equipment identity register, echo canceller. GSM network structure, Protocols, Localization and calling, Handovers.	8
IV	Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol (DHCP). TCP over Wireless Networks – Traditional TCP, Indirect TCP, Snooping TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP, routing and various routing algorithms, multicast routing, security in MANETs.	7
V	Protocols and Tools: Wireless Application Protocol-WAP; Introduction, protocol architecture, and treatment of protocols of all layers; Bluetooth – User scenarios, physical layer, MAC layer, networking, security, link management, Wireless LAN and J2ME.	7

Text Books	1	Mobile Computing for beginners, Raksha Shende, Arizona Business Alliance, 2012 2.
	2	Mobile Communications, Jochen Schiller, Second edition, Addison-Wesley, 2004
	3	Introduction to Computation and Programming using Python, by John Guttag
Reference Books	1	Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Reza Behravanfar, Cambridge University Press, 2004.
	2	Fundamentals of Mobile and Pervasive Computing, Adelstein, Frank, Gupta and Sandeep KS, McGraw-Hill, 2005
	3.	Principles of Mobile Computing, Hansmann, Merk and Nicklous, Stober, Springer, Second Edition.
On-line TL Material		https://nptel.ac.in/courses/117/104/117104099/

Course Title: Brain Machine Interface										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC4	3	1	--	4	10	15	50	--	--
Course Code	23BTAIL405									
Teaching Mode	Offline	4			Total	75			--	
Duration of ESE	2.5 hrs					75				

Course Objectives	Understand to the basic concepts of Brain Machine Interface.
	Understand the processing of human brain signals.
	Understand how these neural and computation work hand in hand.
Course Outcomes	CO1: Understand the biophysical basis of non-invasive brain signals.
	CO2: Apply signal processing, discrimination, and classification tools to interpret these signals.
	CO3: Analyze tools into a control system for a brain-computer interface.
	CO4: Evaluate the present system for brain-computer interface.
	CO5: Create the real time applications for advancement in the domain.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	Introduction: Course objective and overview, Historical evolution of the field, Interactive system design, Model-based Design and evaluation Design -Case Studies.	6
II	Guidelines in HCI, Empirical research methods in HCI & Task modeling and analysis	7
III	Dialog Design, Cognitive architecture, Object Oriented Programming code sample for brain machine interface & Design -Case Studies.	7
IV	Relating neural activity and perception, Mechanisms of electrical stimulation, application to retinal prosthetics, Novel methods for neural interface & Intracortical prostheses for communication.	7
V	Introduction, Components and signals, Electrodes, Bio signal amplifier, Real-time processing environment, Motor imagery, P300 spelling device, SSVEP, Accuracies achieved with different BCI principles, Applications-twitter, second life, smart home control with BCI.	7

Text Books	1.	Brain-Computer Interface: An Introduction By Rajesh P.N.Rao Publisher:Cambridge University Press,ISBN:9781139032803 DOI:https://doi.org/10.1017/CBO9781139032803
	2.	Theodre Berger W, John k Chapin et all, "Brain computer interfaces, An International assessment of research and developmental trends", Springer.
	3.	Brain-Computer Interfaces,1st Edition - March 10, 2020, Editors: Nick F. Ramsey, José del R. Millán,Hardcover ISBN: 9780444639349, eBook ISBN: 9780444639332, View series: Handbook of Clinical Neurology
	4.	Reza Fazel-Rezai, "Recent Advances in Brain-Computer Interface Systems",Intech Publications.
Reference Books	1.	Brain-Computer Interface Research, eBook | A State-of-the-Art Summary 6 · By Christoph Guger
	2.	Guido Dornhege, "Toward brain-computer interfacing", MIT Press.
	3.	Signal Processing and Machine Learning for Brain-Machine Interfaces, Publication ,Pages: 360 ISBN-13: 978-1-78561-398-2, Format: HBK, Editors: Toshihisa Tanaka, Mahnaz Arvaneh

Course Title: Cyber Security										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC4	3	1	--	4	10	15	50	--	--
Course Code	23BTAIL406									
Teaching Mode	Offline	4			Total	75			--	
Duration of ESE	2.5 hrs					75				

Course Objectives	1. To introduce an advanced element of learning in the field of wireless communication.
	2. To learn about the concepts and principles of mobile computing.
	3. To understand concept of mobile adhoc network.
Course Outcomes	CO1: Understand different types of cyber crimes
	CO2: Apply various cyber security components
	CO3: Analyze the security challenges presented by mobile devices and information systems access in the cybercrime world.
	CO4 Evaluate different tools and methods used in cyber crime
	CO5: Deploy the different Security polices and standards.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	Introduction to Cyber Security, introduction to cybercrime, Reasons of cybercrime, History of cybercrime, Types of cyber crime	5
II	Cyber security components – OSI Layer, Zero-day attacks, Types of network attacks, Application security, end point security, Mobile security, data security, Infrastructure security.	8
III	Fighting cyber-attacks-Authentication, cryptography, firewall, Data loss prevention, Web browsers, Data backup, Cybercrime- Mobile and wireless devices.	8
IV	Tools and methods used in cybercrime-, password cracking, key loggers and spywares, DoS and DDoS attacks, SQL injections, Attacks on wireless networks, Phishing and identity thefts.	8
V	Security issues in Hardware, Security polices and standards.	5

Text Books	1	Introduction to Cyber Security: Guide to the World of Cyber Security, Anand Shinde.
	2	Fundamental Of Cyber Security: Principles, Theory and Practices By Mayank Bhusan, Rajkumar Singh Rathore, Aatif Jamshed.
	3	Cyber Security by Nina Godbole, Sunit Belapure, Wiley India.
Reference Books	1	Cyber security essentials by Charles J. Brooks, Christopher Grow, Philip A. Craig.

Course Title: Pervasive Computing

Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC4	3	1	--	4	10	15	50	--	--
Course Code	23BTAIL407									
Teaching Mode	Offline	4			Total	75			--	
Duration of ESE	2.5 hrs					75				

Course Objectives	1. To introduce pervasive computing abilities.
	2. To introduce tools and techniques used while solving problems using pervasive computing.
	3. To study algorithmic examples in distributed, concurrent and parallel.
Course Outcomes	CO1: Understand survey on pervasive computing building blocks.
	CO2: Apply pervasive computing techniques.
	CO3: Analyze problems for multi-core or distributed, concurrent/Parallel environments
	CO4: Evaluate Middleware for Pervasive Computing
	CO5: Implement Security and Privacy in Pervasive Networks.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	**UNIT I: Introduction:** Distributed Computing Concept, Mobile and Pervasive Computing, Wearable Computing, Properties of Pervasive Computing, Challenges and Technology of Pervasive Computing.	8
II	**UNIT II**: **Pervasive Computing Devices:** Smart Environment: CPI and CCI, Smart Devices: Application and Requirements, Device Technology and Connectivity, Middleware for Pervasive Computing Systems, Pervasive Computing Environments.	7
III	**UNIT III: HCI (Human Computer Interaction):** HCI Service and Interaction Migration, Context-Driven HCI Service Selection, Scenario Study: Video Calls at a Smart Office, and A Web Service–Based HCI Migration Framework are all examples of HCI interfaces in pervasive environments.	7
IV	**UNIT IV: Middleware for Pervasive Computing:** Adaptive middleware, Context aware middleware, Mobile middleware, Service Discovery, Mobile Agents.	7
V	**UNIT V: Security in Pervasive Computing:** Security and Privacy in Pervasive Networks, Experimental Comparison of Collaborative Defense Strategies for Network Security	7

Text Books	1	Stefan Poslad, Ubiquitous Computing, Smart devices, environment and interaction, Wiley.
	2	Frank Adelstein, Sandeep Gupta, Golden Richard III, Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, Tata McGraw Hills
Reference Books	1	Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtorff, Thomas Schaeck, Pervasive Computing, Pearson, Eighteenth Impression, 2014.
	2	BoS Content: Books, Course Notes, Digital contents, Blogs developed by the BoS for bridging the gaps in the syllabus, problem solving approaches and advances in the course

Course Title: **Information Retrieval**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC4	3	1	--	4	10	15	50	--	--
Course Code	23BTAIL408									
Teaching Mode	Offline	4			Total	75			--	
Duration of ESE	2.5 hrs					75				

Course Objectives	Learn and understand Information retrieval concepts, methods and techniques
	Learn and understand the underlying principle of information retrieval for its usage in various applications.
Course Outcomes	CO1: Understand an overview of Information Retrieval
	CO2: Apply various Information Retrieval Models and Techniques.
	CO3: Analyze various evaluation models.
	CO4: Evaluate the concept of probabilistic approach to IR
	CO5: Implement text classification and feature selection

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

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Course Contents:

Unit	Contents	Hours
I	**Fundamentals of Information Retrieval:** Introduction to Information Retrieval, information retrieval problem, inverted index data structure, Boolean retrieval model, Boolean queries	6
II	**Vocabulary and postings lists:** Document delineation and character sequence decoding, Tokenization, Stop Words, Normalization, Stemming, Skip Points, Biword indexes, Positional indexes and their combination schemes. **Dictionary and Tolerant Retrieval:** Search structures for dictionaries, Wild card queries, Permuterm indexes, Spelling correction & Edit distance	7
III	**Evaluation:** Precision, Recall, F measures, MAP, R Precision, ROC Curve, Pooling, Kappa Statistics **Relevance feedback and query expansion:** Relevance feedback, The Rocchio algorithm, Probabilistic relevance feedback, Global methods for query reformulation	7
IV	**XML retrieval:** Basic concepts & challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval. **Probabilistic information retrieval:** Review of basic probability theory, The Probability Ranking Principle, The Binary Independence Model, Bayesian network approaches to IR	7
V	**Text classification and Naive Bayes:** The text classification problem, Naive Bayes text classification, The Bernoulli model **Feature selection:** Mutual information, $\chi 2$ Feature selection, Frequency- based feature selection, Feature selection for multiple classifiers, Comparison of feature selection methods	7

Text Books	1	**Introduction to Information Retrieval** by Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Cambridge University Press, Cambridge, England
	2	**Modern Information Retrieval**, By Baeza-Yates Ricardo, Yates, Pearson Education
Reference Books	1	**Information Retrieval Implementing and Evaluating Search Engines**, By Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormack, MIT Press
	2	**Information Retrieval Algorithms and Heuristics**, By David A. Grossman, Ophir Frieder, Springer

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Syllabus of MDM3 :V SEMESTER

Course Title: **Integrating Database Management Systems with AI**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MDM3	3	-	1		10	15	50	25	--
Course Code	23BTCSL302AI 23BTCSP302AI									
Teaching Mode	Offline	4			Total	75			25	
Duration of ESE	3 hrs					100				

Course Objectives	To provide strong foundations in relational and non-relational database systems for modern AI/ML applications.
	To develop skills in designing, querying, optimizing, and managing databases using SQL, NoSQL, and vector databases.
	To integrate Python programming with databases for AI workflows, data preprocessing, analytics, and machine learning pipelines.
	To understand how large-scale data storage, data engineering, and database optimization support AI model training and deployment.
	To enable students to build intelligent applications using DBMS concepts, AI frameworks, APIs, and cloud-based data systems.
Course Outcomes	**CO1:** Design relational and NoSQL databases suitable for AI/ML and data-intensive applications.
	CO2: Develop Python-based applications that connect databases with AI/ML frameworks and workflows.
	CO3: Apply SQL, indexing, transactions, and query optimization techniques for efficient AI data processing.
	CO4: Build AI-enabled data pipelines using modern database technologies including vector databases and cloud databases.
	CO5: Implement mini-projects integrating DBMS, machine learning models, APIs, and intelligent analytics systems.

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	1	1					1	3	2
CO2	3	3	3	3	3	2	2	1	2	2		1	3	2
CO3	3	3	3	3	3	2	2	2	1	2	2	2	3	3
CO4	3	3	3	3	3	2		2	2	1	2	2	3	3
CO5	3	3	3	3	3	2				2	1	2	3	3

Course Contents:

Unit	Contents	Hours
I	**Fundamentals of DBMS and SQL:** Introduction to DBMS, Database Architecture and Data Models, ER Model and Relational Model, Database Design Basics, SQL Fundamentals: DDL, DML, DCL, Joins, Views, Constraints, Normalization (1NF, 2NF, 3NF) and Introduction to Database Security.	8
II	**Advanced Databases for AI Applications:** Transactions and Concurrency Basics, Query Processing and Indexing, Introduction to NoSQL Databases, MongoDB Basics, Introduction to Vector Databases, AI/ML Data Storage Requirements and Overview of Distributed Databases.	8
III	**Python and Database Integration:** Python Database Connectivity, SQL Alchemy Basics, Data Handling using Pandas, Data Cleaning and Preprocessing, Reading/Writing Database Data using Python and Introduction to APIs and Data Collection.	8
IV	**AI/ML Workflows using Databases:** Databases in Machine Learning Pipelines, Feature Engineering Basics, Data Preparation for ML Models, Integration with Scikit-Learn, Introduction to AI Workflows, Retrieval-Augmented Generation (RAG) Basics and Cloud Database Overview	8
V	**Emerging Trends and Mini Project:** Big Data and AI Overview, Introduction to Hadoop and Spark, Database Security and Ethics in AI, AI Applications using Databases, Case Studies and Industrial Applications and Mini Project.	6

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Text Books	1.	Abraham Silberschatz, Henry Korth, S. Sudarshan — Database System Concepts
	2.	Raghu Ramakrishnan — Database Management Systems
	3.	Aurélien Géron — Hands-On Machine Learning with Scikit-Learn and TensorFlow
Reference Books	1.	Jiawei Han — Data Mining Concepts and Techniques
	2.	Martin Kleppmann — Designing Data-Intensive Applications
	3.	https://www.db-book.com/

Practical List:

1. SQL Query Design and Optimization.
2. Database Normalization Exercises.
3. MongoDB and NoSQL Operations.
4. Python-MySQL Connectivity.
5. Pandas-based Data Cleaning.
6. Machine Learning using Database Data.
7. Vector Database Implementation.
8. Building a RAG-based AI Retrieval System.
9. ETL Pipeline Development.
10. AI Mini Project with Database Backend.

Multidisciplinary Minor – 5

Course Title: **Introduction to Wireless Sensor Network (Multidisciplinary Minor – 5)**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MDM5	4	-	-	4	10	15	50	-	-
Course Code	23BTECL 410AI									
Teaching Mode	Offline	4			TOTAL	75			___	
Duration of ESE	3 Hrs.					75				
Course Objectives	To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.									
	To study the various protocols at various layers and its differences with traditional protocols.									
	To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.									
Course Outcomes	Upon successful completion of this course, student will be able to:									
	CO-1: Understand the fundamentals, architecture, and applications of Wireless Sensor Networks									
	CO-2: Analyze wireless communication principles and standard protocols relevant to WSN									
	CO-3: Compare and evaluate routing protocols for efficient data delivery in WSN.									
	CO-4: Apply energy management, data aggregation, and network planning techniques for WSN design.									
	CO-5: Identify security issues in WSN and explore modern trends, applications, and simulation tools.									

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	1	1	1	–	–	–	–	2	–	2	3	1	0
CO2	2	3	1	2	2	–	–	–	–	2	–	2	2	1	0
CO3	2	3	3	2	2	–	–	–	–	2	–	3	3	2	1
CO4	2	3	3	3	3	–	–	–	1	2	–	3	3	2	2
CO5	2	2	2	2	2	–	1	1	–	2	–	3	2	2	2

Course Contents:

Unit	Contents	Hours
I	**Basics of Wireless Sensor Networks** Introduction to Wireless Sensor Networks (WSN), Real-life applications, Advantages and challenges, Basic parts of a sensor node: sensing, processing, communication, power, and Different types of sensors, Key design issues: energy, reliability, And scalability, Common network topologies: star, tree, mesh.	8
II	**Wireless Communication in WSN** Basics of radio signals and wireless communication, Need for MAC protocols Energy-saving MAC protocols: S-MAC, T-MAC, B-MAC, and introduction to IEEE 802.15.4, Communication challenges: interference, poor links, and timing issues.	8
III	**Routing in WSN** Need of routing in WSN, Flat vs. hierarchical routing, Basic routing techniques: Flooding, Gossiping, SPIN, Common routing protocols: Directed Diffusion, PEGASIS etc., Location-based routing.	8
IV	**Data & Power Management** Data aggregation and fusion, Clustering and cluster-head selection, Power-saving methods: duty cycling, sleep scheduling, Introduction to mobile WSN, Memory and storage management in sensor nodes.	8
V	**Applications, Security & Future Trends** Popular application areas: environment, farming, health, home automation, industries, smart cities, Basic security needs: confidentiality, integrity, authentication, Common attacks: jamming, spoofing, Sybil, sinkhole, denial of sleep, Simulation tools: NS-3, Contiki/Cooja, MATLAB Future trends: energy-harvesting sensors, underwater WSN (UWSN), AI in WSN.	8

Text Books	1.	Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley.
	2.	Holger Karl & Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley.
Reference Books	1.	C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education - 2008.
	2.	Feng Zhao and Leonides Guibas, "Wireless sensor networks", Elsevier publication - 2004.
	3.	Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition, 2003.
	4.	William Stallings, "Wireless Communications and Networks ", Pearson Education - 2004

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MDM: V Syllabus

Course Title: **Introduction to Responsible AI**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	T u	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MDM5	4Hrs	--		4	10	15	50		
Course Code	23BTAIL409XX									
Teaching Mode	Offline	3 Hrs			Total	75				
Duration of ESE	3 Hrs					75				

Course Objectives	**Fairness**: Ensuring AI systems treat all individuals and groups fairly, avoiding biases that co uld lead to discrimination.
	Transparency: Making AI systems understandable and explainable, allowing users to under stand how decisions are made.
	Accountability in the context of AI means putting in place a system of checks and balances to guarantee that someone will always be in charge of the choices and results.
	Privacy and Security AI systems work with **private and classified data**.
	Reliability: Preparing AI systems to function consistently as anticipated in any situation is the goal of the reliability aspect.
Course Outcomes	**CO1:** Understand the fundamental concepts of Responsible AI, including autonomy, adaptability, and interaction.
	CO2: Apply various models and tools for interpreting AI systems, including LIME, SHAP, and ELI5.
	CO3: Analyze ethical reasoning approaches to AI system design and implementation, considering the ethical status of AI systems and relevant guidelines like GDPR and HIPAA.
	CO4: Evaluate methods and metrics for identifying and mitigating bias in AI systems, using case studies such as the COMPAS case.
	CO5: Design strategies for improving fairness and standardization in AI, focusing on data pipelines and ethical AI deployment.

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Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	3	3	2	--	--	--	--	--	--	--	1	-
CO2	1	3	3	3	3	--	--	--	--	--	--	--	1	-
CO3	1	3	3	3	3	--	--	--	--	--	3	3	2	2
CO4	1	3	3	3	3	1	1	--	--	--	3	3	2	2
CO5	2	3	3	3	3	1	1	--	--	--	3	3	2	2

Course Contents:

Unit	Contents	Hours
I	**UNIT I: Introduction** Introduction to Responsible AI, The Background of AI, Autonomy, Adaptability, Interaction. Introduction to Responsible Generative AI. Application of Responsible AI.	**6**
II	**UNIT II: Introduction to Explainable AI**: Transparency, Interpretability in Intelligent Systems, Models for Interpreting AI Systems, explaining decisions of AI Systems, Evaluating Interpretability and Explanation. Application of Explainable AI. Tools of explainable AI like LIME & SHAP. Introduction to Responsible Research and Innovation, The ART of AI- Accountability, Responsibility & Transparency.	**10**
III	**UNIT III: Ethics in Responsible AI** Can AI Systems Be Ethical: Introduction, introduction to ethical action, ethical reasoning approaches by AI Designing Artificial Moral Agents. Ensuring Responsible AI in Practice: Introduction, Governance for Responsible AI, Codes of Conduct, Inclusion and Diversity, The AI Narrative, AI and Society, The Ethical Status of AI Systems.	**10**
IV	**UNIT IV: Bias & Fairness in AI** Bias and its type, fairness, metrics for bias, COMPAS case study and code walk through of bias matrices.	**9**
V	**UNIT V: Privacy preserving AI techniques** Privacy, Securing Federated Learning with Differential Privacy, Homomorphic Encryption Understanding techniques of privacy Preserving ML.	**9**

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Text Books	**1.**	Virginia Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer Nature Switzerland AG 2019, ISBN 978-3-030-30370-9
	2.	Bernd Carsten Stahl, Artificial Intelligence for a Better Future An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies, Springer Nature, ISBN 978-3-030-69977-2
	3.	Practical Explainable AI using python By Pradeep Mishra.
Reference Books	**1.**	Steven John Thompson, Machine Law, Ethics, and Morality in the Age of Artificial Intelligence, IGI Global, ISBN 9781799867982
	2.	Joachim von Braun, Margaret S. Archer Gregory M. Reichberg, Marcelo Sánchez Sorondo, Robotics, AI, and Humanity, Springer Nature Switzerland AGISBN 978-3-030-54172-9
	3	Responsible Machine Learning by Patrick Hall
online TL Material	**1.**	https://www.microsoft.com/en-us/ai/responsible-ai?activetab=pivot1%3aprimaryr6