



**Prof. Ram Meghe Institute Of Technology
And Research Badnera -Amravati**

**An Autonomous Institute Affiliated to
Sant Gadge Baba Amravati University,
Amravati, Maharashtra (India)**

**PROGRAMME SCHEME & SYLLABI
2023-2024**

**B.Tech (Artificial Intelligence and
Data Science)**

(V1.0)



**Prof. Ram Meghe Institute Of Technology And Research,
Badnera - Amravati.**

**Published By
Principal**

Prof. Ram Meghe Institute of Technology and Research, Badnera - Amravati

Prof. Ram Meghe Institute of Technology and Research, Badnera-Amravati
(An Autonomous Institute)
Four Year Under Graduate Degree Program in Bachelor of Technology
Choice Based Credit System (Semester Pattern)
Branch : Artificial Intelligence (AI) and Data Science

SEMESTER: I																		
Sr. No.	Course Code	Course Name	Teaching Scheme						Examination Scheme									
			Hours/ Week			Group	Total Hours/ Week	Credits	THEORY						PRACTICAL			
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	internal Marks		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.		
Theory																		
1	1SF01	Applied Mathematics - I	3			BSC	3	3	3	60	30	10	100	40				
2	1SF02	Applied Physics	3			BSC	3	3	3	60	30	10	100	40				
3	1SF03	Engineering Graphics	2			ESC	2	2	3	60	30	10	100	40				
4	1SF04	Programming for Problem Solving	2			ESC	2	2	3	60	30	10	100	40				
5	1SF05	Professional Communication Skills	1	1		HSSM	2	2	3	60	30	10	100	40				
6	1SAKN01	Multimedia and Web Designing	3			ESC	3	3	3	60	30	10	100	40				
7	1SF06	Design Thinking *	1			ESC	1	1				50	50	25				
Practicals																		
08	1SF07	Applied Physics Lab			2	BSC	2	1							25	25	50	25
09	1SF08	Engineering Graphics Lab			2	VSEC	2	1							25	25	50	25
10	1SF09	Programming for Problem Solving Lab			2	ESC	2	1							25	25	50	25
11	1SAKN02	Multimedia and Web Designing Lab			2	ESC	2	1							25	25	50	25
12	1SF10	NSS/Sports/Yoga/Cultural/Community Service **			2	LLC	2	1							50		50	25
Total			15	1	10		26	21					650				250	
															Total		900	

* Assessment will be based on Unit Tests, Assignments and Case Studies

** Assessment will be based on participation in associated activities of not less than 30 hours

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SEMESTER: II																			
Sr. No.	Course Code	Course Name	Teaching Scheme						Examination Scheme										
			Hours/ Week			Group	Total Hours/ Week	Credits	THEORY						PRACTICAL				
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal Marks		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks	
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.			
Theory																			
01	2SF01	Applied Mathematics - II	3			BSC	3	3	3	60	30	10	100	40					
02	2SF02	Applied Chemistry	3			BSC	3	3	3	60	30	10	100	40					
03	2SF03	Basics of Electrical Engineering	2			ESC	2	2	3	60	30	10	100	40					
04	2SF04	Biology for Engineers	2			BSC	2	2	3	60	30	10	100	40					
05	2SF05	Universal Human Values	2			HSSM	2	2	3	60	30	10	100	40					
06	2SAEKNT01	Introduction to Python	3			ESC	3	3	3	60	30	10	100	40					
07	2SF06	Indian Knowledge Systems *	2			HSSM	2	2				50	50	25					
Practicals																			
08	2SF07	Applied Chemistry Lab			2	BSC	2	1							25	25	50	25	
09	2SF08	Basic of Electrical Engineering Lab			2	ESC	2	1							25	25	50	25	
10	2SAEKNT02	Introduction to Python Lab			2	ESC	2	1							25	25	50	25	
11	2SF09	Workshop/Digital Fabrication Lab			2	VSEC	2	1							25	25	50	25	
Total			17		8		25	21					650				200		
																Total	850		

* Assessment will be based on Unit Tests and Assignments

Exit Option: To qualify for UG Certificate in Artificial Intelligence and Data Science

Title	Credit
1. Two relevant MOOC/NPTEL courses as decided by BOS	4
AND	
1. Internship (Min 60 hrs)	4

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Branch : Artificial Intelligence (AI) and Data Science

SEMESTER: III																			
Sr. No.	Course Code	Course Name	Teaching Scheme						Examination Scheme										
			Hours/ Week			Group	Total Hours / Week	Credits	THEORY						PRACTICAL				
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks	
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.			
Theory																			
01	3SA01	Discrete Mathematics	2			PCC	2	2	3	60	30	10	100	40					
02	3SA02	Data Structures	3			PCC	3	3	3	60	30	10	100	40					
03	3SA03	Programming Methodology	2			PCC	2	2	3	60	30	10	100	40					
04	3SA04	Analog and Digital Electronics	2			PCC	2	2	3	60	30	10	100	40					
05	3SAOE1	Open Elective Course - 1 (OE - 1)	3			OE	3	3	3	60	30	10	100	40					
06	3SA05	Financial Literacy*	2			EEMC	2	2	--	--	--	50	50	25					
07	3SA06	Environmental Science*	2			VEC	2	2	--	--	--	50	50	25					
Practicals																			
08	3SA07	Data Structures Lab			2	PCC	2	1							25	25	50	25	
09	3SA08	Programming Methodology Lab			2	PCC	2	1							25	25	50	25	
10	3SA09	Analog and Digital Electronics Lab			2	PCC	2	1							25	25	50	25	
11	3SA10	CEP/FP: Innovation and Creativity			4	ELC	4	2							25	25	50	25	
Total			16		10		26	21					600				200		
																Total		800	

* Assessment will be based on Unit Tests, Assignments and Teacher assessment during the semester.

Open Elective Course-1: (i) 3SAOE1A Social Science (ii) 3SAOE1B Ancient Management Paradigms (iii) 3SAOE1C Introduction to Constitutional Law

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SEMESTER: IV																			
Sr. No.	Course Code	Course Name	Teaching Scheme						Examination Scheme										
			Hours/ Week			Group	Total Hours / Week	Credits	THEORY						PRACTICAL				
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks	
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.			
Theory																			
01	4SA01	Artificial Intelligence	3			PCC	3	3	3	60	30	10	100	40					
02	4SA02	Operating Systems	3			PCC	3	3	3	60	30	10	100	40					
03	4SA03	Theory of Computation	3			PCC	3	3	3	60	30	10	100	40					
04	MDM1	Multidisciplinary Minor - 1 (MDM - 1)	3			MDM	3	3	3	60	30	10	100	40					
05	4SAOE2	Open Elective Course - 2 (OE - 2)	3			OE	3	3	3	60	30	10	100	40					
06	4SA04	Business Communication*	2			AEC	2	2	--	--	--	50	50	25					
07	4SA05	Entrepreneurship and Start-ups*	2			EEMC	2	2	--	--	--	50	50	25					
Practicals																			
08	4SA06	Artificial Intelligence Lab			2	PCC	2	1							25	25	50	25	
09	4SA07	Operating Systems Lab			2	PCC	2	1							25	25	50	25	
10	4SA08	Computer Skill Laboratory - 1			2	PCC	2	1							25	25	50	25	
11	4SA09	Report Writing and Presentation Skill			4	VSEC	4	2							50	--	50	25	
Total			19		10		29	24					600				200		
																Total	800		

* Assessment will be based on Unit Tests and Assignments.

Open Elective Course - 2: (i) 4SAOE2A Intellectual Property Right (ii) 4SAOE2B Introduction to Cyber Law (iii) 4SAOE2C Stress Management

Exit Option: To qualify for Diploma in Artificial Intelligence and Data Science

Title	Credit
Two relevant MOOC/NPTEL courses as decided by BOS	4
AND	
Internship (Min 60 hrs)	4

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SEMESTER: V																		
Sr. No.	Course Code	Course Name	Teaching Scheme						Examination Scheme									
			Hours/ Week			Group	Total Hours / Week	Credits	THEORY						PRACTICAL			
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
						Max. Marks MSE/ MSIE	Max. Marks TA	Int.	Ext.									
Theory																		
01	5SA01	Data Analytics and Visualization	3			PCC	3	3	3	60	30	10	100	40				
02	5SA02	Computer Network	3			PCC	3	3	3	60	30	10	100	40				
03	5SA03	Compiler Design	3			PCC	3	3	3	60	30	10	100	40				
04	5SA04	Programme Elective Course - 1 (PEC - 1)	3			PEC	3	3	3	60	30	10	100	40				
05	MDM2	Multidisciplinary Minor - 2 (MDM - 2)	3			MDM	3	3	3	60	30	10	100	40				
06	5SAOE3	Open Elective Course - 3 (OE - 3)	3			OE	3	3	3	60	30	10	100	40				
Practicals																		
07	5SA05	Data Analytics and Visualization Lab			2	PCC	2	1							25	25	50	25
08	5SA06	Computer Network Lab			2	PCC	2	1							25	25	50	25
09	5SA07	Compiler Design Lab			2	PCC	2	1							25	25	50	25
10	5SA08	Computer Skill Laboratory - 2			2	PEC	2	1							25	25	50	25
Total			18		8		26	22					600				200	
															Total		800	

PEC - 1 : (i) 5SA04PE1A Data and Internet Security (ii) 5SA04PE1B Probability and Statistics (iii) 5SA04PE1C Expert System Design

Open Elective Course - 3: (i) 5SAOE3B Business Intelligence (ii) 5SAOE3C Project Management (iii) 5SAOE3D Aptitude for Engineers

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SEMESTER: VI																		
Sr. No.	Course Code	Course Name	Teaching Scheme						Examination Scheme									
			Hours/ Week			Group	Total Hours / Week	Credits	THEORY						PRACTICAL			
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.		
Theory																		
01	6SA01	Data Science	3			PCC	3	3	3	60	30	10	100	40				
02	6SA02	Design and Analysis of Algorithms	3			PCC	3	3	3	60	30	10	100	40				
03	6SA03	Database Management Systems	2			PCC	2	2	3	60	30	10	100	40				
04	6SA04	Programme Elective Course - 2 (PEC - 2)	3			PEC	3	3	3	60	30	10	100	40				
05	6SA05	Programme Elective Course - 3 (PEC - 3)	3			PEC	3	3	3	60	30	10	100	40				
06	MDM3	Multidisciplinary Minor - 3 (MDM - 3)	3			MDM	3	3	3	60	30	10	100	40				
07	6SDMP	Disaster Management and Preparedness	2			VEC	2											
Practicals																		
07	6SA06	Data Science Lab			2	PCC	2	1							25	25	50	25
08	6SA07	Design and Analysis of Algorithms Lab			2	PCC	2	1							25	25	50	25
09	6SA08	Database Management Systems Lab			2	PCC	2	1							25	25	50	25
10	6SA09	Computer Skill Laboratory - 3			4	VSEC	4	2							25	25	50	25
Total			19		10		29	22					600				200	
															Total		800	

PEC - 2 : (i) 6SA04PE2A Cyber Security (ii) 6SA04PE2B Programming with Large Dataset (iii) 6SA04PE2C Applied Artificial Intelligence

PEC - 3 : (i) 6SA05PE3A Network Security (ii) 6SA05PE3B Data Mining and Data Warehousing (iii) 6SA05PE3C Artificial Neural Network

Exit Option: To qualify for B. Voc. (Artificial Intelligence and Data Science)

Title	Credit
Two relevant MOOC/NPTEL courses as decided by BOS	4
AND	
Internship (Min 60 hrs)	4

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SEMESTER: VII																		
Sr. No.	Course Code	Course Name	Teaching Scheme						Examination Scheme									
			Hours/ Week			Group	Total Hours / Week	Credits	THEORY						PRACTICAL			
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.		
Theory																		
01	7SA01	Cloud Computing	2			PCC	2	2	3	60	30	10	100	40				
02	7SA02	Machine Learning	3			PCC	3	3	3	60	30	10	100	40				
03	7SA03	Programme Elective Course - 4 (PEC - 4)	3			PEC	3	3	3	60	30	10	100	40				
04	7SA04	Programme Elective Course - 5 (PEC - 5)	2			PEC	2	2	3	60	30	10	100	40				
05	MDM4	Multidisciplinary Minor - 4 (MDM - 4)	3			MDM	3	3	3	60	30	10	100	40				
Practicals																		
06	7SA05	Machine Learning Lab			2	PCC	2	1							25	25	50	25
07	7SA06	Computer Skill Laboratory - 4			2	PEC	2	1							25	25	50	25
08	7SA07	Research Methodology			4	ELC	4	2							50	--	50	25
09	7SA08	Project			12	ELC	12	6							100	100	200	100
Total			13		20		33	23					500				350	
															Total		850	

PEC - 4: (i) 7SA03PE4A Cryptography (ii) 7SA03PE4B Big Data Analytics and Hadoop (iii) 7SA03PE4C Generative Artificial Intelligence

PEC - 5: (i) 7SA04PE5A Digital Forensic (ii) 7SA04PE5B Natural Language Processing (iii) 7SA04PE5C Blockchain with AI

7SA07 Research Methodology: Assessment will be in Two parts. 1) Practical Work and Evaluation (25 Marks) and 2) Seminar Report Preparation and Presentation (25 Marks).

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SEMESTER: VIII																		
Sr. No.	Course Code	Course Name	Teaching Scheme						Examination Scheme									
			Hours/ Week			Group	Total Hours / Week	Credits	THEORY						PRACTICAL			
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
											Max. Marks INTERNAL ASSESSMENT	Max. Marks TA			Int.	Ext.		
Theory																		
01	8SA01	Deep Learning	3			PCC	3	3	3	60	30	10	100	40				
02	8SA02	Programme Elective Course - 6 (PEC - 6)	3			PEC	3	3	3	60	30	10	100	40				
Practical																		
03	8SA03	Internship / On Job Training (OJT) / Apprenticeship			24	ELC	24	12							150	150	300	150
Total			6		24		30	18					200				300	
															Total		500	

PEC - 6 : (i) 8SA02PE6A Basics of Ethical Hacking (ii) 8SA02PE6B Ethics in Data Science (iii) 8SA02PE6C Safe and Responsible use of AI

** Internal Assessment Marks (Total 30 Marks) will be calculated on the basis of MCQ Test Online (15 Marks) UNIT-1 and UNIT-2 and Case Study (15 Marks) based on subject's syllabus*

Sem	SEM I	SEM II	SEM III	SEM IV	SEM V	SEM VI	SEM VII	SEM VIII	Total
Credits	21	21	21	24	22	22	23	18	172

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HONORS																		
SEMESTER	Course Code	Course Name	Teaching Scheme						Examination Scheme									
			Hours/ Week			Group	Total Hours / Week	Credits	THEORY						PRACTICAL			
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.		
Theory																		
IV	4SAH	Advanced Programming for Data Science	3	-	-	Honors	3	3	3	60	30	10	100	40	-	-	-	-
V	5SAH	Advanced Data Science and Analytics	3	-	-	Honors	3	3	3	60	30	10	100	40	-	-	-	-
VI	6SAH	Business and Web Analytics	3	-	-	Honors	3	3	3	60	30	10	100	40	-	-	-	-
VII	7SAH	Data Engineering	3	-	-	Honors	3	3	3	60	30	10	100	40	-	-	-	-
VIII	8SAH1	Deep Learning and its Applications	3	-	-	Honors	3	3	3	60	30	10	100	40	-	-	-	-
Practicals																		
VIII	8SAH2	Minor Project	-	-	6	Honor	6	3	-	-	-	-	-	-	50	50	100	50
Total			15		6		21	18					500				100	
															Total		600	

***MDM BASKETS OF COURSES FOR ALL Departments**

MDM Basket/ Track Name	Sr. No.	Course Code	Course Name	Semester	Students from following Departments can Register	Offered by Department of
Artificial Intelligence	1	4SAMDM1	Artificial Intelligence and Expert Systems	IV	CE, CSE, EXTC, IT, IIoT, ME	Artificial Intelligence and Data Science
	2	5SAMDM2	Applied Artificial Intelligence	V		
	3	6SAMDM3	Generative Artificial Intelligence	VI		
	4	7SAMDM4	Safe and Responsible Artificial Intelligence Systems	VII		
Data Science	1	4SAMDM5	Programming for Data Science	IV	CE, CSE, EXTC, IT, IIoT, ME	
	2	5SAMDM6	Business Intelligence and Analytics	V		
	3	6SAMDM7	Data Engineering	VI		
	4	7SAMDM8	Ethics in Data Science	VII		
Civil Engineering	1	4SCMDM1	Introduction to Environmental Engineering	IV	AI&DS, CSE, EXTC, IT, IIoT, ME	Civil Engineering
	2	5SCMDM2	Introduction to Water Resource Engineering	V		
	3	6SCMDM3	Introduction to Transportation Engineering	VI		
	4	7SCMDM4	Basics of Structural Analysis	VII		
Construction Technology	1	4SCMDM5	Building Planning	IV	AI&DS, CSE, EXTC, IT, IIoT, ME	
	2	5SCMDM6	Construction Materials	V		
	3	6SCMDM7	Basics of Surveying	VI		
	4	7SCMDM8	Basics of Geotechnical Engineering	VII		
Computer Science and Engineering	1	4SKMDM1	Fundamentals of Data Structures	IV	CE, EXTC, IIoT, ME	Computer Science and Engineering
	2	5SKMDM2	Introduction to Algorithms	V		
	3	6SKMDM3	Database Management System	VI		
	4	7SKMDM4	Basics of Enterprise Resource Planning	VII		

*** indicates that the Track for MDM will be decided by respective Board of Studies (BoS)**

***MDM BASKETS OF COURSES FOR ALL Departments**

MDM Basket/ Track Name	Sr. No.	Course Code	Course Name	Semester	Students from following Departments can Register	Offered by Department of	
Software Engineering	1	4SKMDM5	Software Requirements Engineering	IV	AI&DS, CE, EXTC, IT, IIoT, ME	Computer Science and Engineering	
	2	5SKMDM6	Software Architecture	V			
	3	6SKMDM7	Software Project Management	VI			
	4	7SKMDM8	Software Testing and Quality Assurance	VII			
Electronics and Communication Engineering	1	4SEMMDM1	Electronic Instrumentation	IV	AI&DS, CE, CSE, IT, IIoT, ME	Electronics and Telecommunication Engineering	
	2	5SEMMDM2	Electronic Devices and Circuits	V			
	3	6SEMMDM3	Analog and Digital Communication	VI			
	4	7SEMMDM4	Electronic Circuit Design	VII			
Telecommunicatio n Engineering	1	4SEMMDM5	Basic Electronic Communication Systems	IV	AI&DS, CE, CSE, IT, ME		
	2	5SEMMDM6	Introduction to Wireless Communication	V			
	3	6SEMMDM7	Introduction to Mobile Computing	VI			
	4	7SEMMDM8	Satellite and Optic Fiber Communication	VII			
Information Technology	1	4SNMDM1	Data Transmission and Information Technology	IV	AI&DS, CE, CSE, EXTC, IIoT, ME	Information Technology	
	2	5SNMDM2	Data Communication Networks	V			
	3	6SNMDM3	E-Commerce	VI			
	4	7SNMDM4	Management Information Systems	VII			
Cyber Security	1	4SNMDM5	Introduction to Cyber Security	IV	CE, EXTC, IIoT, ME		
	2	5SNMDM6	Fundamentals of Cryptography	V			
	3	6SNMDM7	Basics of Ethical Hacking	VI			
	4	7SNMDM8	Blockchain Technology	VII			

*** indicates that the Track for MDM will be decided by respective Board of Studies (BoS)**

***MDM BASKETS OF COURSES FOR ALL Departments**

MDM Basket/ Track Name	Sr. No.	Course Code	Course Name	Semester	Students from following Departments can Register	Offered by Department of	
IoT	1	4STMDM1	Fundamentals of IoT	IV	AI&DS, CE, CSE, EXTC, IT, ME	Industrial IoT	
	2	5STMDM2	Sensors and Actuators	V			
	3	6STMDM3	Single Board Computers	VI			
	4	7STMDM4	Industrial Internet of Things	VII			
Mechanical Engineering	1	4SMMDM1	Energy Engineering	IV	AI&DS, CE, CSE, EXTC, IT, IIoT	Mechanical Engineering	
	2	5SMMDM2	Automobile Engineering and Electric Vehicles	V			
	3	6SMMDM3	Industrial Engineering	VI			
	4	7SMMDM4	Industrial Automation	VII			
Robotics and Automation Engineering	1	4SMMDM5	Mechatronics	IV	AI&DS, CE, CSE, EXTC, IT, IIoT		
	2	5SMMDM6	Rapid Prototyping	V			
	3	6SMMDM7	Automation Engineering	VI			
	4	7SMMDM8	Robotics and industrial Application	VII			

*** indicates that the Track for MDM will be decided by respective Board of Studies (BoS)**

	DOUBLE MINOR (SPECIALIZATION) BASKETS OF COURSES FOR ALL DEPARTMENTS						
	Double Minor / Specialization Minor Basket Track Name	Sr. No.	Course Code	Course Name	Semester	Students from following Departments can Register	Offered by Department of
	Advanced Programming	1	3SASM	Programming Language for Data Science	III	CSE, CE, EXTC, IT, IIoT, ME	Artificial Intelligence and Data Science
		2	4SASM	Advanced Java Programming	IV		
		3	5SASM	Mobile Application Development	V		
		4	6SASM	Introduction to Gaming	VI		
		5	7SASM	Introduction to Software Development Platform (GitHub)	VII		
		6	8SASM	Databases and SQL for Data Science	VIII		
	Construction Management and Environmental Engineering	1	3SCSM	Environmental Pollution and Control	III	AI&DS, CSE, EXTC, IT, IIoT, ME	Civil Engineering
		2	4SCSM	Water Treatment Engineering	IV		
		3	5SCSM	Waste Water Treatment Engineering	V		
		4	6SCSM	Project Management and Planning	VI		
		5	7SCSM	Construction Material Management	VII		
		6	8SCSM	Construction Quality Management	VIII		
	Web Technology	1	3SKSM	Introduction of HTML	III	AI&DS, CE, EXTC, IT, IIoT, ME	Computer Science and Engineering
		2	4SKSM	Javascript	IV		
		3	5SKSM	Web Engineering	V		
		4	6SKSM	Cloud Technology	VI		
		5	7SKSM	Distributed Database	VII		
		6	8SKSM	User Experience Design	VIII		
	Embedded System	1	3SESM	Fundamentals of Digital Electronics	III	AI&DS, CE, CSE, IT, ME	Electronics and Telecommunication Engineering
		2	4SESM	Digital System Design	IV		
		3	5SESM	Introduction to Microprocessors	V		
		4	6SESM	Microcontroller and Applications	VI		
		5	7SESM	Advanced Microcontrollers	VII		
		6	8SESM	Embedded System and RTOS	VIII		

DOUBLE MINOR (SPECIALIZATION) BASKETS OF COURSES FOR ALL DEPARTMENTS							
	Double Minor / Specialization Minor Basket Track Name	Sr. No.	Course Code	Course Name	Semester	Students from following Departments can Register	Offered by Department of
	Information Processing	1	3SNSM	Fundamentals of Information Technology	III	CE, CSE, EXTC, IIoT, ME	Information Technology
		2	4SNSM	Database Processing	IV		
		3	5SNSM	Network Processing	V		
		4	6SNSM	Data Mining and Warehousing	VI		
		5	7SNSM	Data Visualaization	VII		
		6	8SNSM	Big Data Processing	VIII		
	Industrial IoT	1	3STSM	Introduction to Internet of Things	III	AI&DS, CE, CSE, EXTC, IT, ME	Industrial IoT
		2	4STSM	Industrial Sensors and Actuators	IV		
		3	5STSM	Industrial Networks	V		
		4	6STSM	Embedded System for Internet of Things	VI		
		5	7STSM	Edge and Fog Computing	VII		
		6	8STSM	Internet of Things Security	VIII		
	Manufacturing Techniques	1	3SMSM	Manufacturing Processes-I	III	AI&DS, CE, CSE, EXTC, IT, IIoT,	Mechanical Engineering
		2	4SMSM	Manufacturing Processes -II	IV		
		3	5SMSM	Modern Manufacturing Techniques	V		
		4	6SMSM	Production Management	VI		
		5	7SMSM	Productivity Techniques	VII		
		6	8SMSM	Computer Integrated Manufacturing	VIII		

	Honors Baskets of Courses for all Departments				
	Name of Department	Sr. No.	Course Code	Course Name	Semester
	Artificial Intelligence and Data Science	1	4SAH	Advanced Programming for Data Science	IV
		2	5SAH	Advanced Data Science and Analytics	V
		3	6SAH	Business and Web Analytics	VI
		4	7SAH	Data Engineering	VII
		5	8SAH1	Deep Learning and its Applications	VIII
		6	8SAH2	Minor Project	VIII
	Civil Engineering	1	4SCH	Air Pollution and Control	IV
		2	5SCH	Structural Dynamics	V
		3	6SCH	Geographic Information Systems	VI
		4	7SCH	Advanced Foundation Engineering	VII
		5	8SCH1	Finite Element Method	VIII
		6	8SCH2	Minor Project	VIII
	Computer Science and Engineering	1	4SKH	Data Science and Analytics	IV
		2	5SKH	Natural Language Processing and Text Analytics	V
		3	6SKH	Artificial Neural Network	VI
		4	7SKH	Optimization Techniques for Data Analytics	VII
		5	8SKH1	Computer Vision	VIII
		6	8SKH2	Minor Project	VIII
	Electronics and Telecommunication Engineering	1	4SEH	PLC & SCADA	IV
		2	5SEH	Electronics Circuit Design	V
		3	6SEH	Cognitive Radio	VI
		4	7SEH	Biomedical Signal Processing	VII
		5	8SEH1	VLSI Design Verification and Testing	VIII
		6	8SEH2	Minor Project	VIII

	Honors Baskets of Courses for all Departments				
	Information Technology	1	4SNH	Advanced Data Science	IV
		2	5SNH	Artificial Neural Network	V
		3	6SNH	Advanced Artificial Intelligence	VI
		4	7SNH	Advanced Machine Learning	VII
		5	8SNH1	Advanced Speech and Natural Language Processing	VIII
		6	8SNH2	Minor Project	VIII
	Industrial IoT	1	4STH	IoT Architectures and Protocols	IV
		2	5STH	Internet of Things Security	V
		3	6STH	Embedded Systems and IoT	VI
		4	7STH	Machine Learning For IoT	VII
		5	8STH1	Data Science in IoT	VIII
		6	8STH2	Minor Project	VIII
	Mechanical Engineering	1	4SMH	Energy Audit	IV
		2	5SMH	Computer Aided Design	V
		3	6SMH	Advance Heat Transfer	VI
		4	7SMH	3D Printing and Application	VII
		5	8SMH1	Design of Transmission System	VIII
		6	8SMH2	Minor Project	VIII

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SPECIALIZATION MINOR (SM) BASKET OF COURSES (DOUBLE MINOR) for 3rd Semester

Semester	Course Code	Course Name	Teaching Scheme						Examination Scheme									
			Hours / Week			SM Applicable to	Total Hours /Week	Credits	THEORY						PRACTICAL			
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.		
Theory																		
III	3SASM	Advanced Programming for Data Science	3	--	--	CE, CSE, EXTC, IT, IIoT, ME	3	3	3	60	30	10	100	40	--	--	--	--
III	3SCSM	Environmental Pollution and Control	3	--	--	AI&DS, CSE, EXTC, IT, IIoT, ME	3	3	3	60	30	10	100	40	--	--	--	--
III	3SKSM	Introduction of HTML	3	--	--	AI&DS, CE, EXTC, IT, IIoT, ME	3	3	3	60	30	10	100	40	--	--	--	--
III	3SESM	Fundamentals of Digital Electronics	3	--	--	AI&DS, CE, CSE, IT, ME	3	3	3	60	30	10	100	40	--	--	--	--
III	3SNSM	Fundamentals of Information Technology	3	--	--	CE, CSE, EXTC, IIoT, ME	3	3	3	60	30	10	100	40	--	--	--	--
III	3STSM	Introduction to Internet of Things	3	--	--	AI&DS, CE, CSE, EXTC, IT, ME	3	3	3	60	30	10	100	40	--	--	--	--
III	3SMSM	Manufacturing Processes-I	3	--	--	AI&DS, CE, CSE, EXTC, IT, IIoT	3	3	3	60	30	10	100	40	--	--	--	--
		Total	3	--	--		3	3					100					

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SPECIALIZATION MINOR (SM) BASKET OF COURSES (DOUBLE MINOR) for 4th Semester

Semester	Course Code	Course Name	Teaching Scheme						Examination Scheme									
			Hours / Week			SM Applicable to	Total Hours /Week	Credits	THEORY						PRACTICAL			
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.		
Theory																		
IV	4SASM	Advanced Java Programming	3	--	--	CE, CSE, EXTC, IT, IIoT, ME	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SCSM	Water Treatment Engineering	3	--	--	AI&DS, CSE, EXTC, IT, IIoT, ME	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SKSM	Javascript	3	--	--	AI&DS, CE, EXTC, IT, IIoT, ME	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SESM	Digital System Design	3	--	--	AI&DS, CE, CSE, IT, ME	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SNSM	Data Processing Techniques	3	--	--	CE, CSE, EXTC, IIoT, ME	3	3	3	60	30	10	100	40	--	--	--	--
IV	4STSM	Industrial Sensors and Actuators	3	--	--	AI&DS, CE, CSE, EXTC, IT, ME	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SMSM	Manufacturing Processes - II	3	--	--	AI&DS, CE, CSE, EXTC, IT, IIoT	3	3	3	60	30	10	100	40	--	--	--	--
		Total	3				3	3					100					

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Branch: All Branches

HONOURS BASKET OF COURSES for 4th Semester

Semester	Course Code	Course Name	Teaching Scheme						Examination Scheme									
			Hours / Week			Honours Course Applicable to Students of	Total Hours /Week	Credits	THEORY						PRACTICAL			
			Lecture	Tutorial	P/D				Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
											Max. Marks MSE/ MSIE	Max. Marks TA			Int.	Ext.		
IV	4SAH	Advanced Programming for Data Science	3	--	--	Artificial Intelligence & Data Science	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SCH	Air Pollution and Control	3	--	--	Civil Engineering	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SKH	Data Science and Analytics	3	--	--	Computer Science and Engineering	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SEH	PLC & SCADA	3	--	--	Electronics and Telecomm. Engineering	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SNH	Advanced Data Science	3	--	--	Information Technology	3	3	3	60	30	10	100	40	--	--	--	--
IV	4STH	IoT Architectures and Protocols	3	--	--	Industrial Internet of Things	3	3	3	60	30	10	100	40	--	--	--	--
IV	4SMH	Energy Audit	3	--	--	Mechanical Engineering	3	3	3	60	30	10	100	40	--	--	--	--
		Total	3				3	3					100					

1SF01 - APPLIED MATHEMATICS-I

Teaching Scheme : 03 L/Week

Credit : 03

Pre-requisites:

1. Basic idea of differential and integral calculus.
2. Fundamental knowledge of trigonometric functions.
3. Essential knowledge of Differential Equation.
4. Elementary knowledge of determinant.

Course Learning Objectives:

1. To familiarize with techniques in calculus.
2. To evaluate partial derivatives of explicit and implicit functions.
3. To understand maxima and minima concept.
4. To solve differential equation of certain type of differential equations.
5. To change into a mathematical formation of physical problem.
6. To determine infinite series and their convergence and divergence.

Course Outcomes:

After the completion of course students will be able to...

1. Make use of derivatives for finding n^{th} derivatives and to solve indeterminate forms.
2. Extend the basic ideas of the calculus of functions of single variables to functions of several variables and its concept.
3. Find maximum and minimum value of a function.
4. Solve certain types of differential equations by various methods.
5. Utilize it for engineering problems of electrical circuit.
6. Determine infinite series and their convergence and divergence.

Unit I: Differential Calculus I

Successive differentiation, Leibnitz's theorem on the n^{th} derivative of a product, Indeterminate forms. (07 Hours)

Unit II: Differential Calculus II

Partial differentiation, Euler's theorem on homogeneous function. (06 Hours)

Unit III: Jacobian

Jacobians of explicit functions and implicit function with properties, functional dependence, maxima and minima of function of two independent variables. (07 Hours)

Unit IV: Ordinary differential equations of first order and first degree

Non-homogeneous differential equation, Linear differential equation, reducible to Linear differential equation, Exact differential equation and reducible to Exact differential equation.

(07 Hours)

Unit V: Differential equations of first order and higher degree

Solvable for p, solvable for x and solvable for y, Application to Orthogonal Trajectories and Electrical circuits by Kirchoff's law.

(06 Hours)

Unit VI: Infinite Series

Tests for convergence by p-series test, Comparison test, Ratio test, Rabbe's test and Root test.

(07 Hours)

Recommended Text Book :

1. Wartikar P.N. & Wartikar J.N.- A Text Book of Applied Mathematics Vol.-I & II, Pune V.G. Prakashan, Pune.
2. Grewal B.S. - Higher Engineering Mathematics, 40/e, Khanna Publishers.

Reference Books:

1. Kreyszig E.K. - Advanced Engineering Mathematics, John Wiley.
2. Ramana B.V. - Higher Engineering Mathematics, (TMH).
3. Singh R.R. & Bhatt M. - Engineering Mathematics, (TMH).
4. Dass H. K. – Advance Engineering Mathematics, S. Chand.

1SF02 - Applied Physics

Teaching Scheme : 03 L

Credit : 03

Course Prerequisites:

1. Elementary idea about electric charge, electricity & magnetism.
2. Basic knowledge of material science.
3. Fundamental knowledge of optics.

Course Objectives:

- CLO 1: To enable the students to correlate the theoretical principles of fundamentals of modern aspects in physics with applications oriented studies in engineering.
- CLO 2: To understand the ballistics of charges particles in electric and magnetic fields and applications of cathode ray oscilloscope.
- CLO 3: To impart the knowledge of crystallography.
- CLO 4: To impart the essential knowledge of interference and diffraction of light in various application of engineering physics.
- CLO 5: To impart the knowledge of laser and its various applications in Engineering Physics.
- CLO 6: To impart the knowledge of fibre optics.
- CLO 7: To enhance imagination and creativity in students by performing practical experiments on related topics in various applications in engineering physics.
- CLO 8: To impart the knowledge of fluid dynamics.

Course Outcomes:

- CO 1: Apply the concepts of electric and magnetic fields in mass spectrograph and Cathode Ray Oscilloscope.
- CO 2: The students will gain the basic ideas about crystallography and will be able to identify different types of crystal structures in solids.
- CO 3: The students will be able to utilize the knowledge of interference and diffraction.
- CO 4: The Students will gain the knowledge of LASER, its types and applications.
- CO 5: The Students will acquire the knowledge of fibre optics, its types and applications.
- CO 6: The Students will gain the knowledge of fluid dynamics and its applications.

UNIT I: Electron Ballistics: (08 Hours)

Motion of charged particle in uniform transverse electric and transverse magnetic fields, velocity selector (energy filter), Bainbridge mass spectrograph, Hall effect, cathode ray oscilloscope : working and its block diagram.

UNIT II: Crystallography: (06 Hours)

Crystal structure, Unit cell, Cubic crystal structure: SC, BCC and FCC, Unit cell characteristics: Effective number of atoms per unit cell, atomic radius, coordination number, atomic packing fraction, Miller indices, Bravais lattice Inter-planar distance between adjacent planes.

UNIT III: Interference and Diffraction of Light: (07 Hours)

Fundamental condition of interference, thin film interference due to reflected light, Newton's rings experiment and its applications, Fresnel and Fraunhofer diffraction, plane transmission diffraction grating.

UNIT IV: (06 Hours)

Absorption, spontaneous and stimulated emission of radiation, population inversion, pumping, metastable state, characteristics and applications of laser, Ruby laser, He-Ne Laser.

UNIT V: Fibre Optics: (07 Hours)

Snell's law, total Internal reflection, construction of optical fibre, acceptance angle and acceptance cone, numerical aperture, types of optical fibre, attenuation, fibre optic communication system.

UNIT VI: Fluid Dynamics: (06 Hours)

Viscosity, Stoke's law, streamline and turbulent flow of liquid, Poiseuille's equation, Continuity equation, Bernoulli's theorem.

Text Books:

1. R.K.Gaur & S.L.Gupta: Engineering Physics, Dhanpat Rai & Sons.
2. Hitendra K. Malik & A.K.Singh: Engineering Physics, Tata McGraw Hill
3. M.N. Avadhanulu & P.G. Kshirsagar: Engineering Physics, S.Chand Pub., 2008

Reference Books:

1. Orazio Svelto: Principle of Lasers, Springer
2. Frank L.Pedrotti, Leno M. Pedrotti, Leno S. Pedrotti: Introduction to optics.

1SF03 - Engineering Graphics

Teaching Scheme : 02 L

Credit : 02

Pre-requisites:

1. Knowledge of basic math's and terms.
2. Ability to visualize objects in three dimensions before they are on a page.
3. Computer literacy.

Course Learning Objectives:

CLO 1: To acquire and apply engineering graphics knowledge for communicating ideas, information and instructions.

CLO 2: To understand the representations of 3D objects and their projections.

CLO 3: To understand the representations of orthographic and isometric views of objects.

CLO 4: To summarize the role of engineering drawing in various engineering disciplines.

Course Outcomes:

At the end of course, Learner will be able to

1. Use the drawing instruments effectively to dimension the given figures and describe the methods of projection.
2. Construct the various types of planes in different orientations.
3. Apply knowledge of projection to construct different view of regular solid objects.
4. Define the sectional views of solids such as Prism, Pyramid, Cone, Cylinder & Cube.
5. Identify the pictorial views of the object.
6. Recognize the pictorial views of the object and construct isometric scale, isometric projection & views.

Unit I: Basics of Engineering Drawing and Projection:

Introduction to drawing instrument and their uses, concept of dimensioning and scales, geometric construction. Projection of Point, Projection of Line. **(4hrs.)**

Unit II: Projection of Plane

Projection of different types of planes such as triangular plane, square plane, rectangular plane, pentagonal plane, hexagonal plane, circular plane etc. by using change of position method and auxiliary plane method. **(4hrs.)**

Unit III Projection of Solids:

Projection of solids for Prism, Pyramid, Cone and Cylinder. **(5hrs.)**

Unit IV: Section of Solid:

Section of solids for Prism, Pyramid, Cone and Cylinder **(5hrs.)**

Unit V: Orthographic Projection:

Construction of elevation, plan and side view of given object by using first and third angle projection methods. **(5hrs.)**

Unit VI: Isometric Views and Projection:

Construction of isometric scale, isometric views and projection. **(5hrs.)**

List of Books Recommended: Text Books:

1. Bhatt N. D. & Panchal V. M. Engineering Drawing, 49th Edn., Charotar Pub. House, Anand, Gujarat, 2007.
2. Shah P. J. – Engineering Drawing, S. Chand Publication, 2008.
3. Dhawan R. K. – Engineering Drawing, S. Chand Publication, (5th edition, 2008).
4. Tickoo Sham – AutoCAD, BPB Publications.
5. Ingole D.S. – Engineering Graphics, Nirali Publication, Pune (1st Edition 2020).

1SF04 - Programming for Problem Solving

Teaching Scheme : 02 L

Credit : 02

❖ Course Objectives:

Throughout the course, students will be expected to demonstrate their understanding of Programming for Problem Solving by being able to do each of the following:

1. Develop a solid understanding of the fundamental concepts of programming and problem-solving, including the input-process-output cycle, algorithms, and program design principles such as top-down and bottom-up approaches.
2. Acquire proficiency in the C programming language, including the ability to write and execute basic C programs, effectively use input-output functions, work with variables, data types, and operators, and understand the concept of program execution.
3. Demonstrate competence in using control constructs such as decision-making statements and looping statements to create efficient and structured programs.

❖ Course Outcomes:

After Successful completion of this course, the student will be able to:

1. Understand the basic concepts of computer organization, program design and Algorithms.
2. Explain the basic structure and fundamentals of C programming.
3. Compare and contrast the decision-making constructs and looping statements in C programming.
4. Understand the concept of arrays and string functions in C language.
5. Demonstrate the ability to write and use the concept of functions.
6. Apply the concepts of pointer declaration, assignment and arithmetic operations in C.

➤ Unit I Introduction (Hours: 5)

Organization of Computer, Basic concepts of Problem Solving, Program Design: Top Down, Bottom Up, Input Process Output Cycle, Algorithms: Conventions, Flowchart, Pseudo code

➤ Unit II C Fundamentals (Hours: 5)

Introduction to C language, Basic structure, Program Execution First C Program, Input Output using scanf() and printf(), Data type, Variables, Operators and their precedence.

- **Unit III C Control construct (Hours: 5)**
Decision making using if, if else and switch. Looping using for, while, do while, break and continue. Jumps in loop.
- **Unit IV Array and Strings (Hours: 5)**
Introduction to Array, 1-D array: Declaration & Initialization, 2-D array: Declaration & Initialization, Strings: Declaration & Initialization, String functions.
- **Unit V Functions (Hours: 5)**
Function: Pre defined functions, User defined functions, Multi-function Program, Elements of user defined functions, Return value and their types, Function calls, Function Declaration.
- **Unit VI Pointers (Hours: 5)**
Definition and uses of pointers, pointer declaration, pointer assignment, pointer arithmetic, Pointers and Functions: Call by value and call by reference.

❖ **Text Book:**

- 1) R. S. Salaria : Programming for Problem Solving , Khanna Publication .
- 2) E Balagurusamy: Computing Fundamentals and C Programming- Tata McGraw Hill, Second Edition

❖ **Reference Books:**

1. Herbert Schildt- C Complete reference (Tata McGraw Hill)
2. Yashwant Kanetkar- Let us C- Seventh Edition

1SF05 - Professional Communication Skills

Teaching Scheme : 02 L

Credit : 02

COURSE PRE-REQUISITES: BASIC KNOWLEDGE OF ENGLISH

COURSE OBJECTIVES: The course aims to:

1. Introduce Communication skill and its importance
2. Enhance the Employability and Career Skills of students
3. Orient the students towards grooming as a professional
4. discuss the importance of team building
5. Make them Employability Graduates
6. Develop their confidence and help them attend interviews successfully

COURSE OBJECTIVES: The course aims to:

1. After Completion of the course, Students shall
2. learn about basic communication system and its blocks
3. overcome the barriers in communication
4. study the importance of Time management in professionalism
5. learn to effectively introduce themselves in interviews
6. study the concept of group discussion
7. Learn to build Teams and set SMART Goals

UNIT I

Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers

UNIT II

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management- important parameters of Time management

UNIT III

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—presenting the visuals effectively – 5 minute presentations

UNIT IV

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic – questioning and clarifying –GD strategies- activities to improve GD skills

UNIT V

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview & panel interview – FAQs related to job interviews

UNIT VI

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management through setting SMART goals

TEXT BOOKS :

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students,. OrientBlackSwan: Hyderabad, 2016.

REFERENCES:

1. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
2. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
3. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.
4. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition,Pearson Education, 2011

1SF06 - Design Thinking

Teaching Scheme : 01 L

Credit : 01

❖ Pre-requisites:

1. 12th Standard

❖ Course Learning Objectives:

CLO 1: To familiarize students with design thinking concepts and principles

CLO 2: To ensure students can practice the methods, processes and tools of design thinking

CLO 3: To ensure students can apply the design thinking approach and have ability to model real world situations

❖ Course Outcomes:

After completion of this course the student shall be able to:

CO 1: Examine Design Thinking concepts and principles

CO 2: Practice the methods, processes, and tools of Design Thinking

CO 3: Apply the Design Thinking approach and model to real world situations

❖ Contents:

Unit No. 1: Fundamentals of Design Thinking (02 Hrs.)

Principles of Design Thinking, The process of Design Thinking, How to plan a Design Thinking project

Unit No. 2: Understanding the Design Problem (03 Hrs.)

Search field determination, Problem clarification, Understanding of the problem, Problem analysis, Reformulation of the problem

Unit No. 3: Observing the Problem (02 Hrs.)

Observation Phase, Empathetic design, Tips for observing, Methods for Empathetic Design

Unit No. 4: Defining the Problem (02 Hrs.)

Point-of-View Phase, Characterization of the target group, Description of customer needs

Unit No. 5: Finding and Selecting Ideas (03 Hrs.)

Ideate Phase, The creative process and creative principles, Creativity techniques, Evaluation of ideas

Unit No. 6: Prototyping

(03 Hrs.)

Prototype Phase, Lean Startup Method for Prototype Development, Visualization and presentation techniques

❖ Textbooks:

1. Christian Mueller-Roterberg, Handbook of Design Thinking, Research Gate November 2018
2. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Amazon books
3. Dr. D. Ravindran, Introduction to Design Thinking, Notion Press

1SF07 - Applied Physics Lab

Teaching Scheme : 02 P

Credit : 01

Course Prerequisites:

1. Identify and handle various equipment likes vernier calliper, micrometer screw gauge, multimeter, spectrometer.
2. Basic knowledge of graphical representation of observed values.

Course Objectives:

To gain practical knowledge by applying experimental methods to correlate with the theory.

Apply the analytical techniques and graphical analysis to the experimental data.

To develop basic understanding of various experimental principles involved.

Course Outcomes:

After completion of this course, the students will able to:

- 1) Develop experimental skills to impart practical knowledge in real time.

Understand principle, concept, working and applications of areas in physics and compare the results obtained with theoretical calculations.

Conduct experiment and record experimental data, Analyse the obtained data and Draw conclusions from the Labortary exercise based on the analysed data

List of Experiments/ Practicals:

Applied Physics Lab

Minimum : 08 experiments/ Practicals are to be performed.

List of Experiments:

1. Study of CRO I: To measure A.C voltage, D.C voltage and frequency using CRO.
2. Study of CRO II: To determine frequency of unknown signal by using Lissajous patterns.
3. To determine wavelength of monochromatic light by using Newton's Ring experiment.
4. To determine wavelength of monochromatic light by using Plane transmission diffraction grating.
5. Determination of grating element of diffraction grating, using LASER beam.
6. Study of various crystal structures.
7. To determine Miller Indices of crystal planes.
8. To plot the V-I characteristics of LED and to find its striking potential.
9. To measure the intensity and divergence of given LASER beam.
10. To determine the coefficient of viscosity using Stoke's law.
11. Study of Hall effect in semiconductor.

1SF08 - Engineering Graphics Lab

Teaching Scheme : 02 P

Credit : 01

Course Learning Objectives:

CLO 1: To understand the concepts of drawing in engineering.

CLO 2: To improve the visualization skills for better understanding of projection of solids.

CLO 3: To acquire skills to interpret and convert multi-views drawing into single view and vice-versa.

Course Outcomes:

At the end of course, Learner will be able to –

1. Illustrate the projection of points, lines and surfaces.
2. Construct different types of solids in different positions along with their sectional views.
3. Understand the concept of orthographic and isometric projection.

List of Practical :

1. Projection of Line.
2. Projection of Plane.
3. Projection of Solid.
4. Section of Solid.
5. Orthographic Projection.
6. Isometric Views and Projection.

1SF09 - Programming for Problem Solving Lab

Teaching Scheme : 02 P

Credit : 01

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Programming for Problem Solving by being able to do each of the following:

1. Develop a solid understanding of the fundamental concepts of programming and problem-solving, including the input-process-output cycle, algorithms, and program design principles such as top-down and bottom-up approaches.
2. Acquire proficiency in the C programming language, including the ability to write and execute basic C programs, effectively use input-output functions, work with variables, data types, and operators, and understand the concept of program execution.
3. Demonstrate competence in using control constructs such as decision-making statements and looping statements to create efficient and structured programs.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the basic concepts of problem-solving in programming and explain the input-process-output cycle.
2. Identify and explain the basic structure of a C program, including input-output using scanf() and printf().
3. Compare and contrast the decision-making constructs and looping in C
4. Understand the concept of arrays, including 1-D and 2-D arrays
5. Utilize pre-defined functions in C and demonstrate the ability to write and use user-defined functions.
6. Apply the concepts of pointers in C, including their declaration, assignment, and arithmetic operations.

List of Experiments:

Minimum 8 experiments are to be performed.

1. Set up a C programming environment (compiler, IDE, etc.).
2. Write a simple program to display "Hello, World!".
3. Solve a simple problem using a top-down approach and develop a program accordingly.
4. Use flowcharts or pseudo code to represent the algorithm for a specific problem.
5. Write program to illustrate precedence of operator
6. Write programs that demonstrate the use of if, if-else, and switch statements for decision making.
7. Create and manipulate 1-D, 2-D arrays (declaration, initialization, accessing elements).
8. Explore string manipulation functions (strcpy, strcat, strlen, etc.)

9. Write programs using user-defined functions to solve specific tasks
10. Understand and use return values and their types.
11. Explore the concept of call by value using pointers.
12. Explore the concept of call by reference using pointers

1SAKN01 – Multimedia and Web Designing

Teaching Scheme : 03 L

Credit : 03

❖ Course Objectives :

Throughout the course, students will be expected to demonstrate their understanding of Multimedia and Web Design by being able to do each of the following:

1. Understand the fundamental concepts and components of multimedia, including its historical development and current trends.
2. Memorize multimedia authoring tools and techniques to create and manipulate graphics, images, and multimedia content.
3. Gain proficiency in web technologies, including web architecture, protocols, web server-client communication, and the creation of web pages using HTML and CSS.

❖ Course Outcomes :

After Successful completion of this course, the student will be able to:

1. Discuss the various components of multimedia technology recognizing its past, present, and future.
2. Identify different multimedia authoring tools, techniques and use graphics and image data representations.
3. Explain the Web history, its architecture and discuss the major issues in web solution development.
4. Understand the basics of HTTP and the concepts of persistent and non-persistent connections.
5. Apply HTML elements, attributes and tags to design well-structured web pages.
6. Develop the appearance and layout of web pages with CSS.

➤ UNIT 1: Introduction to multimedia:

(Hours: 8)

Introduction and Multimedia Data Representations, Introduction to Multimedia, Components of Multimedia, Multimedia: Past and Present Early History of Multimedia, Hypermedia, Multimedia in the New Millennium, Multimedia Software Tools, Multimedia in the Future.

➤ UNIT II: Multimedia Authoring and Data Representations:

(Hours: 7)

Multimedia Authoring and Tools: Multimedia Authoring, VRML. Graphics and Image Data Representations: Graphics/Image Data Types, 1-Bit Images, 8-Bit Gray-Level, Images, Image Data Types.

➤ UNIT III: Introduction to the Web:

(Hours: 7)

History of web, Protocol governing the web, Web architecture, Major issues in Web solution development, Web servers, Web browsers, Internet Standards, TCP/IP protocol suites, IP Address, MIME.

- **UNIT IV: Hypertext Transfer Protocol (HTTP):** **(Hours: 8)**
Introduction, web server and client, Resources, URL and its Anatomy, Message Format, Examples, Persistent and non-persistent Connections, Web caching, Proxy.
- **UNIT V: Hypertext Markup language (HTML):** **(Hours: 8)**
History of HTML, HTML basics, Elements, attributes and tags of HTML, Basic Tags, Advanced Tags, Frames, Images, Meta Tag, planning of web page, Model and Structure of web site, Designing web pages, Multimedia content.
- **UNIT VI: Cascading Style Sheet (CSS):** **(Hours: 7)**
Introduction, advantages, Adding CSS, Browser compatibility, CSS and page layout, Selectors, Grouping, Type Selectors.

❖ **TEXT BOOK :**

1. Ze-Nian, Li, Mark S. Drew “Fundamentals of Multimedia” (Pearson Education)
2. Roy Uttam K: Web Technologies, Oxford University Press, 2010.

❖ **REFERENCES :**

1. Rajan Parekh “Principles of Multimedia” (Tata McGraw-Hill)
2. S.J.Gibbs & D.C.Tsichritzis “Multimedia Programming”, Addison Wesley 1995
3. Mohler J.L. & Duff J.M.: Designing Interactive Web Sites, CENGAGE Learning.
4. Joel Sklar: Text Book of Web Design, CENGAGE Learning.

1SAKN02 Multimedia and Web Designing Lab

Teaching Scheme : 02 P

Credit : 01

❖ List of Practical's :

1. Write a HTML program to design static webpage which should allow to enter user's personal data.
2. Create a static webpage using table tags of HTML which contains subject are on the left had side and minimum and maximum mark on the right hand side.
3. Create a static web page which defines all text formatting tags of HTML in tabular format.
4. Make a form in html web page which takes all the details of person.
5. Create html page which make a use of Internal/ External CSS file. A CSS File must use following CSS Selector.
6. Create a HTML web page which uses CSS Border, Background, Padding.
7. Create a web page which embed image, video and Links in Table.
8. Create a Web page which uses CSS Lists (Ordered, Unordered) .
9. Create a Web page which uses CSS Image / Video Tags.
10. Create a HTML web page which uses CSS Navigation bar.
11. Create a HTML page which showcase images in gallery.
12. Create a Mini project for
 - a. Students Notice Board
 - b. Result Display Board
 - c. Personal information Valet
 - d. Many more

2SF01 - APPLIED MATHEMATICS-II

Lectures: 3 Hrs/Week

Credits: 03

Pre-requisites:

- 1) Basic Knowledge of Matrix and Complex number.
- 2) Elementary Integral Calculus.

Course Learning Objectives :

1. To deal with system of equations and solutions of Eigen value problem.
2. To express real valued periodic function in terms of sines and cosines
3. To Use Complex number theory in engineering application such as signal processing.
4. To familiarize with techniques in integral calculus.
5. To know the idea of double integration and to evaluate, change the order and apply it to get the area of the region.
6. To evaluate triple integral and its applications that is to find volume by triple integral.

Course Outcomes :

After the completion of course students will be able to...

1. Make use of system of equations in matrix forms.
2. Find the periodic functions as an infinite series.
3. Able to apply de Moivre's theorem in various concepts of complex number.
4. Use new technique DUIS and to evaluate Beta and Gamma function.
5. Evaluate double integral, triple integral and its applications.

Unit I : Matrices

Rank of a matrix, Consistency of linear system of equations by matrix method, Eigen values and Eigen vectors, Cayley-Hamilton theorem (without proof). (07 Hours)

Unit II :Fourier series

Fourier expansion of function in $(C, C+2L)$, half range Fourier series. (06 Hours)

Unit III : Complex Numbers

Roots of complex number by deMoivre's theorem, Hyperbolic and inverse hyperbolic functions, Separation of real and imaginary parts, Logarithm of complex numbers. (07 Hours)

Unit IV : Integral Calculus I

Differentiation under integral sign, Beta Function and Gamma Function. (07 Hours)

Unit V : Integral Calculus II

Double integration, change of order of integration, transformation to polar coordinates, Evaluation of area by double integration. (06 Hours)

Unit VI : Integral Calculus III

Triple integration, Transformation to spherical polar coordinates, Volume of solid by triple integration. (07 Hours)

TEXT BOOK: -

- (1) Wartikar P.N. & Wartikar J.N.- A Text Book of Applied Mathematics, Vol.-I, & II, Pune V.G. Prakashan, Pune.
- (2) Grewal B.S. - Higher Engineering Mathematics, 40/e, Khanna Publishers

REFERENCE BOOKS: -

- 1) Kreyszig E.K. - Advanced Engineering Mathematics, John Wiley
- 2) Ramana B.V. - Higher Engineering Mathematics, (TMH)
- 3) Singh R.R. & Bhatt M. - Engineering Mathematics, (TMH)
- 4) Dass H.K. – Advanced Engineering Mathematics (S. Chand)

2SF02 - Applied Chemistry

Teaching Scheme : 03 L

Credit : 03

Pre-Requisites:

1. Fundamentals of redox reactions and electrochemistry.
2. Knowledge of chemical reaction.
3. Basic knowledge of qualitative and quantitative analysis.

Course Learning Objectives:

1. To enable students to manufacture functional materials on the basis of chemical forces.
2. To provide the knowledge of properties of cement and their applications.
3. To impart knowledge of characteristics of water and its disadvantages in boiler technology.
4. To impart knowledge of processes used for the removal of impurities in water.
5. To enable students to calculate various types of hardness of unknown water samples.
6. To provide knowledge about significance of fuels and lubricants.
7. To summarize students with operating principles, working processes and applications of energy conversion and storage devices.
8. To impart knowledge of various type of corrosion and corrosion control methods.

Course Outcomes:

After the completion of the course the students will be able to...

1. Apply the knowledge of chemical forces to design functional materials.
2. Apply the knowledge of useful engineering materials such as cement and lubricant.
3. Describe properties of hard water, its disadvantages and various processes for removal of water impurities.
4. Describe properties of chemical fuels, analysis methods and its applications.
5. Identify various types of corrosion, mechanism and control methods to protect metals.
6. Describe operating principles working processes and applications of energy conversion and storage devices.

UNIT I: ENGINEERING MATERIALS AND THEIR PROPERTIES:

(06 Hrs)

Introduction, Classification of Engineering materials, Chemical Forces in materials- Primary forces and Secondary forces, Properties of materials, Role of chemical forces in alteration of magnitude of the properties such as Density, Melting Point, Solubility, Strength, Stiffness, Elasticity and Plasticity. Real life examples where these interactions played major role to enhanced their properties: - vulcanized rubber and plasticized PVC.

UNIT II: CEMENT ENGINEERING:**(06 Hrs)**

Introduction, Types of cement, Raw materials used for the manufacturing of Portland cement, Manufacturing of Portland cement by wet process. Functions of chemical constituents of cement: Tri-calcium aluminate, Tri-calcium silicate, Di-calcium silicate, Tetra-calcium aluminoferrite, magnesia, sulphur trioxide, iron oxide, alkalis, free lime, alumina. Physical Properties of Portland cement: Heat of hydration, Fitness, Soundness, Strength, Setting and hardening.

UNIT III: WATER CHARACTERISTICS & THEIR EFFECTS ON BOILER:**(08 Hrs)**

Introduction. Characteristics of water: - Hardness, pH, alkalinity, DO, TDS and Chloride ion concentration. Disadvantages of characteristics of water in Boiler: - Scale & sludge, Priming & Foaming, Caustic embrittlement and Boiler corrosion. Methods of analysis: - EDTA method, Iodometric method and conductometric titration. Methods for removal of impurities: Sedimentation, Neutralization, Zeolite process, De-Ionization process and Reverse osmosis. Calculation of hardness by data obtained from EDTA and zeolite processes.

UNIT IV: FUEL and LUBRICANT:**(07 Hrs)**

Introduction, Types of Fuels, Properties of Fuels: Ignition Temperature, Calorific value. Types of calorific value.

Solid Fuel: Coal, classification of coal, analysis of coal: ultimate analysis.

Liquid Fuel: Crude oil, Fractional distillation of crude oil, Properties of liquid fuel: Octane number and Cetane number.

Gaseous Fuel: Hydrogen gas, economy of hydrogen gas as fuel.

Lubricants: Introduction, classification of lubricants, properties of lubricants, uses of lubricants.

UNIT V: ENERGY SOURCES & STORAGE DEVICES:**(06 Hr)**

Introduction, Principle of batteries, Types of Batteries: Primary Batteries-Dry Cell, Mercury cell, Secondary Batteries- NICAD (Ni-Cd) battery, Lithium-ion battery. Green energy sources: Photovoltaic cell (Solar Cell), Fuel Cell.

UNIT VI: CORROSION & Its CONTROL:**(07 Hrs)**

Introduction, Types of corrosion: Dry and Wet corrosion, Mechanism of dry and wet corrosion, Factor affecting corrosion: Nature of metal and nature of environment, Types of wet corrosion-Pitting corrosion, waterline corrosion, stress and galvanic corrosion, Methods of corrosion control-

Cathodic protection: Sacrificial anode and impressed current method, Protective coating: Galvanizing and Tinning process.

Text Books

1. Engineering Chemistry by Jain & Jain (Dhanpat Rai & Sons)
2. Engineering chemistry by S. S. Dara, S. Chand Publication
3. Engineering & Technology Vol-I & II-by Rajaram& Kuriocose
4. Engineering Chemistry by Prasanta Rath (Cengage learning)
5. Engineering & Technology by Shashi Chawala, Dhanpat Rai & Sons.
6. Engineering Chemistry by K. Sesha Maheswaramma, Mridula Chugh, Pearson.

2SF03 - Basics of Electrical Engineering

Teaching Scheme : 02 L

Credit : 02

❖ Pre-requisites:

1. Concepts of Electrostatics and Current Electricity.
2. Fundamentals of Magnetic effect of electric current, magnetism and Electromagnetic Induction.

❖ Course Learning Objectives :

- CLO 1 :** To introduce students with different terminologies in electrical engineering and network simplification methods of resistances.
- CLO 2 :** To understand DC Circuit analysis.
- CLO 3 :** To understand magnetic circuits and Electromagnetic induction.
- CLO 4 :** To understand Single phase A.C. fundamentals.
- CLO 5 :** To understand Three phase A.C circuits.
- CLO 6 :** To understand single phase Transformer and Safety in electrical installation.

❖ Course Outcomes :

After completion of this course the student shall be able to :

- CO 1:** Understand fundamentals of Electrical Engineering and be adequately trained to solve Network of resistances by using transformation techniques.
- CO 2:** Demonstrate DC circuits by finding different parameters like voltage, currents, resistance using laws and theorems.
- CO 3:** Explain different properties of electromagnets and phenomenon of electromagnetic induction in magnetic circuits.
- CO 4:** Illustrate the different terms of AC and analyze single phase AC circuits.
- CO 5:** Explain Three phase A.C circuits
- CO 6:** Explain single phase Transformer and Safety in electrical installation.

UNIT I: Fundamentals of Electrical Engineering: (05 Hours)

Basic concepts of Current, Voltage, Power, energy and relationship between them. Resistance, Resistivity, Conductance, Conductivity, Network simplification of Resistances (Series, Parallel, Delta-Star and Star-Delta transformation)

UNIT II: DC Circuit Analysis : (05 Hours)

Types of Sources, Current and voltage division principle, Ohm's Law, Kirchhoff's Current Law, Kirchhoff's Voltage Law, Superposition Theorem, Thevenin's Theorem

UNIT III: Magnetic circuits and Electromagnetic Induction: (05 Hours)

Basic concepts of Flux, flux density, MMF, Reluctance, Permeance, Magnetic field intensity and their relationship. Series Magnetic circuits, B-H curve, Principle of electromagnetic induction, Types of Magnetically induced EMF, Concept of self and mutual Inductance.

UNIT IV: A.C. Fundamentals: (05 Hours)

Generation of sinusoidal alternating voltages and currents, Different terminologies associated with AC circuit. Behavior of AC circuit containing Pure R, L, and C. Phasor representation in rectangular & polar form, Impedance and admittance concept. Series R-L, R-C and R-L-C circuit, Resonance in Series R-L-C circuit, Power in single phase circuit: - Concepts of active, reactive and apparent power, Power factor

UNIT V: Poly-phase Circuits : (05 Hours)

Generation of Three phase voltages, current and power, Star connected and delta connected balanced circuits, Relationship between line current, phase current and line voltage, phase voltage, analysis of balanced three phase circuits Power measurement in Three phase circuit.

UNIT VI: Single phase Transformer : (05 Hours)

- Single-phase transformer construction and working (Ideal and practical) , Types of Transformer, EMF equation of Transformer, Efficiency & Regulation of transformer, condition for maximum efficiency.
- Electrical Safety : Safety precautions in electrical installation, Earthing, Types of Earthing (Plate and Pipe Earthing)

Recommended Text Books :

1. B. L. Thereja, Basic electrical engineering, S. Chand Publications.
2. D.P. Kothari, I.J. Nagrath, "Basic Electrical Engineering", TMH Publishing Co. Ltd., New Delhi, 3rd edition
3. Leonard S. Bobrow, "Fundamentals of Electrical Engineering", 2nd Edition, Oxford Press.
4. Kulshreshtha D.C., " Basic Electrical Engineering" , First Ed., TMH

Reference Books :

1. Leonard S. Bobrow, “Fundamentals of Electrical Engineering”, 2nd Edition, Oxford Press. R
2. A.E. Fitzgerald, D.E. Higginbotham, “Basic Electrical Engineering”, McGraw Hill Book Co., New York, 2nd edition
3. Dr.S.L.Uppal, “Electrical Wiring, Estimating and Costing”, Khanna Publishers.

2SF04 - Biology for Engineers

Teaching Scheme : 02 L

Credit : 02

Course Learning Objectives:

CLO1: To acquire the knowledge of basic concepts of biology and need of the subject in Engineering.

CLO2: To study the human organs and their analogy with the engineering applications.

CLO3: To acquire the knowledge of various medical tools and instruments used in medical field.

CLO4: To be acquainted with the latest trends in bio-engineering.

CLO5: To become familiar with the concept of Bio-mimicry and understand how nature has inspired innovations in technology.

Course outcomes:

1. Understand basic biological concepts and define the terminologies.
2. Understand various organs in body, their function; it's analogy with engineering applications.
3. Acquire knowledge of medical tools and machineries used in the treatment.
4. Understand the concepts of 3D printing and its biomedical applications and trends in bio-engineering.
5. Understand the concepts like biosensors, biofuels and biochips
6. Understand the concept of Bio-mimicry and nature inspired technology.

UNIT-I

Introduction to Basic Biology:

Cell: What is a Cell, Cell theory, Cell shapes, structure of a Cell, Cell cycle chromosomes, The Plant Cell and animal Cell, protoplasm, prokaryotic and eukaryotic Cell, Plant Tissue and Animal Tissue. Carbohydrates, proteins, Amino acid, nucleic acid (DNA and RNA) and their types. **(4 Hours)**

UNIT-II

Human Organ Systems and Bio Designs – 1

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics.). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). **(4 Hours)**

UNIT-III

Human Organ Systems and Bio Designs – 2

Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis). **(5 Hours)**

UNIT-IV

Trends in Bioengineering-1

Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D Printed tooth, Dental implants, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Biomedical sensors, devices and measurement systems. **(4 Hours)**

Unit-V

Trends in Bioengineering-2

Cloning in microbes, plants and animals, Basics of biosensors, biochips, Bio fuels. Tissue engineering And its application, transgenic plants and animals. **(4 Hours)**

Unit-VI

Nature-Bioinspired Materials and Mechanisms:

Bio-mimicry, Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs). **(5 Hours)**

Reference Books:

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
3. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
4. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
5. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
6. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
7. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
8. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.

Reference for Biomedical sensors:

<https://www.intechopen.com/chapters/48226>

2SF05 - Universal Human Values

Teaching Scheme : 02 L

Credit : 02

Objective : To facilitate in students the understanding of Universal Human Values and imbibe professional Ethics.

COURSE OUTCOMES

1. Understand the need for value education and its significance in personal and societal development.
2. Understand the harmony between the 'I' and the body and its significance for overall well-being.
3. Identify and appreciate the values in human-human relationships, emphasizing trust (Vishwas) and respect (Samman).
4. Develop a holistic perception of harmony at all levels of existence.
5. Communicate effectively about the importance of harmony in nature, promoting awareness and inspiring others to adopt sustainable practices.
6. Recognize the relevance of a humanistic constitution and humanistic universal order.

UNIT I

Process for Value Education

Understanding nature and scope for Value Education, Self-Exploration–concept and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being

UNIT 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’, Understanding the needs of Self (‘I’) and ‘Body’ – Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer), Understanding the characteristics and activities of ‘I’ and harmony in ‘I’, Understanding the harmony of I with the Body

UNIT III

Understanding Harmony in the Family and Society- Harmony Human - Human Relationship

Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas.

UNIT IV

Building the Universal Harmonious Order

Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitvaas comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to worldfamily!

UNIT V

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence

UNIT VI

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

TEXT BOOK

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

REFERENCES

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Susan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, R R Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

2SF06 - Indian Knowledge System

Teaching Scheme : 02 L

Credit : 02

Course Objectives: In this course students will know and understand contribution of ancient Indian scientists through :

- 1) Introduction to contribution of Indian scientist in various fields of Science and Technology and Astronomy
- 2) Introduce to contribution of Indian scientist in Chemistry , Metallurgy and Mathematics.
- 3) Introduction to contribution of Indian scientist in Medical Sciences and Life Sciences.

Course Outcomes: After Successful completion of this course, the student will be able to:

- 1) Discuss contribution of Indian Scientists in various fields of scientists and technology.
- 2) Narrate contribution of Indian Scientists in the field of Astronomy.
- 3) Discuss contribution of Indian Scientists in the field of Chemistry and Metallurgy
- 4) Discover contribution of Indian Scientists in the field of Mathematics
- 5) Collect contribution of Indian Scientists in the field of Medical Science and Ayurveda.
- 6) Discuss contribution of Indian Scientists in the field of Plant and Animal Science.

Unit I : India's Contribution to Science and Technology:

Pre-Independence contribution. Brief information about various fields of contributions.

(4 Hrs)

Unit II :Contribution in Astronomy:

The Beginnings of Indian Astronomy, The Early Historical Period, The Siddhāntic Era, The Kerala School, Other Post-Siddhāntic Developments.

(4 Hrs)

Unit III : Contribution to Chemistry and Metallurgy:

Early Chemical Techniques, Atomism in Vaiśeṣika, Chemistry in Early Literature, Classical Age, Laboratories and Apparatus

Metallurgy before and during the Harappan Civilization, Iron Metallurgy and its applications, Zinc Metallurgy. (4 Hrs)

Unit IV : Contributions to Mathematics :

First Steps , contributions from: early historical period, the classical period, the classical period: post Aryabhatta, contributions of Shri P C Mahalanobis, Shri Shrinivasa Ramajujan. (4 Hrs)

Unit V : Contributions to Medical Science and Ayurveda as way of life, health and well being

The tradition of surgery, Inoculation for smallpox, Microbiology and Paracitology, Communicable diseases and epidemics, An evolving pharmacopoeia, Cross-cultural interactions, What is Ayurveda? Integrative approach to healthcare, Integrative approach to healthcare, Principles of Ayurvedic healing, Five elements, three Doshas and Treating diseases to restore health. (4 Hrs)

Unit VI : Contributions to Plant and Animal Science

Plant Science in Ancient India, Animal Science in Ancient India, Indian Traditional Knowledge on Environmental Conservation. (4 Hrs)

Text Book :

- 1) Indian Contributions to Science compiled by Vijnana Bharati

Reference Books:

- 1) History of Science and technology in India by Dr. Binod bihari satpathy
- 2) Hindu achievements In exact science by Benoy Kumar Sarkar
- 3) Science in Ancient India by Subhash C. Kak

2SF07 - Applied Chemistry Lab

Teaching Scheme : 02 P

Credit : 01

Pre-Requisites:

1. Basic knowledge of qualitative and quantitative analysis.
2. Basic knowledge of titrations-based experiments.
3. Knowledge of chemistry lab precautions, prohibitions and safety aids.

Course Learning Objectives:

1. To impart skills of quantitative and qualitative analysis.
2. To provide knowledge of synthesis of co-crystal.

Course Outcomes:

After the completion of the course the students will be able to...

1. Determine the properties of water, chemical fuel, lubricant and cement based on laboratory techniques.
2. Synthesise co-crystals and determination of melting point of it.
3. Handle some important analytical instruments.

LIST OF EXPERIMENTS

1. Preparation of Paracetamol and oxalic acid co-crystal and determination of its melting point.
2. Determination of hardness of water by EDTA method.
3. Determination Alkalinity (NaOH and Na_2CO_3) in given water sample
4. Determination of chlorine in water sample. (Iodometry)
5. Determination of Dissolved Oxygen in Water Sample.
6. Determination of pH of unknown sample by pH meter.
7. Determination of H^+ ion concentration by conductivity meter.
8. Determination of % CaO in given cement sample.
9. Determination of % of moisture in coal sample by proximate analysis.
10. Determination of viscosity of lubricating oil by Redwood viscometer No.1/No. 2
11. Determination of flash point of lubricating oil by Abel's apparatus
12. Determination of acid value of lubricating oil.
13. Determination of mass of Zn coating on galvanized article.

Minimum nine (09) experiments are to be performed

Text Books

1. Experiments and Calculations in Engineering Chemistry by S. S. Dara, S. Chand & Company LTD.
2. Engineering Chemistry Practical Book by Dipika Jaspal and Arti Malviya.
3. Laboratory Manual on Engineering Chemistry by S. K. Bhasin and Sudha Rani, Dhanpat Rai Publishing Company.

2SF08 - Basics of Electrical Engineering Lab

Teaching Scheme : 02 P

Credit : 01

❖ List of Experiments:

1. To validate Kirchoff's Current Law for DC Circuits .
2. To validate Kirchoff's Voltage Law for DC Circuits
3. To verify Thevenin theorems for DC Circuits.
4. To verify Superposition theorem for DC Circuits.
5. To analyze RLC Series circuit and to plot its phasor diagram.
6. To verify relationships between line and phase values for Star connected load.
7. To verify relationships between line and phase values for Delta connected load.
8. To conduct load test on single phase transformer and pre-determine its efficiency and regulation.
9. Open circuit and short circuit test on Single phase transformer.
10. Demonstration of Earthing

2SF09 - Workshop/Digital Fabrication Lab

Teaching Scheme : 02 P

Credit : 01

Course Objectives:

1. To make familiar with different tools, equipment and to understand their basic purposes.
2. To develop skills and get hands on experience of marking, measuring, cutting, machining, shaping and forming processes.
3. To understand and develop skills for different joining processes.
4. To make the students well versed with basic electrical, electronics and computer components.
5. To understand the modern manufacturing techniques such as CNC, Robotic Operations and 3D printing.

Course Outcomes:

1. Upon completion of this course, the students will gain knowledge of different manufacturing processes, tools & equipment's, which are commonly employed in industries.
2. On completion of this course, the students will be able to improve craftsmanship & fabricate the components using various manufacturing techniques.
3. Students will be conversant with modern electrical, electronics & computer components & their applications

Group A

- 1) **Fitting** : Introduction to different tools , equipment's and operations in Fitting Shop. Prepare one job in the Fitting shop, involving operations like marking, filing, hacksaw cutting, drilling and tapping etc.
- 2) **Sheet Metal** : Introduction to Sheet Metal tools and equipment's, their uses, different sheet metal joints and operations in Sheet Metal. Prepare one job in the Sheet Metal shop.
- 3) **Welding** : Introduction to Welding, welding tools and equipment's, their uses. Brief introduction to different welding processes, different welding joints. Prepare one job in the Welding shop.

- 4) **Smithy** : Introduction to different tools , equipments and Smithy operations like upsetting, drawing ,bending, forming etc. Prepare one job in the smithy shop.
- 5) **Carpentry** : Introduction to different wood working tools , equipment's and machines , types of joints and operations performed in Carpentry Shop. Prepare one job in the Carpentry shop.
- 6) **Machining** :- Introduction and practice of basic machining operations on Drilling , Lathe and shaper machine tools.

Group B

- 1) To identify the computer hardware parts, understand working of these parts, & Assemble demonstrate its working
- 2) Identification of various electrical & electronic components & tools used in domestic/industrial applications
- 3) Development of circuit schematic using EDA tools
- 4) 3D printing demonstration
- 5) Robotic operations demonstration
- 6) CNC operations demonstrations

Note- Students have to perform any 4 practical from group A & any 3 practical from group B

2SAEKNT01 - Introduction to Python

Teaching Scheme : 03 L

Credit : 03

❖ Course Objectives:

Throughout the course, students will be expected to demonstrate their understanding of Introduction to Python by being able to do each of the following:

1. Develop a strong foundational understanding of the Python programming language, including its basic concepts, data types, operators, and control flow structures.
2. Gain proficiency in working with strings, functions, and various data structures such as lists, tuples, and dictionaries.
3. Acquire skills in file handling, data manipulation using Pandas and NumPy, and object-oriented programming principles.

❖ Course Outcomes:

After Successful completion of this course, the student will be able to:

1. Define the basic concepts of Python, including variables, data types, and operators.
2. Explain different string manipulation techniques and functions.
3. Use different data structures in python to perform various operations on data.
4. Implement the concepts and procedures of file handling in Python for real-world scenarios.
5. Utilize the Pandas library to manipulate and analyze data effectively.
6. Demonstrate the application of object-oriented programming principles in Python.

Unit I : Introduction (Hours: 8)

Basic concepts of Python, Variables, Data types, Operators, Conditional Statements, Control Statements, Looping Statements, Global and local variables.

Unit II : Strings and Functions (Hours: 8)

Strings: String Manipulation, Accessing Strings, Basic Operations, String slices.

Function: Functions, defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions

Unit III : Data Structures in Python (Hours: 8)

Lists, Tuple, Dictionaries: Introduction, accessing data structure, operations related to data structure, working with data structures, function related to data structure.

Unit IV : File Handling (Hours: 7)

Opening and closing file, Reading and writing files, Date and Time with its functions, Introduction to Modules and packages

Unit V : Working with Data in Python (Hours: 7)

NumPy library and Manipulation of Data with Pandas

Unit VI : Classes and objects (Hours: 7)

Overview of OOP, Class Definition, Creating Objects, Objects as Arguments, Objects as Return Values, Builtin Class Attributes, Inheritance, Overloading, Overriding, Data hiding

❖ Text Book:

1. Martin C Brown, “Python: The Complete Reference”, McGraw Hill
2. Mueller, J., & Massaron, L. (2019). Python for data science. 2nd edition. Hoboken, NJ, John Wiley & Sons, Inc

❖ Reference Books:

1. Larry Lutz, “Python for Beginners: Step By Step Guide to Learning Python Programming”, CreateSpace Independent Publishing Platform, First edition, ISBN, 1717410588, 9781717410580, 2018
2. Nicholas Ayden, “Python Programming”, Independently Published, First Edition, ISBN, 1707051933, 9781707051939, 2019.
3. Michał Jaworski, Tarek Ziadé, “Expert Python Programming”, Packt Publishing Ltd., Third Edition, ISBN, 9781789808896, 2019.

2SAEKNT02 - Introduction to Python Lab

Teaching Scheme : 02 P

Credit : 01

❖ List of Experiments/ Practical's :

1. Introduction and Installation of Python.
2. Write a python program to find largest of three numbers.
3. Write a python script that prints prime numbers less than 20.
4. Write python program in which a function is defined and calling that function prints Hello World
5. Write python program to store data in list and then try to print them.
6. Write python program to print list of numbers using range and for loop
7. Write python program to demonstrate working with dictionaries in python.
8. Write python program to demonstrate working with tuples in python.
9. Write python program to create, concatenate and print the string and accessing substring from given string.
10. Write python program to load data from dataset and analyze the data.
11. Write python program to subtract five days from current date.
12. Write python program to convert string to date-time.

B.Tech. Third Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
3SA01	Discrete Mathematics	02	00	00	02

Course Prerequisite: Basic knowledge of Mathematics.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Discrete Structure by being able to do each of the following:

1. Learn basic terminology, formal logic, proofs, sets, relations, functions, and recursion.
2. Use formal logic proof and logical reasoning to solve problems.
3. Relate the ideas of mathematical induction to recursion and recursively defined structures.
4. Relate interpret and apply the concepts of discrete mathematics to various areas of Computer Science.

Course Outcomes:

On completion of the course, the students will be able to

1. Describe predicates, quantifiers, and logical connectives.
2. Explain deductive logic and examine the solution based on logical inference.
3. Examine properties of relations and identify equivalence and partial order relations.
4. Investigate Semi-group and monoids, and Product and Quotient of Groups.
5. Assess algebraic structure for a given mathematical problem.
6. Inspect different traversal methods for trees and graphs.

	Subject: (3SA01) Discrete Mathematics	L
Unit-1	Mathematical Logic: Statements & Notation, Connectives, Equivalence Formula, Duality Law, Tautological Implication, Normal forms.	05
Unit-2	Theory of inference: The theory of inference for the statement calculus, Validity using truth tables, Predicate calculus, Inference theory of the Predicate Calculus.	05
Unit-3	Set Theory: Basic concepts, Venn Diagrams, Representation of Discrete Structure, Relation and ordering, Partial Ordering, Functions, Recursions, Sets and predicates.	05
Unit-4	Algebraic Structures: Semi-groups and Monoids, Product & Quotients of semi-groups, Polish expression & their compilation, Groups, Product and Quotients of Groups.	05
Unit-5	Lattice & Boolean Algebra: Boolean algebra, Functions on Boolean Algebra, Boolean Functions as Boolean Polynomials, Minimization of Boolean Functions.	05

Unit-6	Graphs Theory: Basic concepts, Paths, Reachability & connectedness, Matrix representation of graphs, Trees: tree searching, undirected trees.	05
	Total	30

Text Book:

J.P.Trembley and R.Manohar, “Discrete Mathematical Structures with application to Computer Science” 1988 (MCG)

Reference Books:

1. C.L.Liu : “Combinational Mathematics” Mc Graw Hill, 1988.
2. Stanant “Discrete Structure” Prentice Hall.
3. C.L.Liu “Element of Discrete Mathematics” Second Edition McGrawHill, 1987.
4. Norman L.Biggs “Discrete Mathematics” Second Edition, Oxford.

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Course Code	Course Title	L	T	P	C
3SA02	Data Structures	03	00	00	03

Course Prerequisite: Basic Knowledge of Programming and Discrete Mathematics.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Structure by being able to do each of the following:

1. To understand the linear and nonlinear data Structures and its memory representations.
2. To perform different operations on data structures such as insertion, deletion, searching and traversing.
3. To understand various data searching and sorting methods with its complexity.
4. To introduce various techniques for representation of the data in the real world.

Course Outcomes:

On completion of the course, the students will be able to

1. Describe algorithm complexity and string processing techniques.
2. Discuss linear arrays and record structures using sorting and searching algorithms.
3. Examine memory representation and operations on linked lists, including insertion, deletion, and traversal.
4. Analyze stack and queue data structures and recursions.
5. Inspect binary trees and binary search trees.
6. Design graphs using traversal algorithms and illustrate the efficiency of sorting algorithms.

	Subject: (3SA02) Data Structures	L
Unit-1	Introduction to Data Structures: Introduction to Data structures, Data Structure Operations, Algorithmic Notation, and Complexity of algorithms. String processing: storing strings, character data type, string operations, word processing, and First pattern matching algorithm.	07
Unit-2	Array & Record Structure: Linear arrays: Memory Representation of arrays, traversing linear arrays, insertion & deletion operations, Bubble sort, linear search and Binary search algorithms. Multi-dimensional arrays, Pointer arrays. Record structures and Matrices.	07
Unit-3	Linked lists: Linked lists: Memory Representation of Linked List, traversing a linked list, searching a linked list. Memory allocation & garbage collection. Insertion & deletion operations on linked lists. Header linked lists, Two- way linked lists.	07

Unit-4	Stack & Queue: Stacks: Sequential Memory Representation of Stack, Arithmetic expressions: Polish notation. Recursion, Tower of Hanoi. Queues: Sequential Memory Representation of Queue, DE Queue, Priority queues.	07
Unit-5	Trees: Introduction to Trees, Binary trees, Memory Representation of Binary Tree, Traversing binary trees, Header nodes, Binary Search Tree, Heap and heap sort, Path length & Huffman's algorithm.	07
Unit-6	Graph & Sorting Algorithms: Introduction to Graphs, Memory representation of graphs, Warshalls' algorithm, operations on Graphs, Breadth First Search, Depth First Search, Sorting: Insertion Sort, Selection Sort.	07
	Total	42

Text Book:

Seymour Lipschutz: Data Structures, Schaum's Outline Series, McGraw-Hill, International Editions.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni: Fundamentals of Data Structures, CBS Publications.
2. Data Structure Using C, Balagurusamy.
3. Standish: Data Structures in Java, Pearson Education.
4. Trembley, Sorenson: An Introduction to Data Structures with Applications, McGraw Hill.

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Course code	Course Title	L	T	P	C
3SA03	Programming Methodology	02	00	00	02

Course Prerequisite: Basic Knowledge of Programming

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Object-Oriented Programming by being able to do each of the following:

1. To learn object-oriented concepts using Java programming language.
2. To implement classical problems using object-oriented programming.
3. To demonstrate software development skills using Java programming language for real-world applications.

Course Outcomes: On completion of the course, student will be able to–

1. Describe the basics of object-oriented design concepts like classes, objects, encapsulation, abstraction, inheritance, and polymorphism.
2. Outline the different methods and classes and objects.
3. Examine the concept of Inheritance and Polymorphism.
4. Identify the Exception Handling Techniques.
5. Inspect applications in Java by applying concepts like interfaces, packages and exception handling.
6. Construct application using Java concepts like API, Event Handling, Swing and AWT.

	Subject: (3SA03) Programming Methodology	L
Unit-1	Introduction to Object Oriented Programming: Introduction, Need of OOP, Principles of Object-Oriented Languages, Java Virtual Machine, Java Features, Program Structures, Variables, Primitive Data Types, Identifier, Literals, Operators, Primitive Type Conversion and Casting, Flow of Control.	05
Unit-2	Classes and Objects Classes: Objects, Methods, Constructors, Class Variable, this keyword, Arrays, Command Line Arguments, User-defined inputs using I/O package.	05
Unit-3	Inheritance and Polymorphism: Inheritance, Method Overriding, super keyword, final keyword, Abstract class, polymorphism, Interfaces, Packages.	05

Unit-4	Exception Handling and File Handling: Introduction to Exception, Exception handling Techniques, User-defined exception. Input/ Output The java.io.File Class, Reading and Writing Files using Java I/O packages, Random Access Files.	05
Unit-5	AWT and Event Handling: Introduction to AWT, Components and Containers, Layout Managers, Basic AWT Components (Label, TextField, Button), Event Handling, Event Sources, Listeners, Adapters and Anonymous Inner Classes.	05
Unit-6	Exploring Swing: Introduction to Swing and its Features, Simple Swing Application, MVC Architecture, Layout Managers, Swing Components: JLabel, ImageIcon, JTextField, JButton, JToggleButton, JCheckBox, JRadioButton, JList, JComboBox.	05
	Total	30

Text Book:

1. Herbert Schildt: Java Complete References (McGraw Hill) (7th Edition).

Reference Books:

1. E. Balagurusamy: Programming with Java (McGraw Hill)
2. Sachin Malhotra and Saurabh Choudhary: Programming in Java, Oxford University Press 2010.
3. Khalid Mughal: A Programmer's Guide to Java Certification, 3rd Edition (Pearson)
4. Liang: A text Book of Java Programming, (PHI)
5. Sharnam Shah and Vaishali Shah: Core Java for Beginners, (SPD), 2010.

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Course Code	Course Title	L	T	P	C
3SA04	Analog and Digital Electronics	02	00	00	02

Course Prerequisite: Applied Physics and Basics of Electrical Engineering.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding by being able to do each of the following:

1. To get the introductory knowledge of basic analog devices like PN Junction Diode, Bipolar Junction Transistor and Field Effect Transistor.
2. To understand number systems and conversion between different number systems.
3. To get basic knowledge about digital ICs and digital systems.
4. To study the design of combinational circuits and sequential circuits

Course Outcomes: On completion of the course, the students will be able to

1. Describe the basic concepts of semiconductor devices.
2. Explain BJT operations and characteristics.
3. Examine different operational amplifier and its application.
4. Compare and contrast different Number System and basics of conversion of number systems.
5. Realize different minimization techniques to obtain minimized expressions.
6. Design Combinational and Sequential Circuits.

	Subject: (3SA04) Analog and Digital Electronics	L
Unit-1	PN Diode and its application: PN-Junction Diode, Characteristics and Parameters, Static and Dynamic Resistance, Zener diode: Characteristics and application as Voltage regulator.	05
Unit-2	BJT FET and MOSFET: BJT operation, BJT Voltages and Currents, BJT as Switch, Common-Base Characteristics, Common-Emitter Characteristics, Common-Collector Characteristics.	05
Unit-3	FET and MOSFET: Basic operation of Junction Field Effect Transistors, MOSFETs & CMOS. Introduction to Operational amplifier.	05
Unit-4	Number System & Minimization Technique: Binary Number System, Signed and unsigned Number, Octal Number System, Hexadecimal Number System, Conversions Between Number Systems, 1s and 2s Complements Representation, Subtraction using 1's and 2's Complements, Gray Code Minimization Technique: Logic Gates, Karnaugh Map (up to 4 variable).	05
Unit-5	Combinational Circuits: Introduction, Design Procedure, Adders, Subtractors, Binary Parallel Adder, 4 Bit Parallel Subtractor BCD adder, BCD Subtractor, Multiplexer, De-multiplexer.	05

Unit-6	Sequential Circuits: Flip-flops: S-R, J-K, Master slave J-K, D-type, T-type, Registers: SISO, SIPO, PISO, PIPO, Counters: Asynchronous and Synchronous counter, Up/Down counter.	05
	Total	30

Text Book:

1. David A. Bell: “Electronic Devices and Circuits”, 5th Ed, Oxford University Press.
2. Jain R.P. “Modern Digital Electronics”, 3rd Ed, TMH.

References:

1. Anand Kumar, Pulse and Digital Circuits, Prentice-Hall of India Pvt. Limited.
2. Morris Mano, "Digital Design", Prentice-Hall, 3rd Edition.

B.Tech. Third Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
3SAOE1A	(Open Elective – 1(A)) Social Science	03	00	00	03

Course Prerequisite: Nil.

Course Learning Objectives:

1. Understand key social science concepts, Indian culture, social structures, and governance.
2. Study the impact of industry and environment on society and sustainable development.
3. Identify and evaluate major social problems in the context of Indian society.

Course Outcomes:

After successfully completing the course, students will be able to:

1. Understand the basic concepts in social science in the era of globalization
2. Comprehend the knowledge of Indian Culture, social structure and marriage institutions in India
3. Understand the environment in industry and its impact on society
4. Understand the Indian federal system and its executive framework
5. Explore the major social problems in India
6. Understand the human society and social sustainable development.

	Subject: (3SAOE1A) (Open Elective - 1) Social Science	L
Unit-1	Introduction to Social Science: Importance to Engineer, Seven categories of Social Sciences (Anthropology, Sociology, History, Geography, Political science, Economics and Linguistics), Rural and Urban problems associated with society.	07
Unit-2	Fundamental concept in social science: i. Indian Culture- Aryan culture and Dravidian Culture ii. Social structure and social system in India. iii. Family and marriage institutions in India.	07
Unit-3	Impact of Industrialization on society: i. Environment in industry with development of science and technology. ii. Fatigue of workers. iii. Motivation, selection and training of workers.	07
Unit-4	Indian Constitution and Parliament: Salient features of Indian constitution. Fundamental Rights and Duties. Directive Principles of State, Composition and powers of Indian Parliament, President of India: Election and Powers. Prime Ministers and Council of Minister.	07

Unit-5	Major social problems in India: i. Illiteracy ii. Un-employment iii. High population. iv. Poverty. v. Corruption.	07
Unit-6	Human Society and Environment: i. Human values and professional ethics. ii. General issues on environment ecology, bi-diversity and climate change. iii. Economics and social sustainable development iv. Human resource management, public health, law enforcement and good governance.	07
	Total	42

Text Books:

1. Social Problems in India, Ram Ahuja, Rawat Publication New Delhi.
2. A New Look into Social Sciences: Sheikh Sabir, A.M. Shiekh and Jaya Dwadshiwar, Sage Publication New Delhi.
3. Ethical Science, Dr. G. N. Nimbarte, Dattson Publication, Nagpur.

Reference Books:

1. Labour Problems and Social Welfare: R. C. Saxsena, Prakashan Kendra, Lucknow.
2. Introduction to Sociology, Vidhyabhushan and Sachdeva, KitabMahal, New Delhi

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Course Code	Course Title	L	T	P	C
3SAOE1B	(Open Elective – 1(B)) Ancient Management Paradigms	03	00	00	03

Course Prerequisite: Nil

Course Learning Objectives:

The course is designed with the following main objectives

1. To identify some of the commonly felt problems that individuals, organizations and the society faces.
2. To illustrate the usefulness of Gita in addressing real-life problems and challenges.
3. To demonstrate how alternative world views and paradigms of management could be developed with a knowledge of Ancient Indian wisdom such as Gita.
4. To provide a good introduction to Ancient Indian wisdom using Gita as a vehicle

Course Outcomes:

After successfully completing the course, students will be able to-

1. Describe the insights into ethics and values to promote meaningful impact in organizations.
2. Discuss the notion of spirituality in workplace.
3. Develop an understanding about leadership excellence.
4. Examine insights into how to make effective choices.
5. Assess the concepts of contemporary management and value-based leadership.
6. Analyze the insights about how to lead a life with excellence and happiness.

	Subject: 3SAOE1B (Open Elective - 1) Ancient Management Paradigms	L
Unit-1	Spirituality in Business and Workplace: Current Challenges in Business Management & Society, Relevance of Ancient Indian Wisdom for contemporary society, Spirituality in Business, Visada Yoga, Sankhya Yoga, Karma Yoga.	07
Unit-2	Spirituality in Workplace: The notion of Spirituality, An introduction to Bhagavad Gita & its relevance, Jnana Yoga, Karma Vairagya Yoga.	07
Unit-3	Perspectives on Leadership: Abhyasa Yoga, Paramahansa Vijnana Yoga, Perspectives on Leadership, Failed Leadership: Causes & Concerns, Leadership Perspectives in the Gita.	07
Unit-4	Perspectives on Work: Aksara-Parabrahman Yoga, Raja-Vidya-Guhya Yoga, Vibhuti-Vistara-Yoga, Perspectives on Work, Axioms of Work & Performance, The Notion of Meaningful Work.	07
Unit-5	Perspectives on Self-Management: Mind as a key player in an individual, Meditation as a tool for self-management, Role of Yoga in addressing stress & burnout of managers, Mind as a key player in an individual, Visvarupa-Darsana Yoga, Bhakti Yoga, Ksetra-Ksetrajna Vibhaga Yoga	07

Unit-6	Perspectives on Understanding: Self-Management by understanding the world within, Values & their role in Self-management, Shaping the personality through Trigunas, Gunatraya-Vibhaga Yoga, Purusottama Yoga.	07
	Total	42

Prescribed Books:

1. The Bhagabad Gita- S. Radhakrishnan (Trs & Ed)
2. Bhagwat Gita from Geeta Press, Gorakhpur, UP.

Reference Books:

1. Mahadevan, B. Writings on Gita & Management, Amazon Asia-Pacific Holdings Private Limited.
2. Swami Ranganathananda, (2001), “Universal Message of the Bhagavad Gita”, 3 Volumes, Advaita Ashrama, Kolkata.
3. Swami Dayananda Saraswati, (2007), “The value of values”, Arsha Vidya Research & Publication Trust, Chennai.
4. Swami Chinmayananda, (1996), “Holy Geeta”, Central Chinmaya Mission Trust, Mumbai.
5. Concept of Yoga in the Gita- S. C. Panigrahi
6. Bhagabad Gita & Modern Life- K. M. Munshi & R. R. Diwakar
7. The Lord Speaks (2016)- B. K. Tripathy
8. Srīmad Bhagabad Gita Bhasya of Sri Sankaracharya- A. G. K. Warriar (Trs)
9. The Ethical Philosophy of Gita- P. N. Srinivasachari

Suggested Online Link:

1. <https://www.youtube.com/watch?v=8g90E9nBnyE> (English)
2. <https://www.youtube.com/watch?v=Tsg3lWHCm0k> (Hindi)

B.Tech. Third Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
3SAOE1C	(Open Elective – 1(C)) Introduction to Constitutional Law	03	00	00	03

Course Prerequisite: Nil.

Course Learning Objectives:

The course is designed with the following main objectives

1. Explain the basic principles of the Constitution and the salient features of the Indian Constitution.
2. Examine the distinction between Fundamental Rights and Directive Principles, and evaluate their enforceability and the constitutional remedies available.
3. The reasons and justifications of the growth of fundamental rights in India have to be understood through judicial intervention.
4. Explore the setup and powers of the Constitutional Judiciary in India, focusing on the jurisdiction and independence of Supreme Court and High Courts.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Describe foundational concepts of the Indian Constitution, such as its preamble's significance and interpretive role.
2. Discuss the Prescription of fundamental rights and Human rights and its Judicial Interpretation.
3. Examine the concept of Right to Equality & the different facets of Right to Freedoms.
4. Investigate the concept of Freedom against exploitation, freedom of religion, Minority Rights and the Constitutional remedies for violation of fundamental rights.
5. Assess the concept of directives principles and its relations with fundamental rights.
6. Inspect the Constitutional Judiciary's role within India's legal framework, including its jurisdiction, independence, and the power of judicial review.

	Subject: 3SAOE1C (Open Elective - 1) Introduction to Constitutional Law	L
Unit-1	Historical Backgrounds to the framing of the Indian, Constitution: General Idea about the Constitution. Assembly of India, Preamble- Nature & significance and Salient Features of the Constitution of India.	07
Unit-2	Fundamental Rights: Its meaning, nature & significance, Relationship of fundamental Rights and Human Rights, Citizenship, State: Definition and Judicial Interpretation. [A. 12], Law: Meaning of Law and Judicial Review, Laws inconsistent with, or in derogation of fundamental Rights; Doctrine of severability.	07
Unit-3	Right to Equality [A. 14 to A. 18]: Concept and significance of the Right to Equality, Doctrine of Reasonable classification, Prohibition Against Discrimination, Equality in Public Employments, Abolition of Untouchability. Right to Freedoms [A. 19 to A. 22]: Six fundamental freedoms; Freedom of speech and expression, Freedom to assemble peacefully and without arms, Freedom to from Associations and unions, Freedom to move freely throughout the territory of India, Freedom to practice any profession or to carry on any occupation,	07

	trade or business. Protection in Respect of Conviction for offences: No ex-post-facto Law, No Double Jeopardy, No Self- Incrimination.	
Unit-4	Right to Life and Personal Liberty, Right to Education. Right against Exploitation [A. 23 and A. 24]: Prohibition of traffic in human beings and forced labour, Prohibition of compulsory services, Prohibition of Child Labour. Right to Freedom of Religion [A. 25 to A. 28]. Cultural and Educational Right [A. 29 and A, 30].	07
Unit-5	Right to Constitutional Remedies [A. 32]: Writs; Types and Scope Directive Principal of State Policy [A. 36to A.51]: Concept of Welfare State and Social Justice, Meaning, Nature and Significance of Directive Principles, Fundamental Duties [A. 52-A].	07
Unit-6	Constitutional Judiciary and the power of Judicial Review Judicial Setup in India; Difference between Constitutional Courts, Courts and Tribunals Constitutional Courts- Supreme Court and High Courts - Jurisdiction and power Independence of Judiciary under Indian Constitution, Judicial Appointments etc.	07
	Total	42

Text Books:

1. G C V Subba Rao, Indian Constitutional Law, S Gogia& Company, Hyderabad
2. J N Pandey, Constitutional Law of India, Central Law Agency, Allahabad
3. Dr D DBasu, Introduction to the Constitution of India, Butterworth Lexis Nexis.

Reference Books:

1. M P Jain, Indian Constitutional Law, Wadhwa& Company, Nagpur.
2. V N Shukla, Constitution of India, Eastern Book Company, Lucknow.
3. Granville Austin, Indian Constitution: Cornerstone of a Nation, Oxford University Press, New Delhi.
4. H. M. Seervai, Constitutional Law of India (3 Volumes) Universal Law Publishing Co Pvt Ltd.

B.Tech. Third Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
3SA05	Financial Literacy	02	00	00	02

Course Prerequisite: General Awareness, Logical and Analytical Thinking.

Course Learning Objectives:

1. Explain foundation of financial literacy such as savings, investment, taxation, and insurance
2. Teach the relevance and process of financial planning
3. Relate and promote financial well-being

Course Outcomes: On completion of the course, the students will be able to

1. Describe different types of accounts and investment instruments.
2. Explain different types of government investment policies.
3. Examine different Equity Linked Savings Schemes and Deposit Schemes.
4. Identify different types of Loans and roles of Reserve Bank of India.
5. Assess various banking and insurance products.
6. Inspect financial market and different products.

	Subject: (3SA05) Financial Literacy	L
Unit-1	Basics of Savings and Investment: Why are investing and savings important? Savings Vs Investment, Power of Compounding, What should be the investment objectives?	05
Unit-2	Risk and Return, Inflation effects on Investment, Investor's Age and Assets Allocation. Tax saving Schemes Government Schemes-National Saving Certificates, Public Provident Fund, Post Office Schemes.	05
Unit-3	Equity Linked Savings Schemes, Retirement Benefits Schemes- NPS (New Pension System), Banking Activities: Deposits and Types of Deposits-Saving Bank Accounts, Fixed Deposit Accounts, Recurring Deposit Account, Special Term Deposit Schemes.	05
Unit-4	Loans and Types of loan advanced by Banks and Other secondary functions of Bank. Banking structure in India and Role of Reserve Bank of India.	05
Unit-5	Insurance related Products: Role of Insurance as risk management tool, various types of Insurance: Life Insurance, Term Life Insurance, Endowment Policies, ULIP, Health Insurance, Regulatory role of IRDA.	05
Unit-6	Financial Markets: Capital Market Vs Money Market, Securities and its types, i.e., Equity, Debentures or Bonds, IPOs and FPOs, Mutual Funds, Types of Mutual Funds, Brokers, sub-brokers.	05
	Total	30

Reference Books:

1. Investment Planning by SEBI
2. Indian financial System, by T.R.Jain and R.L.Sharma, V.K. Global Publisher
3. Money and Banking by T.R. Jain and R.K. Kaundal, VK Global Publisher
4. Kothari, R. (2010). Financial Services in India.
5. Financial Literacy Education by A. Zokaityte. Publisher: Palgrave Macmillan.
6. Investment Management by V.A. Avadhani. Publisher: Himalaya Publishing House Pvt. Ltd.

Term Work:

Students should complete the following activities:

1. Prepare a personal monthly budget and a basic saving plan using real-life data.
2. Analyze case studies of investment options such as Mutual Funds, PPF, NPS, or Insurance schemes.
3. Prepare a comparative report on different banking products and loan types.
4. Submit assignments based on financial markets, securities, and government schemes.

Marking Scheme: (Distribution of 50 Marks (Teacher Assessment))

1. Assignment Based Evaluation (15 Marks)
2. Financial report plan (15 Marks)
3. MCQ Test Based Evaluation (20 Marks)

B.Tech. Third Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
3SA06	Environmental Science	02	00	00	02

Course Prerequisite: Nil

Course Learning Objectives:

1. The importance of Environmental Studies.
2. The need of renewable and non-renewable energy resources.
3. The components, structures and types of ecosystems.
4. The Impact of different types of pollution.

Course Outcomes: On completion of the course, the students will be able to

1. Understand the scope and importance of environmental studies.
2. Apply the knowledge of renewable and non-renewable energy resources.
3. Understand the concept of ecosystem.
4. Apply the knowledge of environmental pollution.
5. Understand the current environmental issues of India.
6. Understand the role of Information Technology in environment and human health.

	Subject: (3SA06) Environmental Science	L
Unit-1	The Multidisciplinary nature of environmental studies: Definition, scope and importance, Need for public awareness.	05
Unit-2	Renewable and non renewable resources: Natural resources and associated problems, Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people. Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Energy Resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, case studies, Role of individual in conservation of natural resources.	05
Unit-3	Eco Systems: Concept of an eco system, structure and function of an eco system, Producers, consumers, decomposers, Food chains, food webs. Introduction, types, characteristic features, structure and function of the following eco systems: Forest ecosystem, Grass land ecosystem, Desert ecosystem, Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)	05
Unit-4	Environmental Pollution: Definition, Causes, effects and control measures of: Air pollution, Water pollution, Noise pollution, role of an individual in prevention of pollution, Pollution Case Studies.	05

Unit-5	Current Environmental Issues in India: Water conservation-development of watersheds, Rain water harvesting and ground water recharge, Eutrophication and restoration of lakes, Conservation of wetlands, Ramsar sites in India. Climate Changes – Global warming, Acid rain, Ozone layer Deflection, Waste Management - Swachha Bharat Abhiyan.	05
Unit-6	Human population and the environment: Population explosion- family welfare program, Environment and human health, Human rights, Women and child welfare, Role of information technology in Environment and human health. Visit to environment assets-river / forest / grassland / hill / mountain. Visit to a polluted site-urban/rural/industrial/agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hills slopes, etc (field work equal to 5 lecture works)	05
	Total	30

Text Book:

1. Textbook of Environmental studies, Erach Bharucha, UGC.

Reference Books:

1. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd.
2. Environmental studies, Nidhi Dhawan, Kiran Bist, I.K. International House Pvt, Ltd.

Term Work: 50 Marks

Marking Scheme:

1. Field Visit – 10 Marks
2. Attendance – 10 Marks
3. Class Test (Internal) – 10 Marks
4. Assignment (2 Nos.) – 20 Mark

B.Tech. Third Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
3SA07	Data Structures Lab	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Structures Lab by being able to do each of the following:

1. Demonstrate the ability to implement and analyze basic data structures and algorithms.
2. Develop problem-solving skills using appropriate data structures and algorithmic techniques.
3. Enhance understanding of advanced data structure concepts and their applications.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Data Structures so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 3SA02 – Data Structures Syllabus.

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Course Code	Course Title	L	T	P	C
3SA08	Programming Methodology Lab	00	00	02	01

Course Learning Objectives:

1. Apply object-oriented programming principles using Java to develop modular and reusable applications.
2. Design and implement Java programs with robust exception handling and file I/O operations.
3. To use Java concepts like API, Event Handling, Swing and AWT to develop GUI-based application Programs.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Java for Programming Methodology so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 3SA03 – Programming Methodology Syllabus.

B.Tech. Third Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
3SA09	Analog and Digital Electronics Lab	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Analog and Digital Electronics by being able to do each of the following:

1. To get the introductory knowledge of basic analog devices like PN Junction Diode, Bipolar Junction Transistor and Field Effect Transistor.
2. To get basic knowledge about digital ICs and digital systems.
3. To study the design of combinational circuits and sequential circuits.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Analog and Digital Electronics and so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 3SA04 – Analog and Digital Electronics Syllabus.

B.Tech. Third Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
3SA10	CEP / FP: Innovation and Creativity	00	00	04	02

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Innovation & Creativity by being able to do each of the following:

1. Understand the fundamentals of creative thinking and innovation principles.
2. Apply creative problem-solving techniques to real-world challenges.
3. Develop and refine ideas into functional prototypes using design thinking methods.

Course Outcomes:

On completion of the course, students will be able to-

1. Recognize on real-world examples of creativity, invention, and innovation,
2. Implement creative problem-solving techniques in real-life situations
3. Learn and implement various creative problem-solving techniques, such as brainstorming, lateral thinking, and design thinking.

List of Experiments:

Minimum 8 to 10 practical's are to be performed based on subject related to Innovation and Creativity

1. To discuss on the definitions and distinctions between creativity, invention, and innovation.

Field: Students analyze real-world examples of creativity, invention, and innovation in various industries.

2. To break down the creative process into stages and discuss each stage in detail.

Field: Group activity where students brainstorm and identify examples of each stage in a chosen context.

3. To explore different models or analogies for the creative process

Field: Students create their own creative process model based on their understanding.

4. To discuss theories on creative potential and common blockages.

Field: Self-assessment exercises and group discussions to identify personal creative potential and perceived blockages.

5. To present on common myths and misconceptions about creativity.

Field: Debate or discussion on the validity of these myths and their impact on innovation.

6. To provide a list of practical tips for discovering and applying creative potential.

Field: In-class exercises where students practice these tips and share their experiences.

7. To understand the importance of teamwork in the creative and innovation process.

Field: Group projects where students work together to solve a creative challenge or develop an innovative solution.

8. To discuss examples of nature-inspired innovations (biomimicry).

Field: Outdoor field trip or research assignment where students explore natural phenomena and brainstorm potential applications.

9. To explain the principles of idea generation and brainstorming techniques.

Field: Conduct brainstorming sessions on specific challenges or topics relevant to the course

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SA01	Artificial Intelligence	03	00	00	03

Course Prerequisite: Basic Knowledge of Programming, Introduction to Python, Discrete Mathematics and Data Structures.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of the Artificial Intelligence.

1. To present an overview of Artificial Intelligence (AI) principles and approaches
2. To understand the historical evolution of Artificial Intelligence
3. To learn various searching techniques and identify to address a particular problem

Course Outcomes:

After successfully completing the course, students will be able to-

1. Describe concepts of Artificial Intelligence and different types of intelligent agents and their architecture.
2. Explain different types of uninformed search strategies.
3. Illustrate different types of heuristic search strategies.
4. Investigate various knowledge representation issues.
5. Use predicate logic for knowledge representation.
6. Inspect adversarial search and game theory.

	Subject: (4SA01) Artificial Intelligence	L
Unit-1	Introduction to AI: Introduction: What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Risks and Benefits of AI, Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.	07
Unit-2	Uninformed Search Strategies: Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies: Breadth-First Search, Uniform-Cost Search, Depth First Search, Bidirectional Search, Depth Limited Search, Iterative Deepening Depth-First Search.	07
Unit-3	Informed Search Strategies: Basic Concept of Heuristic Search and Knowledge, Designing of Heuristic Function, Heuristic Search Strategies: Generate-And-Test, Best-First Search, Problem Reduction, Hill Climbing, Constraint Satisfaction, Means-Ends-Analysis.	07
Unit-4	Knowledge Representation and Issues: Representation and Mapping. Approaches to Representation, Issues in Representation: Important attribute, relationship among attributes, choosing the granularity of representation, representing sets of Objects, finding the right structures as needed.	07

Unit-5	Knowledge Representation using Predicate Logic: Representing Simple Facts in Logic, Representing Instance and ISA relationship, Computable Functions and Predicates, Resolution.	07
Unit-6	Adversarial Search & Games: Game Theory, Optimal Decisions in Games, Mini-Max Search, Alpha Beta Pruning, Additional Refinements, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms.	07
	Total	42

Text Book:

1. Artificial Intelligence: A Modern Approach by Stuart Russell & Peter Norvig (Pearson - 4th Ed.)
2. Artificial Intelligence by Elaine Rich and Kevin Knight (Tata McGraw Hill - 3rd Ed.)

Reference Books:

1. Artificial Intelligence by Ela Kumar (IK International Publishing House Pvt. Ltd.)
2. A First Course in Artificial Intelligence by Deepak Khemani (Tata McGraw Hill - 1st Ed.)
3. Artificial Intelligence and Expert Systems by Patterson (PHI)
4. Introduction to Artificial Intelligence by Rajendra Akerkar (PHI Learning Pvt. Ltd.)

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SA02	Operating Systems	03	00	00	03

Course Prerequisite: Computer Fundamentals, Programming Concepts and Data Structures.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of the Operating System.

1. To understand the fundamental concepts and structure of operating systems
2. To study and analyze process management, scheduling, synchronization, and deadlock handling
3. To explore memory management, file systems, and I/O system design.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Explain basic Components and Services of Operating system.
2. Analyze and Solve CPU scheduling problems using different scheduling algorithms.
3. Examine the critical section problem and resolve it.
4. Investigate Memory Management issues like Fragmentation, Virtual Memory Management.
5. Assess File-System Interface and Free Space Management.
6. Evaluate Input-Output Systems and Inspect various disk scheduling algorithms.

	Subject: (4SA02) Operating Systems	L
Unit-1	Introduction to Operating System: Introduction: Operating System definition, OS Evolution, Components and Services, Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Inter-process Communication, Threads Overview, Multithreading Models and Threading Issues.	07
Unit-2	Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SJF, RR, Priority.	07
Unit-3	Process Synchronization: Process Synchronization Basics: The Critical-Section Problem, Synchronization Hardware, Semaphores, Monitors, Deadlocks: Definition & Characterization, Deadlocks Prevention, Avoidance, Detection and Recovery from Deadlock.	07
Unit-4	Memory Management: Memory Management Background, Swapping, Contiguous Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Management: Background, Demand paging scheme, Process Creation, Page Replacement Policies, Allocation of Frames, Thrashing.	07
Unit-5	File-System Interface: Directory Structure, File-System Mounting, File Sharing, Protection. File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, File Recovery.	07

Unit-6	I/O System: I/O Systems: Overview, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O to Hardware Operations, Disk Structure, Disk Scheduling Algorithms: FCFS, SSTF, SCAN, C-SCAN, LOOK, C- LOOK, Disk Management, Swap-Space Management, RAID Structure.	07
	Total	42

Text Book:

1. Avi Silberschatz, P.B.Galvin, G.Gagne: “Operating System Concepts” (9/e) John-Wiley & Sons.

Reference Books:

1. A.S Tanenbaum “Modern Operating Systems” Pearson Education.
2. William Stallings “Operating Systems” Prentice-Hall.
3. D M Dhamdhare “Operating Systems” Tata McGraw-Hill.
4. P.Balkrishna Prasad: “Operating Systems” Scitech Publications (I) Pvt. Ltd.

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SA03	Theory of Computation	03	00	00	03

Course Prerequisite: Discrete Mathematics, Data Structures and Basic Knowledge of Programming.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of the Theory of Computation.

1. To understand different automata theory and its operation.
2. To understand mathematical expressions for the formal languages.
3. To study computing machines and comparing different types of computational models.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Describe the basic concepts of formal languages of finite automata techniques.
2. Explain the formal relationships among machines, languages and grammars.
3. Classify properties of Regular Languages.
4. Examine context free grammar for various languages.
5. Design Push Down Automata for given languages.
6. Inspect computability, decidability, recursive function theory for problem solving.

	Subject: (4SA03) Theory of Computation	L
Unit-1	Finite State Machines: Alphabet, String, Formal and Natural Language, Operations, Definition and Design DFA (Deterministic Finite Automata), NFA (Non-Deterministic Finite Automata), Conversion of NFA into DFA. Conversion of NFA with epsilon moves to DFA.	07
Unit-2	Regular Expression and Regular Sets: Definition and Identities of Regular Expressions, Construction of Regular Expression of the given Language, Construction of Language from the RE, Conversion of FA to RE using Arden's Theorem, Regular grammar.	07
Unit-3	Properties Of Regular Languages: Pumping Lemma for Regular Languages, Applications of the Pumping Lemma, Closure properties of RLs (proofs not required), Decision Properties of Regular Languages, Equivalence and Minimization of Automata, Regular Grammar.	07
Unit-4	Context Free Grammar and Languages: Introduction of CFG, Derivation Process: Leftmost Derivation, Rightmost Derivation, Derivation Trees, Ambiguous grammar, Simplification of CFG, Normal Forms (CNF and GNF).	07
Unit-5	Pushdown Automata: Introduction and Definition of PDA, Construction of PDA, Acceptance of CFL, Equivalence of CFL and PDA: Inter-conversion, Introduction of DCFL and DPDA, Context Sensitive Language, Linear Bounded Automata.	07

Unit-6	Un-Decidability: Decidability and Undecidability, Properties of recursive & non-recursive enumerable languages, Complements of recursive and RE languages, Post's Correspondence Problem, other undecidable Problems, Introduction to recursive function theory.	07
	Total	42

Text Book:

1. Hopcraft H.E. and Ullman J: Introduction to Automata Theory, Languages and Computation.
2. Mishra and Chandrasekharan: Theory of Computation, PHI,3rd Edition.

Reference Books:

1. Rajesh K. Shukla: Theory of Computation, CENGAGE Learning, 2009.
2. K V N Sunitha and N Kalyani: Formal Languages and Automata Theory, McGraw Hill,2010.
3. Lewis H.P. and Papadimitriou C.H.: Elements of Theory of Computation.
4. C. K. Nagpal: Formal Languages and Automata Theory, Oxford University Press, 2011.
5. Vivek Kulkarni: Theory of Computation, OUP India, 2013.
6. Peter Linz: An Introduction to Formal Languages and Automata.

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SAOE2A	Intellectual Property Right	03	00	00	03

Course Prerequisite: Nil

Course Learning Objectives:

1. Impart awareness on Intellectual Property Rights (IPR) and various regulatory issues related to IPR
2. Familiarize students with the shades of Intellectual Property Rights (IPR)
3. Awareness on intellectual property rights and various regulatory issues related to IPR.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Define the concept of intellectual property and list its various forms.
2. Explain the process of obtaining a patent, including eligibility criteria and rights associated with patents.
3. Apply copyright laws to determine eligibility for protection and understand procedures for registration.
4. Analyze trademark classification and evaluate criteria for registration.
5. Synthesize understanding to develop strategies for registration and protection of industrial designs.
6. Evaluate the significance of trade secrets in business operations and analyze precautionary measures for protection.

	Subject: 4SAOE2A (Open Elective – 2(A)) Intellectual Property Right	L
Unit-1	Introduction to Intellectual Property Rights: Role of IP in the Economic and Cultural Development of the Society, IP Governance. IP as a Global Indicator of Innovation, Origin of IP, History of IP in India. Patents, Copyrights and Related Rights, Trademarks, Trade Secrets	07
Unit-2	Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention, Rights Associated with Patents, Enforcement of Patent Rights, Inventions Eligible for Patenting, Non-Patentable Matters, Patent Infringements, Process of Patenting.	07
Unit-3	Copyrights: Classes of Copyrights, Criteria for Copyright, Ownership of Copyright, Copyrights of the Author, Copyright Infringements, Liability of Owner of an Auditorium/Hall, Fair Use Doctrine, Non-Copyright Work, Copyright Registration, Judicial Powers of the Registrar of Copyrights, Fee Structure, Copyright Symbol, Validity of Copyright.	07
Unit-4	Trademarks: Eligibility Criteria, Who Can Apply for a Trademark, Acts and Laws, Designation of Trademark Symbols, Classification of Trademarks, Registration of a Trademark is Not Compulsory, Validity of Trademark, Types of Trademarks Registered in India, Trademark Registry, Process for Trademarks Registration. Famous Case Law: Coca-Cola Company vs. Bisleri International Pvt. Ltd.	07

Unit-5	Industrial Design: Eligibility Criteria, Acts and Laws to Govern Industrial Designs, Design Rights, Enforcement of Design Rights, Non-Protectable Industrial Designs India, Protection Term, Procedure for Registration of Industrial Designs, Importance of Design Registration, Cancellation of the Registered Design, Application Forms, Famous Case Law: Apple Inc. vs. Samsung Electronics Co.	07
Unit-6	Trade Secret: Criteria for Trade Secret, Registration and Protection Time of Trade Secrets, Rights Associated with Trade Secrets, Enforcement of Trade Secrets, When to Apply for Trade Secret Protection, Precautionary Measures to be Taken by Enterprises/Organizations, Disparity Between Trade Secrets and Patents, Renowned Trade Secrets	07
	Total	42

Text Book:

1. Prof. Rupinder Tewari and Ms. Mamta Bhardwaj, "Intellectual Property: A Primer for Academia" by, Publication Bureau, Panjab University, Chandigarh, 2021.
2. K. V. Nithyananda, "Intellectual Property Rights: Protection and Management", by Cengage Learning India Private Limited, 2019.

Reference Books:

1. Deborah E. Bouchoux, "Intellectual Property for Paralegals – The Law of Trademarks, Copyrights, Patents & Trade Secrets", 4th Edition, Cengage Learning, 2012.
2. N. S. Gopalakrishnan and T. G. Agitha, "Principles of Intellectual Property", Eastern Book Company, Lucknow, 2009.
3. M. M. S. Karki, "Intellectual Property Rights: Basic Concepts", Atlantic Publishers, 2009.
4. Ganguli Prabuddha, "Intellectual Property Rights--Unleashing the Knowledge Economy", Tata McGraw Hill, 2001.

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SAOE2B	Introduction to Cyber Law	03	00	00	03

Course Prerequisite: Nil.

Course Learning Objectives:

1. Introduction to basics of Computer, Internet and Cyber Law.
2. Demonstrate the concepts of e-Commerce and Inspect the principles of Information Technology Act, 2000.
3. Describe Cyber Crimes and, Enlist and predict the types of Cyber Crimes.
4. Examine the Internet Security issues.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Describe the fundamentals of computer, internet and cyber law.
2. Outline the fundamentals of E-Commerce.
3. Illustrate the knowledge of cybercrimes.
4. Classify the cybercrimes.
5. Explain the principles of Information Technology Act.
6. Inspect the Internet security issues.

	Subject: 4SAOE2B (Open Elective – 2(B)) Introduction to Cyber Law	L
Unit-1	Fundamentals of Computer, Internet and Cyber Law Functional Components of Computer, applications of computers, Internet architecture, world wide web, internet server and types, Need for Cyber Law, difference between Cyber Crimes and Conventional Crimes.	07
Unit-2	Introduction to E-Commerce Electronic data interchange and legal issues, e-commerce models, e-banking, credit card, e-mail, e-governance and objective, models and types.	07
Unit-3	Concepts of Cyber Crime Characteristics of Cyber Crime, Causes and Measures to combat Cyber Crimes, Cyber Crimes against Individuals, Institution and State.	07
Unit-4	Categories of Cyber Crimes Classification of Cyber Crimes, Hacking, Cracking, Digital Forgery, Cyber Stalking/ Harassment, cyber terrorism, Cyber Pornography and Obscenity, Identity Theft, Cyber Defamation, Virus attacks, Computer Fraud, Social Networking Crimes.	07

Unit-5	Information Technology Act, 2000 Silent features of Information Technology Act, 2000, Definitions, Digital Signatures and Certificates, Security Procedures, Electronic Contracts, Penalties and Adjudication, Liabilities of Service Providers.	07
Unit-6	Internet Security: Internet Security, ethical issues of Information Technology- software piracy, firewall and types of firewalls, biometrics and internet security products software.	07
	Total	42

Recommended Books:

1. Pavan Duggal, "Cyber Law", LexisNexis India Publication, 2023, ISBN: INK8196241070.
2. Pavan Duggal, "Cyber Frauds, Cybercrimes and Law in India", Cyber Law University Publication, 2023.
3. Nilakshi Jain, Ramesh Menon, "Cyber Security and Cyber Laws", Wiley India, 2020, ISBN: 9390395755
Sharma Vakul - Information Technology Law and Practice
4. Nandan Kamath, "Law Relating to Computer, Internet and E-commerce", LexisNexis India Publication, 5th Edition, 2016, ISBN: 9789350351819.
5. P. Soni, "Cyber Laws", Sony Prakashan, Nagpur, 2020.

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SAOE2C	Stress Management	03	00	00	03

Course Prerequisite: Nil

Course Learning Objectives:

1. Facilitating the Incorporation of Effective Coping Techniques
2. Assisting Students in Achieving a Relaxed Physiological State
3. Exploring the Role of Yoga in Stress Management.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Recall the etymology and definitions of yoga.
2. Explain the principles of yoga and yogic practices.
3. Explain the relationship between mind and body in stress management.
4. Apply yoga techniques for managing stress in various life situations.
5. Analyze the relationship between yogic diet and nutrients for positive health.
6. Practice pranayamas and meditative asanas for relaxation and mental clarity.

	Subject: 4SAOE2C (Open Elective – 2(C)) Stress Management	L
Unit-1	Introduction to Yoga and Yogic practices: Etymology of Yoga and Definitions of Yoga, History and Development of Yoga, Aim, Objectives and Misconceptions about Yoga.	07
Unit-2	General Introduction: Shad-darshan, four paths of Yoga, Principles of Yoga and Yogic practices.	07
Unit-3	Yoga and Stress Management: Human Psyche: Yoga and Modern Concepts, Stress and Psychosomatic Disorders, Relationship between Mind and Body, Mental Hygiene and Role of Yoga in Mental Hygiene, Mental Health: A Yogic perspective, Prayer and Meditation for Mental Health.	07
Unit-4	Psycho-Social Environment and its importance for Mental Health: Concept of Stress according to Modern Science and Yoga, Role of Yoga in Stress management, Role of Yoga in Life management.	07
Unit-5	Wellness-Prevention and promotion of positive health: Health: meaning and definition, Yogic concepts for health and diseases, Yogic principles for healthy life, Introduction to yogic diet and nutrients.	07
Unit-6	Pranayamas & Meditative Asanas: Pranayamas: Equal breathing, Intercoastal breathing, clavicular breathing, diaphragm breathing, alternate nostril breathing, Relaxative Asanas: Padmasana, Sthitapathanasana, Sukhasana, Vajrasana.	07

	Total	42
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Text Book:

1. Iyengar, BKS. (2003). The Art of Yoga. New Delhi: Harper Collins Publishers.
2. Maguire, Imelda. (2005). Yoga for a Healthy Body. London: Greenwich Editions.

Reference Books:

1. Nagendra, H.R., & Nagarathana, R. (2004). Yoga Practices for Anxiety & Depression. Bangalore: Swami Sukhabodhanandha Yoga Prakashana.
2. Sukhabodhanandha, Swami. (2002). Stress Management. Bangalore: Prasanna Trust.
3. Andrews, Linda Wasmer. (2005). Stress Control for Peace of Mind. London: Greenwich Editions.
4. Yogendra, Hansa Jayadeva, & Desai, Armaiti Neriosand. (1991). Yoga for Back and Joint Disorders. Mumbai: Dr. Jayadeva Yogendra for the Yoga Institute.

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SA04	Business Communication	02	00	00	02

Course Prerequisite: Professional Communication Skill.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of the Business Communications.

1. To develop awareness of the complexity of the communication process.
2. To develop effective listening skills in students so as to enable them to comprehend instructions and become a critical listener.
3. To develop effective oral skills so as to enable students to speak confidently interpersonally as well as in large groups.
4. To develop effective writing skills so as to enable students to write in a clear, concise, persuasive and audience centered manner.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Describe Nature and Process of Communication.
2. Outline importance of Organizational Communication.
3. Discover the importance of Oral Communication and Applications of Conversation Control.
4. Outline guidelines for improving Listening Skills and developing Non-verbal Communication Skills.
5. Examine draft for structured business messages and cover letters.
6. Design Business Letters from standard layout and formal report using different visual aids.

	Subject: (4SA04) Business Communication	L
Unit-1	The Nature and Process of Communication: The Role of Communication, Defining Communication, Classification of Communication, The Purpose of Communication, The Process of Communication, The Elements of Communication, The Major Difficulties in Communication, Barriers to Communication, Conditions for Successful Communication, The Seven C's of Communication, Universal Elements in Communication.	05
Unit-2	Organizational Communication: The Importance of Communication in Management, Communication Concerns of the Manager, Communication Training for Managers, Communication Structures in Organizations, Line and Staff Management, Information to be Communicated at the Workplace. Intercultural Communication Skills: Globalization and Intercultural Communication, The New Global Mantra: Go Local, Cultural Sensitivity, Developing Cultural Intelligence, Guidelines for Intercultural Communication, E-Mail and Intercultural Communication.	05
Unit-3	Oral Communication: What Is Oral Communication? Three Aspects of Oral Communication, INTERCULTURAL COMMUNICATION, Oral Communication and Electronic Media.	05

	Conversation Skills: What is Conversation?, Social Conversation, Effective Conversation, Example: Conversation Control, Applications of Conversation Control.	
Unit-4	Listening: What Is Listening? The Process of Listening, Factors that Adversely Affect Listening, Characteristics of Effective and Ineffective Listeners, Guidelines for Improving Listening Skills, Responsive Listening Non-verbal Communication: What is Non-verbal Communication Characteristics of Non-verbal Communication, Classification of Non-verbal Communication, Responding to Power Posturing, Guidelines for Developing Non-verbal Communication Skills.	05
Unit-5	Written Business Communication: The Art of Writing, The Skills Required in Written Communication, INFORMATORY WRITING, The Purpose of Writing, PERSUASIVE WRITING, Clarity in Writing, EXAMPLES OF CLEAR AND UNCLEAR WRITING, REWRITING A LETTER.	05
Unit-6	Business Letters: Memos, and E-mails, Introduction, Writing Routine and Good-News Letters, WRITING A PERSUASIVE LETTER, Writing Memos, Essentials of Good Business Letters and Memos, REDRAFTING A MEMO, Form and Layout of Business Letters, Writing E-mails. Report Writing: What Is a Report? The Purpose of a Report, Kinds of Reports, The Terms of Reference, The Objectives of a Report, Planning and Organizing Information, Writing Reports, Short Management Reports, Long Formal Reports, Using Diagrams and Visual Aids in Reports.	05
	Total	30

Text Book:

1. P. D. Chaturvedi and C. Mukesh, "Business Communication", Pearson Publication.

Reference Books:

1. Bovee, Courtland, John Thill & Mukesh Chaturvedi. Business Communication Today: Dorling Kindersley, Delhi.
2. P. D. Chaturvedi & M. Chaturvedi, "Business communication: Concepts, cases and applications", Pearson Education, 2nd Edition, 2017.
3. M. Raman, & P. Singh, "Business Communication", Oxford University Press, 2nd Edition, 2012.

Term Work:

Student will perform following activities:

- a) Submit the assignment based on syllabus with real time examples.
- b) Identify the topic for presentation to understand the norms of Business Communication.
- c) Attend test to understand the syllabus thoroughly and apply to solve the problems.

Marking Scheme: (Distribution of 50 Marks)

1. Assignment Based Evaluation (15 Marks)
2. Presentation (15 Marks)
3. MCQ Test Based Evaluation (20 Marks)

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SA05	Entrepreneurship and Start-ups	02	00	00	02

Course Prerequisite: Nil

Course Learning Objectives:

1. Acquiring Entrepreneurial quality, competency, motivation, spirit and resourcefulness.
2. Familiarization with various uses of human resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Describe the dynamic role of entrepreneurship and small businesses.
2. Illustrate Business Plan Creation.
3. Create Idea to Startup and Ownership for Small Business.
4. Organize and Manage a Small Business.
5. Inspect Financial Planning and Control.
6. Design strategies New Product or Service Development.

	Subject: (4SA05) Entrepreneurship and Start-ups	L
Unit-1	Introduction to Entrepreneurship and Start – Ups: Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation Types of Business Structures, Similarities/differences between entrepreneurs and managers.	05
Unit-2	Business Ideas and their implementation: Discovering ideas and visualizing the business Activity map Business Plan	05
Unit-3	Idea to Start-up: Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis	05
Unit-4	Management: Company's Organization Structure, Recruitment and management of talent. Financial organization and management	05
Unit-5	Financing and Protection of Ideas: Financing methods available for start-ups in India Communication of Ideas to potential investors – Investor Pitch Patenting and Licenses	05
Unit-6	Strategies: Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy.	05
	Total	30

Reference Books:

1. Steve Blank and Bob Dorf, “The Startup Owner’s Manual: The Step-by-Step Guide for Building a Great Company”, K & S Ranch, ISBN – 978-0984999392.
2. Eric Ries, “The Lean Startup: How Today’s Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses”, Penguin UK, ISBN – 978-0670921607.
3. Adrian J. Slywotzky with Karl Weber, “Demand: Creating What People Love Before They Know They Want It”, Headline Book Publishing, ISBN – 978-0755388974.
4. Clayton M. Christensen, “The Innovator’s Dilemma: The Revolutionary Book That Will Change the Way You Do Business”, Harvard business ISBN: 978-142219602.

Term Work:

Student will perform following activities:

- a) Submit the assignment based on syllabus with real time examples.
- b) Identify business application domain and prepare plan for execution as well as evaluation.
- c) Attend test to understand the syllabus thoroughly and apply to solve the problems.

Marking Scheme: (Distribution of 50 Marks)

1. Assignment Based Evaluation (15 Marks)
2. Business Planning Based Evaluation (15 Marks)
3. MCQ Test Based Evaluation (20 Marks)

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SA06	Artificial Intelligence Lab	00	00	02	01

Course Learning Objectives:

1. To present an overview of Artificial Intelligence (AI) principles and approaches.
2. To understand the historical evolution of Artificial Intelligence.
3. To learn various searching techniques and identify to address a particular problem.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Explain different types of uninformed search strategies and informed search strategies.
2. Illustrate different types of heuristic search strategies.
3. Design adversarial search and game theory.

List of Experiment:

*Minimum 8 to 10 practical's are to be conducted based on subject **4SA01 – Artificial Intelligence Syllabus.***

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SA07	Operating Systems Lab	00	00	02	01

Course Learning Objectives:

1. To make students aware of the kernel and shell structure of the operating systems.
2. To understand & analyze the concept of process & its scheduling techniques.
3. To understand comprehend memory management techniques.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Operating Systems so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 4SA02 – Operating Systems Syllabus.

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SA08	Computer Skill Laboratory – 1	00	00	02	01

Course Learning Objectives:

1. To be able to understand basics of Advance Tools and Technology.
2. To able to Design a program to solve the problems using modern tools.
3. To be able to identify scope and applications of advanced tool.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Modern Tools and Technology so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on advanced programming technology and tools.

B.Tech. Fourth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
4SA09	Report Writing and Presentation Skill	00	00	04	02

Course Learning Objectives:

1. To teach the skills using Information and Communication Technology tools.
2. To explain basics of Information Technology and report writing.
3. To explore the internet searching using ICT tools.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Describe the basic concepts of information and communication technology tools.
2. Write effective technical reports and procedures that cater to the needs of their target audience.
3. Apply the concepts of ICT and structure, write and verbally present a professional report.

List of Experiment:

Minimum 8 practical's are to be conducted based on software Tools and Technology related to Report Writing and Presentation Skill.

1. Understand and demonstrate Technical Report Formatting in MS-Word.
2. Format Table of Content in MS-Word.
3. Perform Statistical Analysis in MS-Excel.
4. Perform Advanced Statistical Analysis in MS-Excel.
5. Create Presentation in MS Power Point with slide master, graphics, images, clip and multimedia features.
6. Installation of Latex Software on Windows Operating System.
7. Prepare project report using Latex.
8. Perform different operation using NumPy Library in Python.
9. Write commands and perform operation related Python programming.
10. Perform Statistical Tool based operation in R Programming.

B.Tech Fourth Semester (Artificial Intelligence and Data Science)

Honors

Course Code	Course Title	L	T	P	C
4SAH	Advanced Programming for Data Science	03	00	00	03

Course Prerequisite : Basic Knowledge of Programming and Introduction to Python.

Course Learning Objectives :

1. To develop proficiency in performing advanced mathematical and numerical operations using NumPy, enabling efficient handling of large-scale data and complex calculations.
2. To equip students with the skills to effectively arrange, manipulate, and analyze data using Pandas Series, fostering a strong foundation in data cleaning and transformation.
3. To provide students with the capability to import and manage data from CSV files into Pandas DataFrames, preparing them for real-world data handling and preprocessing tasks.
4. To enable students to execute various mathematical and statistical operations on Pandas DataFrames, facilitating comprehensive data analysis and insight extraction.

Course Outcomes:

After undergoing the course, the students will be able to:

1. Write mathematical operations by using NumPy.
2. Explain and discuss the data using Pandas Series.
3. Use the data from csv file into Pandas Dataframe.
4. Compare and contrast mathematical and statistical operations on Panadas DataFrame.
5. Evaluate the data using matplotlib library.
6. Construct and synthesize different plots using Seaborn.

	Subject: (4SAH) Programming Language for Data Science	L
Unit-1	NumPy: Introduction, Ndarray Object, Creating ndarrays, DataTypes for ndarrays, array attributes of numpy, Indexing and Slicing, Iterating over Array, Array Manipulation, Mathematical Functions, Arithmetic Operations, Statistical Functions, Sort Search and Counting Functions, Matrix Library, numpy.linalg module.	07

Unit-2	Pandas Introduction and Series: Introduction, features and installation, Data Structures in Pandas: Series, DataFrame and Panel, Descriptive Statistics Series: Defining series from list,dictionary and numpy arrays, Indexing in series, Creating Series from Dataset with the pd.read_csv() and accessing rows using .head(), tail(), Attributes 40 in Series object (.values, .index, .size, .name, and .is_unique.dtype), Methods on a Series Objects (.sum(), .product(), .mean(), .idxmax(), .idxmin(), .value_counts(), .apply(), .map()), Sorting of series by value and index.	07
Unit-3	Fundamentals and Basic Operations with DataFrames: Introduction to DataFrames, DataFrame Attributes, Basic DataFrame Operations, DataFrame Methods, Sorting in DataFrame	07
Unit-4	Advanced DataFrame Manipulations and Data Management: 1. Filtering the Data: Filtering Rows Based on Conditions, Methods for Filtering 2. Data Extraction and Indexing: Customize and Reset Index, Row Retrieval, Methods for Data Extraction 3. Advanced DataFrame Operations: MultiIndex, GroupBy, Merging, Joining, and Concatenating DataFrames 4. Importing and Exporting Data: Importing Excel/CSV Files, Exporting DataFrames to Excel/CSV Files	07
Unit-5	Matplotlib: Introduction to Matplotlib, Parts of Figure, Types of input to plotting functions, Introduction to Pyplot, Figure Class, Axes Class, Different types of plots (Line Graph, Bar Chart, Histogram, Scatter Plot, Pie Chart, Box Chart), Multiplots, The Lifecycle of Plot, Annotations Working with images : Importing image data into numpy arrays, plotting numpy arrays as image	07
Unit-6	Seaborn: Introduction and features of Seaborn, Seaborn vs Matplotlib, Figure Aesthetic, Color palette, Seaborn Plotting functions: relplot, catplot, Histogram, Bar Plot,Box Plot, Facet Grid, Pair Grid, HeatMap	07
	Total	42

Text Book:

1. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython By Wes McKinney

Reference Books

1. Learning the Pandas Library by By Matt Harrison
2. Pandas for Everyone: Python Data Analysis By Daniel Y. Chen.

B.Tech. Fifth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
5SA01	Data Analytics and Visualization	03	00	00	03

Course Prerequisite: Data Structures, Probability and Statistics, Programming Methodology and Python Programming.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Analytics and Visualization by being able to do each of the following:

1. To understand Data Analytics Life Cycle and Business Challenges.
2. To equip students with knowledge of big data analytics architecture, processes, and its application in business intelligence.
3. To develop competency in data visualization concepts, tools, and best practices for effective communication of data insights.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the basics of business intelligence with respect to big data.
2. Discuss various components of Big Data Analytics, including its architecture, stack, and virtualization techniques.
3. Apply the Data Analytics Lifecycle to real-world problems by identifying relevant roles, tasks, and deliverables in each phase from data discovery to operationalization.
4. Design appropriate visualizations (charts, graphs, maps) for various types of data and analytic goals.
5. Evaluate visualization design principles and avoid common design mistakes.
6. Develop effective and ethical data dashboards that account for data integrity, visual clarity, and communication.

	Subject: (5SA01) Data Analytics and Visualization	L
Unit-1	Introduction to Big Data: Business Intelligence, Decision Support Systems, Data Warehousing; Definition of Big Data, Big data characteristics & considerations, Introduction to Hadoop.	07
Unit-2	Big Data Analytics: Big data analytics, Drivers of Big data analytics, Big Data Stack, Typical analytical architecture, Virtualization & Big Data, Virtualization Approaches, Business Intelligence Vs Data science, Applications of Big data analytics	07
Unit-3	Data Analytics Lifecycle: Need of Data analytic lifecycle, Key roles for successful analytic projects, Various phases of Data Analytic Lifecycle: Discovery, Data Preparation, Model Planning, Model Building, Communicating Results, Operationalization.	07
Unit-4	Visualization: Why Visualize Data? Types of Data, Data Visualization in Practice, Defining the Goal of Your Data Visualization, Scatter Charts and Bubble Charts, Line Charts, Column Charts, and Bar Charts, Maps, Tables versus Charts.	07
Unit-5	Data Visualization and Design: Preattentive Attributes, Gestalt Principles, Data Visualization Design Issues, Common Mistakes in Data Visualization Design, Color and Perception, Color Schemes and Types of Data, Custom Color using HSL Color System, Common Mistakes in the Use of Color in Data Visualization.	07
Unit-6	Data Dashboards: What Is a Data Dashboard? Data Dashboards Taxonomies, Data Dashboard Design. Explaining Visually to Influence with Data: Know your Audience and Message, Storytelling with Charts, Storytelling and Presentation Design. Missing Data and Data Errors, Biased Data, Adjusting for Inflation Deceptive Design.	07
	Total	42

Text Book:

1. David Dietrich and Barry Hiller, “Data Science & Big Data Analytics”, EMC education services, Wiley publications, 2012.
2. J. Camm, J. Cochran, M. Fry and J. Ohlmann, “Data Visualization: Exploring and Explaining with Data”, Cengage publications, 2022.

Reference Books:

1. Business Intelligence – Data Mining and Optimization for Decision Making – Carlo Vercellis – Wiley Publications.
2. Big Data & Analytics – Seema Acharya & Subhashini Chellappan – Wiley Publications.
3. Big Data (Black Book) – DT Editorial Services – Dreamtech Press.
4. Data Mining: Concepts and Techniques Second Edition – Jiawei Han and Micheline Kamber – Morgan KaufMan Publisher.
5. Beginning R: The Statistical Programming Language – Mark Gardner – Wrox Publication.

B.Tech. Fifth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
5SA02	Computer Network	03	00	00	03

Course Prerequisite: Programming Fundamentals, Data Structures, Operating Systems, Analog and Digital Electronics and Discrete Mathematics.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Computer Network by being able to do each of the following:

1. To provide students with fundamental knowledge of computer network architectures, models, and communication technologies.
2. To familiarize students with the principles, protocols, and operations of various network layers including application, transport, network, and data link.
3. To introduce the basics of network management and security practices in modern communication systems.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the basic concepts of computer networks, network types, network architectures, topologies, OSI and TCP/IP models.
2. Explain the functionalities and protocols of the Application Layer.
3. Analyze the mechanisms of the Transport Layer, including connection-oriented and connectionless protocols.
4. Examine Network Layer services such as routing, addressing (IPv4, NAT), packet switching techniques, and congestion control, and assess their impact on network performance.
5. Apply Data Link Layer protocols and techniques for error detection and correction, media access control, and data link control.
6. Evaluate basic concepts of network management and security to monitor and secure communication systems using SNMP and other tools.

	Subject: (5SA02) Computer Network	L
Unit-1	Introduction and Physical Layer: Introduction to computer network, LAN, MAN, WAN, PAN, Ad-hoc Networks, Network Architectures- ClientServer, Peer to Peer, Network Topologies. Communication Models- OSI Model, TCP/IP Model, Design issues for layers. Transmission media- Guided media, unguided media. Transmission Modes. Network Devices- Hub, Repeater, Bridge, Switch, Router, Gateways.	07
Unit-2	Application Layer: Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP).	07
Unit-3	Transport Layer: Introduction, Transport-Layer Services, Connectionless and Connection Oriented Protocols, Transport-Layer Protocols: Simple Protocol, Stop-and-Wait Protocol, Go-Back-N Protocol (GBN), User Datagram Protocols: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP Connection.	07
Unit-4	Network Layer Introduction to Network layer Network Layer Services: Packetizing, Routing and Forwarding, Other Services Packet Switching: Datagram Approach: Connectionless Service, Virtual-Circuit Approach: Connection-Oriented Service, Network Layer performance: Delay, Throughput, Packet Loss, Congestion Control, IPV4 Address: Address Space, Classful Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Resolution (NAT).	07
Unit-5	Data Link Layer: Introduction, Nodes & Links, Services, Two categories of link, Two sub-layers, Error detection and correction: Introduction, Block Coding, Cyclic codes, Checksum, Forward Error Correction, Data link control: DLC services, Data-Link Layer Protocol, HDLC, Point-To-Point Protocol, Media Access Control (MAC): Random Access, Controlled Access, Channelization.	07
Unit-6	Network Management & Security: Introduction to Network Management, Configuration Management, Fault Management, Performance Management, Security Management, Accounting Management, SNMP: Managers and Agents, Management Components.	07
	Total	42

Text Book:

1. Behrouz A. Forouzan: Data Communication and Networking, (5/e) (TMH).

Reference Books:

1. William Stallings: Data & Computer Communications, 6/e, Pearson Education
2. William L. Schweber: Data Communication, McGraw Hill
3. J.Freedy : Computer Communication & Networks, AEW Press
4. D. Corner: Computer Networks & Internet, Pearson Education.

B.Tech. Fifth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
5SA03	Compiler Design	03	00	00	03

Course Prerequisite: Basic knowledge of Programming in C, Discrete Mathematics, Operating Systems and Theory of Computation.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Compiler Design by being able to do each of the following:

1. To learn concepts of programming language translation and phases of compiler design
2. To understand the common forms of parsers.
3. To study concept of syntax directed definition and translation scheme for the representation of language.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the fundamentals of compiler and various phases of compilers.
2. Design and implement LL and LR parsers
3. Solve the various parsing techniques like SLR, CLR, LALR.
4. Examine the concept of Syntax-Directed Definition and translation.
5. Assess the concept of Intermediate-Code Generation and run-time environment
6. Explain the concept code generation and code optimization.

	Subject: (5SA03) Compiler Design	L
Unit-1	Introduction to Compilers: Language Processor, The Structure of a Compiler. Lexical Analysis: The role of lexical analyzer, Input Buffering, Specification of tokens, Recognition of tokens, The lexical analyzer generator Lex, Finite Automata, From Regular Expressions to Finite Automata, State minimization of DFA.	07
Unit-2	Syntax Analysis: The role of the parser, Review of context free grammar for syntax analysis: Parse Tree and Derivation, Ambiguity in Grammar, Elimination of left recursion and left factoring. Top-down parsing: recursive descent parsing, predictive parsers, Transition diagrams for predictive parsers, FIRST and	07

	FOLLOW, LL (1) Grammars, Construction of predictive parsing tables, Non recursive predictive parsing, Error recovery in predictive parsing.	
Unit-3	Bottom up parsing: Handle pruning, Stack implementation of Shift Reduce Parsing, conflicts during shift reduce parsing Introduction to LR parsing: Simple LR, Items and the LR(0) Automation, The LR-Parsing algorithm, Construction of SLR parsing table, More powerful LR Parsers: canonical LR(1) Items, Constructing LR(1) sets of items and canonical LR(1) parsing tables, Constructing LALR parsing tables, The parser generator Yacc.	07
Unit-4	Syntax Directed Translation: Syntax directed definitions, Inherited and synthesized attributes, Evaluation orders of SDD's: Dependency Graphs, S-attributed definitions, L-attributed definition. Application of Syntax-Directed Translation: Construction of syntax trees. Syntax-directed Translation Schemes.	07
Unit-5	Intermediate-Code Generation: Variants of Syntax Trees: Directed Acyclic Graphs (DAG), Three Address Code. Run Time Environments: Storage Organization, Static versus Dynamic Storage Organization, Stack Allocation of Space: Activation trees, Activation Records, Calling Sequences, Variable- Length data on stack. Access to Nonlocal Data on the Stack. Heap Manager: The Memory Manager. Introduction to Garbage Collection: Design Goals for Garbage Collectors.	07
Unit-6	Code Generation: Issues in Design of a Code generator, The Target Language, Address in the target code, Basic blocks and flow graphs. Optimization of Basic Blocks, Peephole Optimization and The Principal sources of Optimization.	07
	Total	42

Text Book:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman Compilers: "Principles, Techniques and Tools", Pearson Education Second Edition.

Reference Books:

1. D. M. Dhamdhere, Compiler Construction—Principles and Practice, (2/e), Macmillan India.
2. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman Compilers: "Principles, Techniques and Tools", Pearson Education (Low Price Edition).
3. V. Raghavan; Principles of Compiler Design, McGraw Hill Education (India), 2010.
4. Andrew Appel, Modern Compiler Implementation in C, Cambridge University press.
5. K C. Louden "Compiler Construction—Principles and Practice" India Edition, CENGAGE.
6. Bennett J.P., "Introduction to Compiling Techniques", 2/e (TMH).

B.Tech. Fifth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
5SA04PE1A	Data and Internet Security	03	00	00	03

Course Prerequisite: Operating Systems, Discrete Mathematics, Data Structures and Fundamentals of Computers.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data and Internet Security by being able to do each of the following:

1. Understand the foundational concepts and the need for data and internet security, including the principles, processes, and lifecycle of securing information systems.
2. Analyze and apply various cryptographic techniques, hashing methods, and secure communication protocols to ensure data integrity and confidentiality.
3. Evaluate and implement security solutions for email, IP networks, and end-user systems while managing security policies, risks, and governance frameworks.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the fundamental principles and key components of data and information security.
2. Apply symmetric and asymmetric encryption techniques, hashing algorithms, and cryptographic tools to protect data.
3. Analyze the structure and security requirements of message authentication codes and cryptographic hash functions including HMAC and SHA.
4. Evaluate email security mechanisms to secure digital communication.
5. Assess and implement IP security protocols, intrusion detection systems, firewalls, and countermeasures against network-based threats.
6. Demonstrate the risk management processes and develop security policies, for secure software development and enterprise protection.

	Subject: (5SA04PE1A) Data and Internet Security	L
Unit-1	Information Security: Introduction, History of Information security, what is Security, Components of Information System, Balancing Information Security and Access, Approaches to Information Security Implementation, The Systems Development Life	07

	Cycle, The Security Systems Development Life Cycle, Security Professionals and the Organization, Communities of Interest, Information Security: Is it an Art or a Science?	
Unit-2	Cryptography: Introduction, Foundations of Cryptology, Cipher Methods: Substitution Cipher, Transposition Cipher, Exclusive OR, Vernam Cipher, Book or Running Key Cipher, Hash Functions. Cryptographic Algorithms: Symmetric Encryption, Asymmetric Encryption, Examples, Encryption Key Size, Cryptographic Tools, Public-Key Infrastructure (PKI), Digital Signatures, Digital Certificates, Hybrid Cryptography Systems, Steganography, Protocols for Secure Communications, Attacks on Cryptosystems.	07
Unit-3	Message Authentication and Hash Functions: Message Authentication Codes and Hash Function: Message Authentication Requirements and Functions Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions (HMAC), Cryptographic Hash Functions, Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Secure Hash Algorithm (SHA).	07
Unit-4	Electronic Mail Security: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, S/MIME, DNSSEC, DNS-Based Authentication of Named Entities, Sender Policy Framework, DomainKeys Identified Mail, Domain-Based Message Authentication, Reporting, and Conformance.	07
Unit-5	IP Security & Network Endpoint Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Firewalls, Intrusion Detection Systems Malicious Software, Distributed Denial of Service Attacks.	07
Unit-6	The Need for Data and Internet Security: Introduction, Business Needs First, Threats, Attacks, Secure Software Development. Risk Management: Overview, Risk Identification, Risk Assessment, Risk Control Strategies, Selecting a Risk Control Strategy, Quantitative Versus Qualitative Risk Control Practices Recommended Risk Control Practices. Planning for Security, Information Security Planning and Governance, Information Security Policy, Standards, and Practices.	07
	Total	42

Text Book:

1. Michael E. Whitman, Herbert J. Mattord, "Principles of Information Security", CENGAGE Learning, 4th Edition.
2. William Stallings, "Cryptography and Network Security Principles and Practice" Eighth Edition, Pearson Edn. 2023.

Reference Books:

1. C.K.Shyamala, N Harini and, Dr T R Padmanabhan, "Cryptography and Network Security", Wiley India, 1st Edition.
2. Atul Kahate, "Cryptography and Network Security", McGraw Hill, 2nd Edition.
3. W. M. Arthur Conklin, "Principles of Computer Security", Greg White, TMH.

B.Tech. Fifth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
5SA04PE1B	Probability and Statistics	03	00	00	03

Course Prerequisite: Applied Mathematics I and II.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Probability and Statistics by being able to do each of the following:

1. Understand the nature of data used for statistical methods and representation of data by various methods.
2. Provide a mathematical framework to access the chances of our predictions coming true.
3. Demonstrate an applicability of test of hypothesis.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe source and type of data in statistics.
2. Explain Data Representation Techniques to real-world example.
3. Apply empirical laws to given data from observation connecting to two variables.
4. Demonstrate the basics concept of probability distributions.
5. Inspect the basics of hypothesis testing.
6. Assess the best possible value of the parameters under specific conditions.

	Subject: (5SA04PE1B) Probability and Statistics	L
Unit-1	Introduction to data: Introduction to statistics; sources of data, Types of Data, Concepts of a statistical population and sample from a population, qualitative and quantitative data, nominal and ordinal data, cross sectional and time series data, discrete and continuous data, frequency and non- frequency data. Different types of scales - nominal, ordinal, ratio and interval.	07
Unit-2	Data Representations: Different types of presentations of data, data tabulation, describing categorical data, frequency distribution of categorical data, Describing numerical data, frequency table for numerical data, graphical representation, Frequency Distributions and Histograms, Pie Charts, Bar Charts, Pareto Chart, Scatter Plots (Degree of Association), Line Charts.	07

Unit-3	Analysis of Quantitative Data: Mean, mode, median, standard deviation, coefficient of correlation, Line of regression.	07
Unit-4	Probability Distribution: Random variables, Continuous random variables, Probability distribution function, Binomial distribution, Poisson distribution, normal distribution.	07
Unit-5	Testing of Hypothesis: Types of errors, power of tests, most powerful tests, Neyman-pearson fundamental lemma and its application, Notion of Uniformly most powerful tests, Likelihood Ratio tests, Description and property of LR test.	07
Unit-6	Sampling of Variables: t-distribution, chi-squared distributions, cumulative distribution function, Conditional PDF, Central limit theorem, confidence interval, z-test, t-test, chi-squared test.	07
	Total	42

Text Book:

1. Ken Black, “Business Statistics for Contemporary Decision Making”, Wiley Student Edition, 2010.
2. S.C.Gupta and V.K.Kapoor, “Fundamentals of Mathematics Statistics”, Sultan Chand and Sons, 2001.

Reference Books:

1. V.K.Rohatgi, A.K. Md.E.Saleh, “An Introduction to Probability and Statistics”, John Wiley, 2015.
2. R. Shanmugam, R. Chattamvelli, “Statistics for scientists and engineers”, John Wiley, 2015.

B.Tech. Fifth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
5SA04PE1C	Expert System Design	03	00	00	03

Course Prerequisite: Artificial Intelligence, Discrete Structures and Data Structures.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Expert System Design by being able to do each of the following:

1. To introduce the fundamentals of expert systems, including their architecture, types, and real-world applications.
2. To develop understanding of knowledge representation and inference mechanisms used in expert system design.
3. To familiarize students with methodologies for expert system development and critical issues such as explainability, ethics, and future trends.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the characteristics, types, advantages, and limitations of expert systems and distinguish between rule-based and model-based systems.
2. Illustrate the architecture of expert systems and explain the role of components such as the inference engine and knowledge base.
3. Apply knowledge representation techniques such as rules, logic, and semantic networks to represent domain knowledge.
4. Analyze inference techniques including forward chaining, backward chaining, and reasoning under uncertainty.
5. Design the structure of a simple expert system using appropriate development methodologies and validation techniques.
6. Evaluate ethical concerns, explainability, and societal impacts related to the deployment of expert systems.

	Subject: (5SA04PE1C) Expert System Design	L
Unit-1	Introduction to Expert Systems: Overview of Artificial Intelligence and Expert Systems, Characteristics of Expert Systems, Applications of Expert System, Rule-based	07

	vs. Model-based Systems, Various Tools and Programming Languages use for Expert Systems, Limitations of Expert Systems, Advantages of Expert Systems.	
Unit-2	Architecture of Expert Systems: Importance of Expert Systems in Decision Making, Characteristics of a Good Expert System Architecture, Expert System Components: Knowledge Base, Inference Engine, User Interface, Forward and Backward Chaining Mechanisms, Types of Expert Systems (Rule-Based, Frame-Based, etc.)	07
Unit-3	Knowledge Representation: Knowledge Representation Techniques: Production Rules and Semantic Networks, Logic-Based Representation (Propositional and Predicate Logic), Knowledge Acquisition Techniques, Handling Incomplete and Uncertain Knowledge, Challenges in Knowledge Representation.	07
Unit-4	Inference Mechanisms: Role of the Inference Engine in Expert Systems, Decision Trees and Rule Matching in Inference Engines, Inference Techniques: Forward and Backward Chaining, Reasoning with Uncertainty: Bayesian Networks and Dempster-Shafer Theory.	07
Unit-5	Expert System Design and Development Methodologies: Principles of Expert System Design, The Role of the Knowledge Engineer, Knowledge Acquisition Strategies and Challenges, Knowledge Base Construction: Structuring Rules and Facts, Validation and Verification of Expert Systems, Purpose of Evaluation and Maintenance of Expert Systems.	07
Unit-6	Advanced Topics and Ethical Considerations: Introduction to Explainable AI (XAI) and its application, Ethical Concerns: Bias, Privacy, and Accountability, Societal Impacts of Expert Systems, Regulations and Standards for Expert Systems Deployment, Future Possibilities for Expert System.	07
	Total	42

Text Book:

1. Peter Jackson, " Principles of Expert Systems", Addison Wesley Publication, 2nd Edition, ISBN: 978-0201503725.
2. Ankur Taly and Christoph Molnar, "Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning", by , Publisher: Springer, 1st Edition (2021), ISBN: 978-3-030-83356-5.

Reference Books:

1. Frederick Hayes-Roth, Donald A. Waterman, and Douglas B. Lenat, "Building Expert Systems", Addison-Wesley Publication.
2. Bruce G. Buchanan and Edward H. Shortliffe, "Rule-Based Expert Systems: The MYCIN Experiments of the Stanford Heuristic Programming Project", Addison-Wesley Publication.
3. S. Rajasekaran and G. A. Vijayalakshmi Pai, "Knowledge-Based Systems", PHI Learning Publication.

B.Tech. Fifth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
5SAOE3B	Business Intelligence	03	00	00	03

Course Prerequisite: Basic Knowledge of Programming.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Business Intelligence by being able to do each of the following:

1. To Study and Explain the Business Intelligence, Analytics and Decision Support system.
2. To study List the technologies for Decision making, automated decision systems.
3. Illustrate multi-criteria Decision-making systems, predictive modelling techniques.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Explain the components and architecture of Business Intelligence systems and their integration with decision support systems.
2. Describe the phases of decision-making to solve business problems using data-driven approaches.
3. Examine data warehousing solutions and use ETL tools effectively for business analytics.
4. Use data mining techniques and sentiment analysis tools to generate actionable insights for business applications.
5. Assess mathematical and spreadsheet-based models for model-driven decision support in uncertain environments.
6. Demonstrate the use of automated decision systems and expert systems in real-world business scenarios, including knowledge representation and inference techniques.

	Subject: (5SAOE3B) Business Intelligence	L
Unit-1	Overview of Business Intelligence and Analytics: Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics.	07

Unit-2	Decision Making: Introduction and Definitions, Phases of the Decision, Making Process, The Intelligence Phase, Design Phase, Choice Phase, Implementation Phase, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components.	07
Unit-3	Descriptive and Predictive Analytics: Data Warehousing Definitions and Concepts, Process Overview, Architectures, ETL Process, Data Warehouse Development and Implementation Issues. Data Mining Concepts, Applications, Process, Methods.	07
Unit-4	Business Reporting and Performance Management: Business Reporting Definitions and Concepts, Data and Information Visualization, Different Types of Charts and Graphs, Emergence of Data Visualization and Visual, Performance Dashboards, Business Performance Management and measurement, Balanced Scorecards, Six Sigma as a Performance Measurement System.	07
Unit-5	Model-Based Decision Making: Decision Support Systems modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making with Pairwise Comparisons.	07
Unit-6	Automated Decision Systems and Expert Systems: Automated Decision Systems, The Artificial Intelligence field, Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems, Introduction to Knowledge Management.	07
	Total	42

Text Book:

1. Ramesh Sharda, Dursun Delen, Efraim Turban, J.E. Aronson, Ting-Peng Liang and David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 2013.

Reference Books:

1. Edward Mize, "Data Analytics: The Ultimate Beginner's Guide to Data Analytics", Venture Ink Publication, 2017.
2. Rick Sherman, "Business Intelligence Guidebook: From Data Integration to Analytics", Morgan Kaufmann Publication.
3. Ralph Kimball and Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling", Wiley Publication.
4. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publication.
5. Russell Glass and Sean Callahan, "The Big Data-Driven Business: How to Use Big Data to Win Customers, Beat Competitors, and Boost Profits", Wiley Publication.

B.Tech. Fifth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
5SAOE3C	Project Management	03	00	00	03

Course Prerequisite: --

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of the Project Management.

1. Students should be able to understand Project Life Cycle and Project Development Steps.
2. Student should be able to carry out project planning using tools like BAR chart.
3. Student should be able to carry out project planning using tools Networking methods like CPM, PERT etc.
4. Student should know process and need of PERT.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Apply the knowledge of management functions like planning, scheduling, executing and controlling to construction projects.
2. Solve and apply various planning tools like BAR chart to compare and control the project at the time of execution.
3. Demonstrate their capability for preparing the project networks to work out best possible time for completing the project.
4. To understand the concept of PERT.
5. Develop the various report writing techniques for successful completion of projects.
6. To understand importance and application of project management performance.

	Subject: (5SAOE3C) Project Management	L
Unit-1	Project Project, Project life cycle - Conceptual Phase, Planning Phase, Execution Phase, Termination phase, Project Stakeholders. Concept of feasibility study, Project identification considering objectives and SWOT analysis, Screening of Project Ideas.	07

Unit-2	Introduction on Bar Chart: Work break down structure, Project Monitoring & Controlling, Planning Tools: Basic concept of Bar Chart, their advantage, limitations, Numerical on Bar Chart. Technical Feasibility: Process selection, Level of automation, Plant capacity, Acquiring technology, appropriate technology plant location, Equipment selection & procurement, Govt. policies.	07
Unit-3	Networking: Networking – Activity, Event, Dummy Activity, Fulerson’s numbering rule. Introduction of Critical Path Method four kinds of floats. Numerical on TF, FF, IF.	07
Unit-4	PERT: PERT: Concept, technique, three time estimates, average time, Critical path, slack computation, S.D, Variance, Numerical on PERT.	07
Unit-5	Project Report: Preparation of project report, Risk analysis, Sensitivity analysis, Methods of rising capital.	07
Unit-6	Introduction to: Projected balance sheet, Projected profit & loss statement, Projected cash flow, Rate of return, Discounted playback period, Return after taxes. Initial review, Performance analysis, Ratio analysis, Sickness, Project revival, Organization aspects.	07
	Total	42

Text Books:

1. Kumar Neeraj Jha, “Construction Project Management- Theory and Practice”, Pearson Education, New Delhi ,17.

Reference Books:

1. K. K. Chitkara, “Construction Project Management- Planning, schedule and controlling”, second edition”, Tata McGraw Hill Education pvt. Ltd, New Delhi.
2. John M. Nicholas and Herman steven, “Project management for engineers, business and technology”, fourth edition, Routledge Publication, New York.
3. Prasanna Chandra, “Projects Planning, analysis, selection, financing, implementation and review”, 7th edition, McGraw Hill Education India Pvt. Ltd., New Delhi.
4. Harold Kerzner, “Project Management system approach to planning, scheduling and controlling, second.

B.Tech. Fifth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
5SAOE3D	Aptitude for Engineers	03	00	00	03

Course Prerequisite: Basic knowledge of Mathematics.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Aptitude for Engineers by being able to do each of the following:

1. To learn the basics of aptitude.
2. To learn the fundamentals of Quantitative Aptitude and Reasoning
3. To learn the simple techniques to solve problems on Aptitude and Reasoning.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Apply the knowledge of calculation speed in aptitude.
2. Understand the basic concepts of Arithmetic ability.
3. Understand the basic concepts of Quantitative ability.
4. Develop the General Mental Ability.
5. Acquire satisfactory competency in Reasoning.
6. Apply the basic concepts of Data Interpretation.

	Subject: (5SAOE3D) Aptitude for Engineers	L
Unit-1	Basic of Aptitude: Importance of calculation speed, Multiplication Techniques, Method to find out square and square roots, Cube and Cube roots, Simplification, Basic concepts of Percentage.	07
Unit-2	Arithmetic Ability: Basic concepts of Ratio and Proportion, Combination of Ratios, Numericals on ratio and Proportion, Introduction to Average and its numericals, Problems on Ages.	07
Unit-3	Quantitative Ability: Basic concept of Time and work and its Numericals, Numericals on Pipe and Cisterns, Fundamental relationship between time, speed and distance, Problems on Train.	07

Unit-4	General Mental Ability: Series Completion: Types of Number Series, Alphabet Series, Alphanumeric Series, Continuous pattern series, Introduction to Coding – decoding, Letter coding, Direct letter coding, Number symbol coding, deciphering message word codes, Alpha-Numeric sequence puzzle.	07
Unit-5	Reasoning Ability: Basic concepts of Blood Relation, relation puzzle, coded relation, Important fact of a Clock and Calendar and its numericals, Problem on Directional sense.	07
Unit-6	Data Interpretation: Introduction to Tabulation and its numericals, Basic concepts of Bar Graph and its numericals, Fundamentals of Pie Chart.	07
	Total	42

Text Book:

1. Quantitative Aptitude, Dr. R.S. Aggrawal, S. Chand & Company Ltd.
2. A Modern Approach to Verbal and Non Verbal Reasoning, Dr. R.S. Aggrawal, S. Chand & Company Ltd.

Reference Books:

1. A New Approach to Reasoning Verbal, Non-Verbal and Analytical, BS Sijwali and Indu Sijwali, Arihant Publication Ltd
2. Complete Mathematics Part-1, Rishikesh Kumar, Lucent Publication Ltd.
3. Quantitative Aptitude, Abhijit Guha, McGraw Hill
4. Quantitative Aptitude for CAT, Trishna, Pearson Publication.

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Course Code	Course Title	L	T	P	C
5SA05	Data Analytics and Visualization Lab	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Analytics and Visualization Lab by being able to do each of the following:

1. To understand Data Analytics Life Cycle and Business Challenges
2. To understand Analytical Techniques and Statically Models
3. To understand Statically Modelling Language.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Data Analytics and Visualization so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

*Minimum 8 to 10 practical's are to be conducted based on subject **5SA01 – Data Analytics and Visualization**.*

Software Tools:

Python (Data Analysis and visualization Libraries: Pandas, NumPy, Matplotlib, Seaborn, Plotly, Bokeh) / R (Statistical computing, data visualization Packages: ggplot2, dplyr, Shiny, tidyr) / Tableau
Microsoft Power BI / Grafana / IBM SPSS / SAS.

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Course Code	Course Title	L	T	P	C
5SA06	Computer Network Lab	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Computer Network Lab by being able to do each of the following:

1. To understand the working principle of various communication protocols.
2. To analyze error performance of a digital communication system in presence of noise and other interferences.
3. To learn various searching techniques and identify to address a particular problem.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Computer Network so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 5SA02 – Computer Network.

Software Tools:

Python / C / C++ / Java / Network Simulator - 3 / Wireshark / Cisco Packet Tracer / GNS3 / NetSim.

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Course Code	Course Title	L	T	P	C
5SA07	Compiler Design Lab	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Compiler Design Lab by being able to do each of the following:

1. To Know the basic components of a Compiler.
2. To implement Lexical Analyzer and Syntax Analyzer using various compiler Tool.
3. To implement various parsing methods and code optimization techniques.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Use his / her understanding / knowledge of Compiler Design so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 5SA03 – Compiler Design Syllabus.

Software Tools:

C / C++ / Lex / Yacc / Bison / Flex / ANTLR / Online IDEs (GDB / Replit / Ideone).

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Course Code	Course Title	L	T	P	C
5SA08	Computer Skill Laboratory - 2	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Modern Tools and Technology by being able to do each of the following:

1. To provide practical exposure to the theoretical concepts of the chosen elective subject through hands-on experiments and simulations.
2. To develop the technical skills necessary to apply subject-specific tools, algorithms, and frameworks in real-world problem-solving.
3. To strengthen analytical thinking by engaging students in lab-based assignments, mini-projects, or case studies.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Use his / her understanding / knowledge of Modern Emerging Tools and Technology so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 5SA04PE1A / B / C – Program Elective Course – 1 Syllabus or Modern Emerging Tools and Technology.

Software Tools:

NodeJS / Python / R / Brup Suite Community Edition / Wireshark / Kali Linux / Nmap / Open SSL / CLIPS / Drools / GNU Prolog / SWI Prolog / VSCode / Django / Flask

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Course Code	Course Title	L	T	P	C
5SAH	Advanced Data Science and Analytics	03	00	00	03

Course Prerequisite: Introduction to Python, Data Structures, Programming Methodology and Advanced Programming for Data Science.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Advanced Data Science and Analytics by being able to do each of the following:

1. To introduce foundational concepts and tools in data science, including Python programming and key libraries for analytics.
2. To equip students with techniques in data wrangling, machine learning (supervised & unsupervised), deep learning, and NLP for solving practical problems.
3. To develop an understanding of real-world data science applications, ethical implications, and emerging technologies like big data systems and recommender systems.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Recall the fundamental concepts of data science, including its life cycle, evolution, and essential Python libraries.
2. Explain data wrangling techniques and preprocessing methods such as handling missing data, feature scaling, and encoding in data pipelines.
3. Apply supervised machine learning algorithms like regression, decision trees, and SVM to real-world datasets using model evaluation techniques.
4. Analyze unsupervised learning models like clustering, dimensionality reduction (PCA, t-SNE), and association rules to uncover hidden patterns in datasets.
5. Evaluate the performance of deep learning and NLP models using various metrics and select appropriate models for sentiment analysis and text classification.
6. Design and develop a capstone mini-project by integrating concepts of time series forecasting, recommender systems, and ethical data practices using different tools.

	Subject: (5SAH) Advanced Data Science and Analytics	L
Unit-1	Foundations of Data Science and Python for Analytics: Introduction to Data Science: Key concepts and evolution, Data Science life cycle and workflows, Python essentials for data science, Libraries: NumPy, Pandas, Matplotlib, Seaborn.	07
Unit-2	Data Wrangling and Preprocessing: Data collection, data cleaning and manipulation, Handling missing data, outliers, and categorical variables, Feature scaling, encoding, binning, and transformation, Feature engineering and dimensionality reduction (PCA).	07
Unit-3	Supervised Learning Techniques: Linear and Logistic Regression, Decision Trees and Random Forests, Support Vector Machines (SVM), Model validation: k-Fold Cross Validation, Confusion Matrix, AUC-ROC.	07
Unit-4	Unsupervised Learning and Clustering: Clustering methods: K-means, Hierarchical, DBSCAN, Association Rule Mining: Apriori and FP-Growth, Dimensionality Reduction: t-SNE, PCA revisited, Applications of unsupervised learning in customer segmentation.	07
Unit-5	Deep Learning and NLP: Fundamentals of Neural Networks and Backpropagation, Introduction to Keras and TensorFlow, NLP basics: tokenization, stemming, lemmatization, Applications: Sentiment analysis, Text classification, Word embeddings.	07
Unit-6	Capstone Applications and Ethics in Data Science: Time Series Forecasting (ARIMA, LSTM overview), Recommender Systems: Collaborative Filtering and Content-Based, Big Data ecosystem overview (Hadoop, Spark basics), Data privacy, bias in AI, and ethical considerations, Capstone Mini-Project / Case Studies in various industries.	07
	Total	42

Text Book:

1. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning", Packt Publishing, 3rd Edition, 2019, ISBN: 978-1789955750.

Reference Books:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media Publishing, 2nd Edition, 2019, ISBN: 978-1492041139.
2. Nathan Marz and James Warren, "Big Data: Principles and Best Practices of Scalable Real-Time Data Systems", Manning Publications, 2015, ISBN: 9781617290343.
3. Rajkumar Buyya, Rodrigo N. Calheiros and Amir Vahid Dastjerdi, "Big Data: Principles and Paradigms", Publisher: Morgan Kaufmann.

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA01	Data Science	03	00	00	03

Course Prerequisite: Discrete Mathematics, Data Structures, Programming Methodology and Introduction to Python.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Science by being able to do each of the following:

1. To understand the need of data science and Statistics
2. To understand and apply the different data modelling strategies.
3. To apply the learned concept for the skillful data management.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Explain basics and need of data science
2. Describe proficiency with statistical analysis of data.
3. Demonstrate loading of data and its manipulation for data science
4. Perform linear and multiple linear regression analysis.
5. Develop the ability to build and assess classification-based models
6. Evaluate outcomes and make decisions based on data.

	Subject: (6SA01) Data Science	L
Unit-1	Data Science, Relation with other fields, Computational Thinking, Skills for Data Science, Tools for Data Science, Issues of Ethics, Bias, and Privacy in Data Science Data: Data types, Data Collection, Data Pre-processing.	07
Unit-2	Techniques: Introduction, Data Analysis and Data Analytics, Descriptive Analysis, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis	07

Unit-3	Python: Introduction, Getting Access to Python, Basic Examples, Control Structures, Statistics Essentials: Importing Data, Plotting the Data, Correlation	07
Unit-4	Introduction: Machine Learning, Classification (Supervised Learning), Clustering (Unsupervised Learning), Regression, Gradient Descent, Linear Regression, Multiple Linear Regression.	07
Unit-5	Supervised Learning: Introduction, Logistic Regression, KNN, Decision Tree, Random Forest.	07
Unit-6	Unsupervised Learning: Introduction, Agglomerative Clustering, Divisive Clustering, Expectation Maximization (EM), Introduction to Reinforcement Learning.	07
	Total	42

Text Book:

1. Chirag Shah," A Hands-on Introduction to Data Science ", Cambridge University Press (2020)
ISBN:978- 1-108-47244-9.

Reference Books:

1. Foster Provost & Tom Fawcett, "Data Science for Business", O'Reilly Media Publication, 1st Edition, 2013, ISBN-13: 978-1449361327.
2. Foster Provost & Tom Fawcett, "Data Science for Business", O'Reilly Media Publication, 1st Edition, 2013, ISBN-13: 978-1449361327.
3. Rafael A. Irizarry, Introduction to Data Science: A Python Approach to Concepts, Techniques, and Applications" by CRC Press, 1st Edition, 2016, ISBN-13: 978-1491901415.
4. Joel Grus, "Data Science from Scratch: First Principles with Python" O'Reilly Media Publication, 1st Edition, 2019, ISBN: 978-1492041139.
5. Peter Bruce and Andrew Bruce, "Practical Statistics for Data Scientists" O'Reilly Media Publication, 2nd Edition, 2017, ISBN: 978-1491952962.

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Course Code	Course Title	L	T	P	C
6SA02	Design and Analysis of Algorithms	03	00	00	03

Course Prerequisite: Discrete Mathematics, Data Structures, Theory of Computations and Programming Methodology.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Design and Analysis of Algorithms by being able to do each of the following:

1. Understand algorithmic techniques and efficiency analysis.
2. Apply algorithm design techniques to solve computational problems.
3. Analyze algorithm efficiency using complexity measures.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe fundamental algorithmic concepts and asymptotic analysis.
2. Explain analysis techniques to control structures, loops, recursion, and solve recurrences.
3. Analyze advanced data structures and apply greedy algorithms to solve optimization problems.
4. Apply divide-and-conquer strategies to solve problems like sorting and matrix multiplication.
5. Evaluate graph algorithms like DFS, BFS, and hashing for different problem domains.
6. Create dynamic programming solutions and inspect NP-completeness concepts.

	Subject: (6SA02) Design and Analysis of Algorithms	L
Unit-1	Introduction to elementary algorithmic, problems & instances, Efficiency of algorithms, Average & worst-case analysis, Efficiency considerations. Elementary operations. Asymptotic notation, conditional asymptotic notation	07
Unit-2	Analysis of algorithms: Control structures analysis; sequencing, 'for' loops, recursive calls, while & repeat loops, Average-case analysis, amortized analysis. Solving recurrences.	07

Unit-3	Advanced data structures: Heap, Binomial heaps, disjoint structures. Greedy algorithms: general characteristics. Graphs: minimum spanning trees, Kruskals' algorithm, Shortest-path algorithms, Knapsack Problem.	07
Unit-4	Divide-and-Conquer: Introduction, Multiplying integers, general template, binary search, Sorting: Merge-sort, Quicksort. Insertion sort, Heap sort, Finding median, Matrix multiplication, Cryptography.	07
Unit-5	Exploring Graphs: Traversing trees; Depth-first search for undirected & directed graphs. Breadth-first search. Branch-and-bound. The minimax problem, Hashing.	07
Unit-6	Dynamic programming: Binomial coefficients & world series examples. Principle of optimality, Knapsack problem, Shortest-paths, Memory functions. Introduction to Completeness; class N & NP. Polynomial reduction.	07
	Total	42

Text Book:

1. Aho, Hopcroft & Ullman "The Design & Analysis of Computer Algorithms' (Addison-Wesley).

Reference Books:

1. E. Horowitz and S. Sahani, "Fundamental Algorithms", Galgotia Publication, 2nd Edition, 2007.
2. T. H. Cormen, C. E. Leiserson and R. L. Rivest, "Introduction to Algorithms", McGraw-Hill Publication, 3rd Edition, 2009.
3. D. E. Knuth, "Fundamental Algorithms", Addison-Wesley Publication, 1st Edition, 1997.
4. G. Brassard and P. Bratley, "Fundamentals of Algorithmics", PHI Publication, 1st Edition, 1996.

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Course Code	Course Title	L	T	P	C
6SA03	Database Management Systems	02	00	00	02

Course Prerequisite: Discrete Mathematics, Data Structures, Programming Methodology and Basic Knowledge of Programming.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Database Management Systems by being able to do each of the following:

1. Understand the fundamental concepts of databases and database management systems
2. Master relational database operations and SQL query language
3. Apply principles of database design, normalization, and transaction management.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe Database Management Systems architecture and its components.
2. Discuss relational operations using relational algebra and SQL.
3. Develop normalized databases to reduce redundancy and improve integrity.
4. Analyze queries for better performance.
5. Inspect database transaction management with ACID properties.
6. Design concurrency control and recovery techniques.

	Subject: (6SA03) Database Management Systems	L
Unit-1	Introduction to DBMSs: Databases and Database Users, Characteristics of the Database Approach, Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages.	05
Unit-2	Relational Algebra, SQL: Relational query languages, relational operators, The Relational Algebra, Overview of SQL query language, Basic Structure of SQL queries, Set Operations, Null Values, Aggregate Functions, Views.	05

Unit-3	Normalization: Database Design and Normalization Functional Dependencies, Properties of Relational Decomposition, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.	05
Unit-4	Query Processing and Query Optimization: Overview, Measures of Query Cost, Query Optimization: Overview, Transformation of Relational Expressions, Choice of Evaluation Plans, Materialized Views.	05
Unit-5	Transaction Management: Transaction Concept, Simple transaction model, Storage structure, Transaction Atomicity and Durability, transaction isolation, Serializability, transaction isolation and atomicity	05
Unit-6	Concurrency Control and Recovery System: Lock-Based Protocols, Deadlock Handling, Multiple Granularities, Timestamp- Based Protocols, Validation-Based Protocols	05
	Total	30

Text Book:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, Sixth Edition, McGraw Hill.

Reference Books:

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill
2. Shamkant B. Navathe, RamezElmasri, Database Systems, Pearson Higher Education
3. Garcia-Molina, Ullman, Widom: Database System Implementation, Pearson education.
4. S. K. Singh: Database Systems, Concepts, Design and Applications, Pearson Education.
5. G.K. Gupta: Database Management Systems, McGraw Hill.
6. Toledo and Cushman: Database Management Systems, (Schaum 's Outlines).

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Course Code	Course Title	L	T	P	C
6SA04PE2A	Cyber Security	03	00	00	03

Course Prerequisite: Computer Network and Data and Internet Security.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Cyber Security by being able to do each of the following:

1. Introduce the fundamental concepts of cyber security, including types of cybercrimes, cyber laws, and ethical considerations.
2. Familiarize students with common cyber threats, vulnerabilities, attack methods, and security challenges in both wired and wireless environments.
3. Provide knowledge and skills in cyber forensic tools and techniques for investigating and analyzing cyber incidents across different platforms and devices.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the nature and scope of cybercrimes and interpret key legal frameworks such as the IT Act 2000 and international cyber laws.
2. Explain various cyber offenses including social engineering, cyberstalking, botnets, and cloud-based attacks.
3. Analyze security vulnerabilities and threats related to mobile and wireless devices.
4. Identify and evaluate the tools and techniques used in cyber-attacks.
5. Apply knowledge of computer forensics to conduct digital investigations.
6. Examine forensic challenges in handheld and mobile devices and demonstrate the use of forensic tools for data extraction, preservation, and analysis.

	Subject: (6SA04PE2A) Cyber Security	L
Unit-1	Introduction to Cybercrime: Introduction, Cybercrime, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era.	07

Unit-2	Cyber Offenses: Introduction, Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrime, Botnets, Attack Vector, Cloud Computing	07
Unit-3	Cybercrime: Mobile and Wireless Devices Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Cards Frauds in Mobile and Wireless Computing, Security Challenges posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implementations for Organizations, Organizational Measures for Handling Mobile, Devices Related Security Issues Organizational Security Policies and Measures in Mobile Computing, Laptops.	07
Unit-4	Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.	07
Unit-5	Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, · Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography.	07
Unit-6	Forensics of Hand-Held Devices: Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics, Introduction to Forensics of Hand-Held Devices, Understanding Cell Phone Working Characteristics, Hand-Held Devices and Digital Forensics, Toolkits for Hand-Held Device Forensics, Forensics of iPods and Digital Music Devices, An Illustration on Real Life Use of Forensics, Techno-Legal Challenges with Evidence from Hand-Held Devices, Organizational Guidelines on Cell Phone Forensics	07
	Total	42

Text Book:

1. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley India Pvt Ltd.

Reference Books:

1. Nina Godbole, “Information Systems Security”, Wiley India, New Delhi.
2. Kenneth J. Knapp, “Cyber Security & Global Information Assurance”, Information Science Publishing.
3. James Graham, Richard Howard, Ryan Olson, “Cyber Security Essentials” CRC Press.
4. Jeetendra Pande, “Introduction to Cyber Security” Uttarakhand Open University, 2017.

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA04PE2B	Programming with Large Dataset	03	00	00	03

Course Prerequisite: Discrete Mathematics, Data Structures, Programming Methodology, Python Programming and Probability and Statistics.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Programming with Large Datasets by being able to do each of the following:

1. Understand the fundamental concepts of big data and distributed computing frameworks.
2. Develop proficiency in programming and data processing using Python and scalable tools.
3. Apply scalable machine learning techniques and data storage solutions for large datasets.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the challenges and solutions for processing large datasets.
2. Explain with distributed computing frameworks for big data processing.
3. Illustrate data preprocessing, cleaning, and visualization for large datasets.
4. Examine scalable machine learning algorithms for large datasets.
5. Inspect data storage, query performance, and indexing for large datasets.
6. Design big data tools and techniques to real-world case studies and industry applications.

	Subject: (6SA04PE2B) Programming with Large Dataset	L
Unit-1	Introduction to Big Data and Programming for Large Datasets: Introduction to Big Data, Challenges of processing large datasets, Overview of tools and frameworks (Hadoop, Spark, etc.), Introduction to MapReduce programming, Data preprocessing for large datasets	07
Unit-2	Distributed Computing Frameworks: Introduction to distributed computing, Hadoop ecosystem (HDFS, YARN, Hive, Pig), Introduction to Apache Spark, Data partitioning and shuffling in distributed systems, Data storage formats for large datasets (Parquet, Avro)	07

Unit-3	Data Processing Using Python: Python for data processing (Pandas, NumPy) Introduction to Dask for parallel computing in Python, Handling missing and noisy data, Visualizing large datasets using Matplotlib and Seaborn.	07
Unit-4	Scalable Machine Learning with Large Datasets: Challenges in machine learning with large datasets, Introduction to scalable ML libraries (MLlib, H2O.ai, TensorFlow), Dimensionality reduction techniques (PCA, t-SNE), Distributed model training and evaluation.	07
Unit-5	Data Storage and Query Optimization: Overview of databases for large-scale data (NoSQL, SQL), Introduction to MongoDB and Cassandra, Query optimization techniques for large datasets, Indexing and partitioning for faster queries	07
Unit-6	Case Studies and Industry Applications: Case studies on large-scale data Processing in real-world applications (e.g., e-commerce, healthcare, finance). Real-time data streaming with Kafka and Spark Streaming, Introduction to cloud services for big data (AWS, Google Cloud, Azure), Ethics and challenges in large-scale data handling	07
	Total	42

Text Book:

1. Foster Provost and Tom Fawcett, Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking", O'Reilly Media Publication, 2013, ISBN: 978-1449361327.
2. Nathan Marz, "Big Data: Principles and Best Practices of Scalable Real-Time Data Systems", Manning Publications, 2015, ISBN: 9781617290343.

Reference Books:

1. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 2015, ISBN: 9781491901632
2. Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia, "Learning Spark: Lightning-Fast Data Analytics", O'Reilly Media, 2015, ISBN: 9781449358624
3. Wes McKinney, "Python for Data Analysis", O'Reilly Media, 2017 (2nd Edition), ISBN: 9781491957660
4. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 2019 (2nd Edition), ISBN: 9781492032649
5. Martin Kleppmann, "Designing Data-Intensive Applications", O'Reilly Media, 2017, ISBN: 9781449373320
6. Tyler Akidau, Slava Chernyak, Reuven Lax, "Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing", O'Reilly Media, 2018, ISBN: 9781491983874.

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA04PE2C	Applied Artificial Intelligence	03	00	00	03

Course Prerequisite: Basic Programming Knowledge, Artificial Intelligence and Data Structures.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Applied Artificial Intelligence by being able to do each of the following:

1. To apply AI techniques to solve real-world problems.
2. To integrate AI models into practical applications such as natural language processing (NLP), computer vision, and robotics.
3. To evaluate the ethical implications and societal impact of AI technologies.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the evolution of AI and explain basic search strategies and intelligent agent behaviors.
2. Explain machine learning techniques including classification, regression, clustering, and reinforcement learning.
3. Examine deep learning models using neural networks and pre-trained architectures like CNNs.
4. Investigate NLP techniques such as text classification, sentiment analysis, and sequence modeling using LSTM or Transformers.
5. Recommend AI applications in key industries and formulate planning problems with classical and real-world techniques.
6. Evaluate ethical considerations and the societal impact of AI technologies and propose strategies for responsible AI use.

	Subject: (6SA04PE2C) Applied Artificial Intelligence	L
Unit-1	Introduction to Artificial Intelligence: Definition and History of AI, Machine Learning vs Deep Learning, Applications of AI in the Modern World, Problem Solving Agents, Search Strategies: Depth-first, Breadth-first, Heuristic Search.	07

Unit-2	Machine Learning Fundamentals: Supervised Learning (Regression, Classification), Unsupervised Learning (Clustering, Association), Reinforcement Learning, Evaluation Metrics: Accuracy, Precision, Recall, F1-Score, ROC-AUC, Overfitting and Underfitting, Cross-Validation.	07
Unit-3	Deep Learning and Neural Networks: Basics of Neural Networks and Deep Learning, Backpropagation, Convolutional Neural Networks (CNN) for Image Recognition, Transfer Learning and Pre-trained Models, Introduction to Tools and Libraries for Deep Learning.	07
Unit-4	Natural Language Processing (NLP): Text Preprocessing and Tokenization, Sentiment Analysis and Text Classification, Named Entity Recognition (NER), Sequence Models for NLP (LSTM, Transformers), NLP Applications: Chatbots, Machine Translation, and Text Summarization.	07
Unit-5	AI in Real-world Applications and Planning: AI in Healthcare: (Diagnosis, Drug Discovery, and Personalized Medicine), AI in Finance: (Fraud Detection, Algorithmic Trading, Credit Scoring), AI in Agriculture: (Crop Monitoring, Precision Farming, Pest Detection) Planning Problem Formulation, Classical Planning Techniques (STRIPS, Partial Order Planning), Planning and Acting in the Real World (Uncertainty Handling)	07
Unit-6	AI Ethics and Future Trends: Ethical Issues in AI: Bias, Privacy, and Accountability, Social and Economic Impact of AI Technologies, Autonomous Systems and Decision-Making, AI in Governance, Security, and Privacy, Future Directions in AI: AGI, AI in Robotics, AI for Sustainability.	07
	Total	42

Text Book:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education / Prentice Hall Publication, 2020, ISBN: 978-0134610993.
2. François Chollet, "Deep Learning with Python" (Second Edition), Publisher: Manning Publications, Publication Year: 2021, ISBN: 978-1617296864.

Reference Books:

1. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, Farrar, Straus and Giroux Macmillan Publication, 1st Edition, 2019, ISBN: 978-0374257835
2. Mariya Yao, Adelyn Zhou and Marlene Jia, "Applied Artificial Intelligence: A Handbook for Business Leaders", TOPBOTS Publication, 1st Edition, 2018.
3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media, Inc. Publication, 2019.

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA05PE3A	Network Security	03	00	00	03

Course Prerequisite: Discrete Mathematics, Data and Internet Security, Basic Knowledge of Programming and Programming Methodology.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Network Security by being able to do each of the following

1. To understand the fundamental principles of network security, cryptography, and classical encryption techniques in the context of secure communication systems.
2. To analyze and apply symmetric and asymmetric encryption algorithms, digital signature schemes, and security protocols to protect data and communication.
3. To explore and evaluate the security challenges and solutions in modern networking environments, including web, wireless, cloud, and IoT infrastructures.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Explain the core concepts of computer and network security, including OSI security architecture, security services, mechanisms, and classical encryption techniques.
2. Apply basic and advanced cryptographic techniques such as substitution, transposition, symmetric and asymmetric key encryption, and steganography to secure information.
3. Analyze and compare symmetric key encryption algorithms like DES and AES, and their principles, structures, and operations including block and stream ciphers.
4. Evaluate the working and security of asymmetric encryption algorithms such as RSA, ElGamal, Diffie-Hellman, and ECC, along with digital signature schemes.
5. Assess network and internet security mechanisms such as SSL, TLS, HTTPS, SSH, and wireless network protocols including IEEE 802.11 standards.
6. Identify and address security risks in cloud and IoT systems using appropriate security models.

	Subject: (6SA05PE3A) Network Security	L
Unit-1	Introduction to Network Security: Computer Security Concepts, The OSI Security Architecture- Security Services, Security Mechanisms and Security attacks, A Model for Network Security – Classical Encryption Technique – Symmetric Cipher Model – Substitution Technique.	07

Unit-2	Cryptography Concepts and Techniques: Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.	07
Unit-3	Symmetric key Ciphers: Traditional Block Cipher Structures, Data Encryption Standard (DES), DES Example, Block Cipher Principles, Advanced Encryption Standard (AES), AES Structure, AES Transformation Function, AES Example, Block cipher operation, Stream ciphers.	07
Unit-4	Asymmetric key Ciphers: Principles of public key cryptosystems, RSA Algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, and Elliptic Curve Cryptography, Digital Signatures, Schnorr and NIST Digital Signature Scheme.	07
Unit-5	Network and Internet Security: Transport-level Security: Web security considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH). Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security.	07
Unit-6	Cloud and IoT Security: Cloud Security and IoT Security: Cloud Computing, Cloud Security Concepts, Cloud Security Risks and Countermeasures, Cloud Security as a Service, An Open-Source Cloud Security Module. Internet of Things (IoT) Security: The Internet of Things, IoT Security Concepts and Objectives, An Open-Source IoT Security Module.	07
	Total	42

Text Books:

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th and 8th Edition.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition.

Reference Books:

1. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition
2. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
3. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
4. Introduction to Network Security: Neal Krawetz, CENGAGE Learning
5. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA05PE3B	Data Mining and Data Warehousing	03	00	00	03

Course Prerequisite: Discrete Mathematics, Data Structures, Programming Methodology, Data Analytics and Visualization and Business Intelligence.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Mining and Data Warehousing by being able to do each of the following:

1. To introduce fundamental concepts, methodologies, and applications of data mining and its role in extracting knowledge from large datasets.
2. To enable students to understand the architecture, modeling, and design strategies of data warehouses for analytical processing.
3. To provide knowledge of advanced techniques and design aspects of conceptual, logical, and physical data warehouse modeling including OLAP operations and performance optimization.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the need, applications, and challenges of data mining and data mining techniques.
2. Discuss data preprocessing techniques such as data cleaning, integration, transformation.
3. Examine the core architecture and components of a data warehousing, and OLAP operations using multidimensional models.
4. Illustrate conceptual models for data warehouse design.
5. Inspect logical models of data warehouse design.
6. Evaluate physical data warehouse design such as materialized views, indexing strategies and data cube computation.

	Subject: (6SA05PE3B) Data Mining and Data Warehousing	L
Unit-1	Introduction to Data Mining: Data Mining, Need of Data Mining? What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined? Which Technologies Are Used? Applications of data mining, Major Issues in Data Mining	07

Unit-2	Introduction to Data & Data Preprocessing: Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity. Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.	07
Unit-3	Introduction To Data Warehousing: A Historical Overview of Data Warehousing, Spatial and Spatiotemporal Data Warehouses, New Domains and Challenges, Data Warehouse Concepts: Multidimensional Model, OLAP Operations, Data Warehouse Architecture, Data Warehouse Design, Business Intelligence Tools.	07
Unit-4	Conceptual Data Warehouse Design: Conceptual Modeling of Data Warehouses, Hierarchies, Balanced Hierarchies, Unbalanced Hierarchies, Generalized Hierarchies, Alternative Hierarchies, Parallel Hierarchies, Nonstrict Hierarchies, Advanced Modeling Aspects, Facts with Multiple Granularities, Many-to-Many Dimensions.	07
Unit-5	Logical Data Warehouse Design: Logical Modeling of Data Warehouses, Relational Data Warehouse Design, Time Dimension, Logical Representation of Hierarchies, Balanced Hierarchies, Unbalanced Hierarchies, Generalized Hierarchies, Alternative Hierarchies, Parallel Hierarchies, Nonstrict Hierarchies, Advanced Modeling Aspects, Facts with Multiple Granularities, Manyto-Many Dimensions, Slowly Changing Dimensions, SQL/OLAP Operations.	07
Unit-6	Physical Data Warehouse Design: Physical Modeling of Data Warehouses, Materialized Views, Algorithms Using Full Information, Algorithms Using Partial Information, Data Cube Maintenance, Computation of a Data Cube, PipeSort Algorithm, Indexes for Data Warehouses, Bitmap Indexes, Bitmap Compression, Join Indexes, Evaluation of Star Queries.	07
	Total	42

Text Book:

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Elsevier, 3rd Edition, 2006, ISBN: 9780123814791
2. Alejandro Vaisman and Esteban Zimányi, "Data Warehouse Systems: Design and Implementation", Springer-Verlag Berlin Heidelberg, 2014, ISBN: 9783642546556.

Reference Books:

1. Arun K. Pujari, "Data Mining Techniques", Orient BlackSwan/Universities Press, 3rd Edition, 2013, ISBN: 9788173718126
2. Paulraj Ponniah, "Data Warehousing Fundamentals", John Wiley & Sons, 2001, ISBN: 9780471412540
3. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw-Hill, 35th Reprint, 2016, ISBN: 9780070587410.

B.Tech Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA05PE3C	Artificial Neural Network	03	00	00	03

Course Prerequisite: Discrete Mathematics, Data Structures, Artificial Intelligence and Expert System Design.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Artificial Neural Network by being able to do each of the following:

1. To introduce the structure and functioning of biological and artificial neurons, and the foundational architectures and models in neural networks.
2. To develop an understanding of supervised and unsupervised learning algorithms, including back propagation, Hopfield networks, and adaptive resonance theory.
3. To explore advanced neural network models such as deep learning, CNNs, auto encoders, and generative models, and their applications in real-world AI systems.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Explain basics and need of data science
2. Describe proficiency with statistical analysis of data.
3. Demonstrate loading of data and its manipulation for data science
4. Perform linear and multiple linear regression analysis.
5. Develop the ability to build and assess classification-based models
6. Evaluate outcomes and make decisions based on data.

	Subject: (6SA05PE3C) Artificial Neural Network	L
Unit-1	Foundations of Neural Networks: Human Brain and Nervous System, Introduction to Artificial Neural Network, Model of an Artificial Neuron, Early Neural Networks, Activation function, Mculloch Pitts neuron model, ADALINE, MADALINE, Learning methods for Neural Networks, Fixed Increment Learning Algorithm.	07

Unit-2	Backpropagation: Architecture of Backpropagation Network, perceptron model, Single layer Artificial Neural Network, Model for Multilayer Perceptron, Back propagation algorithm, Back Propagation learning, training of network, calculation of error, Method of steepest descent algorithm, effect of learning rate, adding momentum term.	07
Unit-3	Associative Memory: Autocorrelation, Hetro correlation, multiple training encoding strategy, Hopfield Network, error performance of Hopfield network, Exponential BAM, Associative memory for real coded pattern pairs, character recognition application.	07
Unit-4	Adaptive Resonance Theory: Cluster structure, vector quantization, classical ART network, simplifier ART architecture, ART1: architecture, Special features and algorithm, ART2: architecture, Special features and algorithm, character recognition using ART1	07
Unit-5	Rectified Linear Unit : Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Deep Learning Applications.	07
Unit-6	Convolutional Networks: Convolutional Neural Network (CNN) architectures, different types of CNN, pooling operation in CNN, Under complete Autoencoders, Denoising Autoencoder, Encoder–Decoder model, Bidirectional Recurrent Neural Networks (Bi-RNNs) architecture, Long short-term memory (LSTM), Deep Belief Network working, Directed Generative Network working.	07
	Total	42

Text Book:

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications", PHI Learning, 2003, ISBN: 9788120321860.
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press, 2017, ISBN: 9780262035613.

Reference Books:

1. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill, 2004, ISBN: 9780070482920.
2. Simon Haykin, "Neural Networks and Learning Machines", Pearson Education, 3rd Edition, 2009, ISBN: 9780131471399.

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA06	Data Science Lab	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Science Lab by being able to do each of the following:

1. To learn how to handle and clean real-world data using Python.
2. To explore and visualize data using basic tools and libraries.
3. To apply simple machine learning techniques to solve problems.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Data Science so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

*Minimum 8 to 10 practical's are to be conducted based on subject **6SA01 – Data Science Syllabus**.*

Software Tools:

Apache Hadoop / Tableau / Google COLAB / Python / Online IDE's / Jupyter notebook / Anaconda / Orange Data Mining Tool, KNIME Analytics Platform / R-Studio / R-Programming / RapidMiner Studio / WEKA / VS Code.

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA07	Design and Analysis of Algorithms Lab	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Design and Analysis of Algorithms Lab by being able to do each of the following:

1. The principal objective of this course is to build solid foundation in algorithms and their applications.
2. To understand the importance of algorithm and its complexities.
3. To provide a practical exposure of all algorithms.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Develop programs for sorting a given set of elements and analyze its time complexity.
2. Solve and analyze the problems using greedy methods, dynamic programming, backtracking method to solve various problems.
3. Choose appropriate algorithms techniques to solve computational problems.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 6SA02 Design and Analysis of Algorithms.

Software Tools:

C / C++ / JAVA / Jupyter Notebook / Eclipse / NetBeans / VS Code / Python / ALGOX / Code Chef IDE / Online IDE's / Hacker Rank / Leet Code / ALGO Lab.

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA08	Database Management Systems Lab	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Database Management Systems Lab by being able to do each of the following:

1. To Understand difference of SQL and NoSQL Database.
2. To construct simple and advanced database queries using a data language.
3. To recognize the need for transaction management and query processing.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Create Database applications using Query Languages like SQL.
2. Model, design and normalize databases for real life applications.
3. Design and develop transaction processing approach for relational databases.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 6SA03 Database Management Systems.

Software Tools:

SQL / MYSQL / Oracle / SQL Server / POSTGRESS SQL / SQLite / MONGO DB / Cassandra / CouchDB / Redis / ER-Studio / Microsoft Visio / Lucidchart / DbSchema / PHP MySQL Admin / DB Browser / SQL Lite / XAMPP - WAMPP / SQL FIDDLE / Vertabelo / SolarWinds Database Performance Analyzer / Nagios / Prometheus & Grafana / Amazon RDS / Google Cloud SQL / Azure SQL Database / Google BigQuery / SQL Workbench / DBeaver.

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SA09	Computer Skill Laboratory - 3	00	00	04	02

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Modern Tools and Technology by being able to do each of the following:

1. To provide practical exposure to the theoretical concepts of the chosen elective subject through hands-on experiments and simulations.
2. To develop the technical skills necessary to apply subject-specific tools, algorithms, and frameworks in real-world problem-solving.
3. To strengthen analytical thinking by engaging students in lab-based assignments, mini-projects, or case studies.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Use his / her understanding / knowledge of Modern Emerging Tools and Technology so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

*Minimum 8 to 10 practical's are to be conducted based on subject **6SA04PE2 A / B / C – Program Elective Course – 2** or **6SA04PE3 A / B / C – Program Elective Course – 3 Syllabus** or **Modern Emerging Tools and Technology** with One Mini Project have to be submitted by students.*

Software Tools:

Emerging Latest Software Tools and Technology to be used for Practical's and Minor Project.

B.Tech. Sixth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
6SAH	Business and Web Analytics	03	00	00	03

Course Prerequisite: Discrete Mathematics, Data Structures, Programming Methodology, Python Programming and Data Analytics and Visualization.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Business and Web Analytics by being able to do each of the following:

1. To introduce students to the foundations of business analytics, including descriptive, predictive, and prescriptive analytics and their role in data-driven decision-making.
2. To develop analytical skills in data visualization, sampling, estimation, and statistical interpretation relevant to business and web analytics.
3. To equip students with the knowledge of web analytics tools, techniques, and methods for analyzing user behavior, traffic, and optimizing website performance.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Describe the role of business analytics in modern decision-making using descriptive, predictive, and prescriptive analytics techniques.
2. Predict statistical measures and visualization methods for understanding and interpreting business data.
3. Analyze data using sampling techniques and estimate population parameters.
4. Apply web analytics methodologies including log file analysis, goal setting, and performance metrics using tools like Google Analytics.
5. Inspect visitor, traffic, and content analysis of web to understand user behavior through segmentation and search analysis.
6. Design A/B testing, usability evaluation, and in-page behavior analysis to improve web design and user engagement.

	Subject: (6SAH) Business and Web Analytics	L
Unit-1	Introduction to Business Analytics: Analytics Landscape, Why Analytics, Business Analytics-The Science of Data-Driven Decision Making, Descriptive Analytics, Predictive Analytics, Prescriptive Analytics, Descriptive, Predictive, and Prescriptive Analytics Techniques, Big Data Analytics, Web and Social Media Analytics.	07
Unit-2	Descriptive Analytics: Data Types and Scales, Types of Data Measurement Scales, Population and Sample, Measures of Central Tendency, Percentile, Decile and Quartile, Measures of Variation, Measures of Shape – Skewness and Kurtosis, Data Visualization.	07
Unit-3	Sampling and Estimation: Population Parameters and Sample Statistic, Sampling, Probabilistic Sampling, Non-probability Sampling, Sampling Distribution, Central Limit Theorem (CLT), Sample Size Estimation for Mean of the population, Estimation of Population Parameters, Method of Moments, Estimation of Parameters Using Method of Moments, Estimation of Parameters Using Maximum Likelihood Estimation	07
Unit-4	Introduction to Web Analytics: Web Analytics Approach, A Model of Analysis, Context Matters, Log File Analysis, Page Tagging, Metrics and Dimensions, Goals, Conversion Rate, Goal Reports in Google Analytics, Performance Indicators, Going Beyond the Website	07
Unit-5	Learning about Users through Web Analytics: Visitor Analysis, Traffic Analysis, Organic Search, Search Query Analysis, Website Content Reports, Click-Path Analysis, Segmentation - Why & How Segment Data, Segmenting According to page, User Traits, Information Need.	07
Unit-6	Pairing Analytics Data: Personas, Usability Testing & Inspection, Design Objectives, Measuring the Effects of Changes, Measuring Behavior within Pages, Google Analytics In-Page Analytics, Analytics Tools, Analyzing Event Data, A/B Testing, Designing an Experiment.	07
	Total	42

Text Book:

1. U. Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making", Wiley, 2017, ISBN: 9788126569378.
2. Michael Beasley, "Practical Web Analytics for User Experience: UX Designer", Morgan Kaufmann, 2013, ISBN: 9780124046944.

Reference Books:

1. Ger Koole, "An Introduction to Business Analytics", Lulu.com, 2019, ISBN: 9780244442398.
2. Avinash Kaushik, "Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity", John Wiley & Sons, 2009, ISBN: 9780470529393.
3. Eric T. Peterson, "Web Analytics Demystified: A Marketer's Guide to Understanding How Your Website Affects Your Business", Celilo Group Media & Jim Sterne, 2004, ISBN: 9780974358422.

B.Tech Sixth Semester

Course Code	Course Title	L	T	P	C
6SDMP	Disaster Management and Preparedness	02	00	00	00

Course Prerequisites: Environmental Science

Course Learning Objectives:

1. Basic concepts of disasters, hazards, vulnerability, risk, and disaster management.
2. Knowledge of disaster management principles, frameworks, policies, and mitigation strategies.
3. The role of science and technology in disaster risk reduction and sustainable disaster management.

Course Outcomes:

Students will be able to –

1. Define and explain concepts of disaster, hazard, vulnerability, risk, and capacity.
2. Classify and describe different types of disasters, their causes, consequences, and control measures.
3. Apply disaster management cycle approaches including preparedness, response, recovery, and rehabilitation strategies.
4. Analyze disaster management policies, acts, guidelines, and institutional mechanisms in India.
5. Evaluate the applications of GIS, GPS, Remote Sensing, early warning systems, and mitigation technologies in disaster management.

UNIT	Subject: Disaster Management and Preparedness.	L
UNIT I	Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management	2
UNIT II	Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunderstorms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Man-made Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters	8

UNIT III	Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action	8
UNIT IV	Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter-Governmental Agencies	7
UNIT V	Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India	7
UNIT VI	Study of Recent Disasters (at local, state and national level) And Preparation of Disaster Risk Management Plan of an Area or Sector Role of Engineers in Disaster Management	---
	Total	32

Course Marking Scheme (50 Marks)

1. Classroom activeness – 5 Marks;
2. Assignment submission and evaluation – 10 Marks;
3. Class Test/Internal Assessment – 25 Marks;
4. Report Writing on Disaster Management topic – 10 Marks.

Performance Evaluation Criteria:

The Performance of Student securing 25 marks or above will be considered Satisfactory, while students securing below will be considered Unsatisfactory.

Text Books:

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi.

Reference Books:

1. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
2. Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur
3. Disaster Preparedness Kit, American Red Cross

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA01	Cloud Computing	02	00	00	02

Course Prerequisite: Data Communication and Networks, Network Security.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Cloud Computing by being able to do each of the following:

1. To provide students with the fundamentals and essentials of Cloud Computing, as well as Cloud Computing services and tools in real life scenarios.
2. To enable student to explore some important Cloud Computing driven commercial systems and applications.
3. To provide students with essentials of Cloud Computing architecture, Virtualization, Storage concepts.

Course Outcomes: After successful completion of this course, the student will be able to:

1. Describe the fundamental concept, architecture and applications of Cloud Computing.
2. Discuss the problems related to cloud deployment model.
3. Examine the concept of virtualization.
4. Identify the role of network connectivity in the cloud.
5. Assess different Cloud service providers.
6. Inspect the security issues in cloud service models.

	Subject: (7SA01) Cloud Computing	L
Unit-1	Cloud Computing Fundamental, Architecture and Management, Cloud Computing Fundamentals: The need for Cloud Computing, Defining Cloud Computing, Principles of Cloud Computing, and Requirements for Cloud Services. Cloud Computing Architecture and Management: Introduction, Cloud Architecture, Applications on the Cloud, Managing Cloud.	05

Unit-2	Cloud Deployment and Service Models, Cloud Deployment Models: Introduction, Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud. Cloud Service Models: Introduction, Infrastructure as a Service, Platform as a Service, Software as a Service, Other Cloud Service Models.	05
Unit-3	Operating System and Virtualization, Types of Operating Systems, Role of OS in Cloud Computing, Features of Cloud OS. Virtualization: Introduction, Virtualization Opportunities, Approaches to Virtualization, Hypervisors, Virtualization to Cloud Computing.	05
Unit-4	Software Development in Cloud and Networking for Cloud Computing, Introduction, Different Perspectives on SaaS Development, New Challenges, Cloud-Aware Software Development. Networking for Cloud Computing: Introduction, Overview of Data Center Environment, Networking Issues in Data Centers, Transport Layer Issues in DCNs.	05
Unit-5	Cloud Service Providers, Introduction, EMC: IT, and captive cloud toolkit, Google: Platform, Storage, Cloud connects, Cloud Print and App Engine, Amazon Web Services: Elastic Compute Cloud, Simple storage, Simple Queue Service, Microsoft: Windows Azure, IBM Cloud models and IBM Smart Cloud.	05
Unit-6	Open-Source Support for Cloud and Security in Cloud Computing, Open-Source Support for Cloud: Introduction, Open Source Tools for IaaS, Open Source Tools for PaaS, Open Source Tools for SaaS. Security in Cloud Computing: Introduction, Security Aspects: Data, Virtualization and Network Security.	05
	Total	30

Text Book:

1. K. Chandrasekaran : Essentials of Cloud Computing, Edition, CRC Press Taylor & Francis Group.1st Edition, ISBN:978-1-4665-0111-7.

Reference Books:

1. Shrinivasan, J. Suresh: Cloud computing a practical approach for learning and implementation, Pearson publication. ISBN-13: 9788131776513
2. M. N. Rao: Cloud Computing, PHI Learning Pvt. Ltd, 2015. ISBN-13: 9788120350731
3. Rajkumar Buyya, James Broberg and Andrzej M. Goscinski: Cloud Computing: Principles and Paradigms, John Wiley & Sons, Inc. 2011. ISBN:978-0-470-88799-8.
4. Anthony T. Velte , Toby J. Velte and Robert Elsenpeter, Cloud computing a practical approach, Tata McGraw- Hill , New Delhi – 2010. ISBN: 978-0-07-162694-1.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA02	Machine Learning	03	00	00	03

Course Prerequisite: Knowledge of Programming, Data Structures, Probability and Statistics, Linear Algebra, Calculus, Database Management Systems, and Python Programming.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Machine Learning by being able to do each of the following:

1. To provide students with a strong foundation in machine learning concepts, paradigms, optimization techniques, and data-driven modeling approaches.
2. To develop the ability to design, implement, and evaluate supervised and unsupervised machine learning models for regression, classification, and clustering tasks.
3. To enable students to analyze machine learning algorithms, assess model performance, and apply appropriate techniques for solving real-world predictive and data mining problems.

Course Outcomes: After successful completion of this course, the student will be able to:

1. Recall the fundamental concepts, techniques, and applications of Machine Learning.
2. Explain supervised, unsupervised, and reinforcement learning methods and their use cases.
3. Apply optimization, regression, and classification algorithms to solve machine learning problems.
4. Analyze the performance of machine learning models using appropriate evaluation metrics and validation techniques.
5. Evaluate and compare different machine learning algorithms for a given dataset and problem.
6. Design and develop machine learning solutions for real-world prediction and clustering tasks.

	Subject: (7SA02) Machine Learning	L
Unit-1	What is Machine learning, why machine learning, History of Machine Learning, Fundamentals of Machine Learning, Data needed, ML Techniques overview, Validation Techniques, Supervised Learning, unsupervised learning, reinforcement learning.	07

Unit-2	Unconstrained and Constrained optimization, Numerical optimization techniques for constrained and unconstrained optimization: Newton's method, Steepest descent method, Penalty function method.	07
Unit-3	Introduction to Regression, Linear Regression with one variable, Relationship between attributes using Covariance and Correlation, Model Evaluation in Regression, Evaluation Metrics in Regression Models. Gradient decent for Linear regression, Multiple Linear Regression, Non-Linear Regression.	07
Unit-4	Classification Naïve Bayes Classifier, Classifier K-Nearest Neighbors, K-Nearest Neighbor algorithm; SVM for classification and regression problems.	07
Unit-5	Decision Trees Building Decision Trees, Ensembles methods, introduction to Support Vector Machine, Measure of performance, Error analysis, Confusion matrix, ROC.	07
Unit-6	Clustering, Distance measures, Different clustering methods (Distance, Density, Hierarchical), Iterative distance-based clustering; Dealing with continuous, categorical values in K-Means, Constructing a hierarchical cluster, Gaussian mixer model. EM-algorithm for mixture of Gaussians.	07
	Total	42

Text Book:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill (1997) ISBN: 978-0-07-042807-2.

Reference Books:

1. R. O. Duda, P. E. Hart, D. G. Stork, "Pattern Classification", Wiley-Blackwell (2000) ISBN: 978-0-471-05669-0.
2. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press (2014) ISBN: 978-1-107-05713-5.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer (2006) ISBN: 978-0-387-31073-2.
4. Ethem Alpaydin, "Introduction to Machine Learning", PHI Learning Pvt. Ltd. (2014) ISBN: 978-81-203-4965-6.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA03PE4A	Cryptography	03	00	00	03

Course Prerequisite: Discrete Mathematics, Probability and Statistics, Computer Networks, Data Structures, and Basic Programming Knowledge.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Cryptography by being able to do each of the following:

1. To understand the basic concepts of information security, cryptography, and classical encryption techniques.
2. To learn symmetric and asymmetric encryption algorithms and their working principles.
3. To apply cryptographic techniques and security protocols for ensuring secure communication and authentication.

Course Outcomes: After successful completion of this course, the student will be able to:

1. Recall the basic concepts of cryptography, security principles, and types of attacks.
2. Explain symmetric and asymmetric encryption algorithms and their mechanisms.
3. Apply cryptographic algorithms such as DES, AES, RSA, and digital signatures for secure communication.
4. Analyze security protocols such as SSL, TLS, PKI, and authentication mechanisms.
5. Evaluate cryptographic systems based on security strength and performance.
6. Design secure communication systems using cryptographic techniques and authentication methods.

	Subject: (7SA03PE4A) Cryptography	L
Unit-1	Introduction, Need for Security, Principles of Security, Types of Attacks. Introduction, Plain Text and Cipher Text, Substitution and Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Stenography	07

Unit-2	Introduction, Algorithm Types and Modes, An Overview of Symmetric Key Cryptography, Data Encryption Standard (DES), International Data encryption algorithm (IDEA) RC4, Blowfish, Advanced Encryption Standard (AES)	07
Unit-3	Introduction and Overview of Asymmetric Key Cryptography, The RSA Algorithm, Symmetric and Asymmetric key Cryptography, Digital Signatures, Knapsack Algorithms.	07
Unit-4	Introduction, Digital Certificates, Private Key Management, The PKIX Model, Public Key Cryptography Standards (PKCS), XML, PKI and Security, Creating Digital Certificate using Java.	07
Unit-5	Introduction & Basic Concepts, Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Hypertext Transport Protocol (SHTTP), Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), SSL Versus SET, 3-D Secure Protocol, Electronic Money, Email Security, Wireless Application Protocol (WAP) Security.	07
Unit-6	Introduction, Authentication Basics, Passwords, Authentication Tokens, Certificate-based-Authentication, Biometric Authentication, Kerberos, Key Distribution Center (KDC), Security Handshake Pitfalls, Single Sign On (SSO) Approaches.	07
	Total	42

Text Book:

1. Atul Kahate, "Cryptography and Network Security", McGraw Hill (2nd Edition, 2013) ISBN: 978-0-07-070208-0.

Reference Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", PHI (4th Edition, 2017) ISBN: 978-93-528-0382-8.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", McGraw Hill (2nd Edition, 2015) ISBN: 978-1-25-902985-5.
3. Matt Bishop, "Computer Security: Art and Science", Pearson Education (2003) ISBN: 978-0-321-24744-5.
4. Douglas R. Stinson, "Cryptography: Theory and Practice", CRC Press (3rd Edition, 2005) ISBN: 978-1-58488-206-0.
5. Keith M. Martin, "Everyday Cryptography: Fundamental Principles and Applications", Oxford University Press (2nd Edition, 2012) ISBN: 978-0-19-969559-8.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA03PE4B	Big Data Analytics and Hadoop	03	00	00	03

Course Prerequisite: Data Structures and Algorithms, Database Management Systems, Operating Systems, Computer Networks, Programming Methodology and Introduction to Python.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Big Data Analytics and Hadoop by being able to do each of the following:

1. To understand the fundamentals of Big Data, analytics lifecycle, and ecosystem components.
2. To gain knowledge of statistical, machine learning, and data mining techniques used in big data analytics.
3. To develop skills in Hadoop ecosystem tools and big data processing frameworks for real-world applications.

Course Outcomes: After successful completion of this course, the student will be able to:

1. Explain the concepts of Big Data, analytics lifecycle, and its applications in various domains.
2. Apply statistical methods, clustering, and association rule mining techniques for data analysis.
3. Develop regression and classification models for predictive analytics problems.
4. Analyze time series data and text data using appropriate analytical techniques.
5. Evaluate big data storage systems and Hadoop ecosystem components for distributed processing.
6. Design and implement big data solutions using Hadoop tools and frameworks for real-world applications.

	Subject: (7SA03PE4B) Big Data Analytics and Hadoop	L
Unit-1	Introduction to Big Data, State of data analytics and modern ecosystem, Roles in Big Data projects (Data Scientist, Analyst, Engineer), Examples of Big Data applications. Data Analytics Lifecycle: Discovery, Data Preparation, Model Planning, Model Building, Communicate Results Operationalize.	07

Unit-2	Exploratory Data Analysis (EDA) Statistical evaluation methods: Hypothesis Testing, Difference of Means, Wilcoxon Rank-Sum Test, Type I & Type II Errors Overview of clustering, K-means algorithm (concept, use cases, diagnostics) Association Rules: Apriori Algorithm, Frequent itemsets, Rule generation and evaluation	07
Unit-3	Regression: Linear Regression (concept, use cases, diagnostics), Logistic Regression (concept, cautions, applications), Other regression models (overview) Classification, Decision Trees (algorithm, evaluation), Naïve Bayes (Bayes theorem, classifier, smoothing), Diagnostics of classifiers.	07
Unit-4	Time Series Analysis: Overview and Box-Jenkins methodology, AR, MA, ARMA, ARIMA models, ACF (Autocorrelation Function), Model building and evaluation Text Analytics: Steps in text analysis, Text representation, TF-IDF Topic categorization, Sentiment analysis	07
Unit-5	Big Data storage and architecture, Hadoop ecosystem overview, HDFS, YARN, MapReduce Tools: Hive, Pig, HBase, Mahout, Zookeeper Application Development: MapReduce programming model, Parallel processing basics Execution model	07
Unit-6	Database Analytics: SQL essentials, Advanced SQL, In-database analytics, Concepts and need Types: Key-value stores, Document stores Column/tabular stores, Graph databases, Graph Analytics: Graph models and structures, Graph algorithms and use cases, Visualization basics	07
	Total	42

Text Book:

1. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, John Wiley & Sons, Inc. (2015) ISBN:978-1-118-87613-8

Reference Books:

1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers (2014) ISBN:978-1-118-89271-8
2. Mohammad Guller, “Big Data Analytics with Spark: A Practitioner’s Guide to Using Spark for Large-Scale Data Processing, Machine Learning, and Graph Analytics, and High-Velocity Data Stream Processing”, Apress Publisher (2015) ISBN-13:978-1-4842-0965-3
3. Arshdeep Bahga and Vijay Madisetti, “Big Data Science & Analytics: A Hands-On Approach”, (2019) ISBN:978-1-949978-00-1.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA03PE4C	Generative Artificial Intelligence	03	00	00	03

Course Prerequisite: Python Programming, Data Structures and Algorithms, Artificial Intelligence, Machine Learning, Probability and Statistics, Linear Algebra.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Generative Artificial Intelligence by being able to do each of the following:

1. To understand the fundamentals of Artificial Intelligence, neural networks, and the evolution of deep learning leading to Generative AI.
2. To study key generative models such as GANs, VAEs, Transformers, and Large Language Models with their architectures and working principles.
3. To develop the ability to apply generative AI techniques for real-world applications such as text, image, audio generation, and intelligent systems.

Course Outcomes: After successful completion of this course, the student will be able to:

1. Explain the fundamentals of Artificial Intelligence, neural networks, and the evolution of Generative AI.
2. Describe and analyze the architecture and working of GANs, VAEs, Transformers, and LSTM networks.
3. Apply generative AI models for data generation tasks such as text, image, video, and audio synthesis.
4. Analyze performance and challenges of generative models in real-world applications.
5. Evaluate Large Language Models, including pre-training and transfer learning techniques, for different AI tasks.
6. Design and develop basic Generative AI-based applications such as chatbots and content generation systems using GPT models.

	Subject: (7SA03PE4C) Generative Artificial Intelligence	L
Unit-1	History and evolution of AI/ML, Deep learning revolution, Transfer learning, History of Neural, Natural Language Processing, Structure of Artificial Neural Networks, Steps in Training an Artificial Neural Network, Parameters and Hyper parameters, Back propagation.	07
Unit-2	Generative Artificial Intelligence (Generative AI): Concepts and Comparison with Traditional AI, (GANs): Architecture and Working Principle, Components of GANs: Generator and Discriminator, Challenges, and Performance Issues in GANs, Applications of GANs in Image, Video Generation, and Other Real-World Domains	07
Unit-3	Variational Autoencoders (VAEs), Transformers, Attention Mechanism in detail Long Short-Term Memory Networks (LSTMs). Probability and Statistics, Data Preprocessing Techniques, Model Training Techniques.	07
Unit-4	Applications in Various Fields: Art and Creativity, Image and Video Generation, Text Generation, Music Composition, Healthcare Finance. Real-world use cases and challenges in deploying generative AI models.	07
Unit-5	Overview of Generative AI and Large Language Models. Basics of attention mechanisms and Transformer architecture. Pre-training techniques and transfer learning strategies.	07
Unit-6	Study of GPT architecture and variants. Applications of GPT models in text generation and dialogue systems. Case study-based implementation of GPT-based tasks. GPT-based chatbot enhances E-Shop's customer support service.	07
	Total	42

Text Book:

1. Altaf Rehmani, "Generative AI for Everyone: Understanding the Essentials and Applications of This Breakthrough Technology", Independently Published, 2023, ISBN: 9798392038019.
2. Numa Dhamani, "Introduction to Generative AI", Kindle Edition, 2024, ASIN: B0CVRDXF1T.

Reference Books:

1. Josh Kalin, "Generative Adversarial Networks Cookbook: Over 100 Recipes to Build Generative Models Using Python, TensorFlow, and Keras", Packt Publishing, 2018, ISBN: 9781789139907.
2. Jesse Sprinter, "Generative AI in Software Development: Beyond the Limitations of Traditional Coding", Independently Published, 2024, ISBN: 9798321819017.
3. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer, 2018, ISBN: 9783319944623.
4. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press, 2017, ISBN: 9780262035613.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA04PE5A	Digital Forensic	02	00	00	02

Course Prerequisite: Discrete Mathematics, Probability and Statistics, Computer Networks, Data Structures and Programming Methodology.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Digital Forensic by being able to do each of the following:

1. To understand the fundamental concepts, processes, legal aspects, and methodologies of digital forensic investigations.
2. To develop skills in acquiring, preserving, analyzing, and interpreting digital evidence from computer systems, networks, mobile devices and cloud environments.
3. To apply forensic tools and investigation techniques for incident response, cybercrime analysis and forensic reporting.

Course Outcomes: After successful completion of this course, the student will be able to:

1. Explain the fundamentals of digital forensics, cybercrime, digital evidence, and forensic investigation processes.
2. Apply evidence acquisition, preservation, and recovery techniques while maintaining forensic integrity.
3. Analyze storage media, memory, logs, and malware artifacts using forensic methodologies and tools.
4. Investigate network, mobile, cloud, email, and web-based incidents using appropriate forensic techniques.
5. Evaluate digital evidence and prepare forensic reports in compliance with legal and ethical requirements.
6. Design and implement digital forensic investigation solutions for cybercrime, ransomware, fraud, and incident response scenarios.

	Subject: (7SA04PE5A) Digital Forensic	L
Unit-1	Introduction to Digital Forensics, Fundamentals of Digital Forensics, Cybercrime and Cybercriminals, Need and Scope of Digital Forensics, Types of Digital Evidence, Forensic Investigation Process, Legal and Ethical Issues in Digital Forensic.	05
Unit-2	Digital Evidence and Forensic Procedures, Evidence identification and acquisition, Evidence Acquisition Techniques, Live vs. Dead Acquisition, Imaging and Cloning of Storage Devices, Write Blockers, Data Recovery Techniques, Evidence Preservation Methods.	05
Unit-3	Storage Forensics, Disk and Memory Forensics, Disk Structure and Partition Analysis, Deleted File Recovery, Metadata Analysis, Registry Analysis, Volatile Data Collection, Malware and Log Analysis, Introduction to Forensic Tools.	05
Unit-4	Network and Mobile Forensics, Network Forensics Fundamentals, Packet Capture and Analysis, Email Forensics, Web Browser Forensics, Mobile Device, cloud Forensics, SIM and Call Record Analysis, Social Media and Cloud Forensics.	05
Unit-5	Forensic Reporting and Emerging Trends, Documentation and Reporting Standards, Expert Witness and Court Presentation, Incident Response and Investigation, Anti-Forensics Techniques, AI in Digital Forensics.	05
Unit-6	Forensic Investigation Solutions and Case Studies, Design and Development of Forensic Investigation Solutions, Digital Forensic Investigation Frameworks, Automation in Digital Forensics, Ransomware and Malware Investigation Case Studies, Social Media and Financial Fraud Investigation.	05
	Total	30

Text Book:

1. Bill Nelson, Amelia Phillips and Christopher Steuart, "Guide to Computer Forensics and Investigations", Cengage Learning (2018) ISBN:978-1-337-56721-4.
2. Nilakshi Jain and Dhananjay Kalbande, "Digital Forensics", Wiley India (2016) ISBN:978-81-265-5668-3.

Reference Books:

1. Linda Volonino and Reynaldo Anzaldua, "Computer Forensics: Principles and Practices", Cengage Learning (2014) ISBN:978-1-285-06003-4.
2. Gerard Johansen, "Digital Forensics and Incident Response", Syngress / Elsevier (2019) ISBN:978-0-12-805409-3.
3. Brian Carrier, "File System Forensic Analysis", Addison-Wesley (2005) ISBN:978-0-321-26817-4.
4. Eoghan Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet", Academic Press (2011) ISBN:978-0-12-374268-1.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA04PE5B	Natural Language Processing	02	00	00	02

Course Prerequisite: Python Programming, Discrete Mathematics, Data Structures and Algorithms, Theory of Computation, Artificial Intelligence, Machine Learning and Probability and Statistics.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Natural Language Processing by being able to do each of the following:

1. To understand the fundamental concepts, legal aspects, and investigation processes involved in digital forensics.
2. To develop skills in acquiring, preserving, recovering, and analyzing digital evidence from storage devices, networks, mobile devices, and cloud environments.
3. To apply forensic tools, methodologies, and reporting techniques for cybercrime investigation and incident response.

Course Outcomes: After successful completion of this course, the student will be able to:

1. Explain the concepts of digital forensics, cybercrime, digital evidence, and forensic investigation procedures.
2. Apply evidence acquisition, preservation, and recovery techniques in forensic investigations.
3. Analyze storage devices, memory, logs, and malware artifacts using forensic tools and techniques.
4. Investigate network, mobile, cloud, email, and web-based forensic incidents.
5. Evaluate digital evidence and prepare forensic reports following legal, ethical, and professional standards.
6. Design and implement digital forensic investigation solutions for cybercrime, fraud, ransomware, and incident response scenarios.

	Subject: (7SA04PE5B) Natural Language Processing	L
Unit-1	Introduction Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes.	05
Unit-2	Linguistics Resources Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK	05
Unit-3	Regular expressions Finite State Automata, word recognition, lexicon. Morphology, acquisition models, Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF. Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expression	05
Unit-4	Parsing Unification, probabilistic parsing, Treebank. Semantics- Meaning representation, semantic analysis, lexical semantics, WorldNet Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary based approaches.	05
Unit-5	Dialog Systems and Chatbots Introduction to Transformer architectures (BERT, GPT), Transfer learning and fine-tuning pre-trained models for NLP tasks. Intent recognition and response generation.	05
Unit-6	Applications of NLP Spell-checking, Summarization Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries	05
	Total	30

Text Book:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Pearson (3rd Edition, 2023) ISBN:978-0-13-187321-6.
2. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly Media (2009) ISBN:978-0-596-51649-9.

Reference Books:

1. Yoav Goldberg, "Neural Network Methods in Natural Language Processing", Morgan & Claypool Publishers (2017) ISBN:978-1-68173-463-7.
2. Hobson Lane, Cole Howard and Hannes Max Hapke, "Natural Language Processing in Action", Manning Publications (2019) ISBN:978-1-61729-463-1.
3. Jacob Eisenstein, "Introduction to Natural Language Processing", MIT Press (2019) ISBN:978-0-262-04384-8.
4. Delip Rao and Brian McMahan, "Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning", O'Reilly Media (2019) ISBN:978-1-4920-5381-3.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA04PE5C	Blockchain with AI	02	00	00	02

Course Prerequisite: Data Structures and Algorithms, Database Management Systems, Computer Networks, Cryptography fundamentals, Programming Methodology, and Python Programming.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Blockchain with AI by being able to do each of the following:

1. To understand the fundamentals of AI evolution, IoT, Blockchain, and their convergence in modern intelligent systems.
2. To gain knowledge of machine learning concepts and blockchain technologies including Bitcoin, Ethereum, and smart contracts.
3. To develop the ability to design and deploy AI, IoT, and blockchain-based applications for real-time and enterprise use cases.

Course Outcomes: After successful completion of this course, the student will be able to:

1. Recall the basic concepts of AI, IoT, Blockchain, and Machine Learning.
2. Explain the working principles of blockchain, smart contracts, IoT, and AI systems.
3. Apply machine learning and blockchain concepts to solve basic real-world problems.
4. Analyze data, IoT systems, and blockchain architectures for different applications.
5. Evaluate AI, IoT, and blockchain-based solutions for performance and effectiveness.
6. Design simple AI–IoT–Blockchain integrated applications for real-world scenarios.

	Subject: (7SA04PE5C) Blockchain with AI	L
Unit-1	The AI 2.0 Revolution, AI – AI in the Old Days, Status Quo, The Buildup to AI 1.0 Revolution, Machine Learning, Creating AI-Enabled Applications, What is AI 2.0? – Early Warning Systems for Wildlife, Azure Cognitive Services, IoT – Introduction and Definition and use, Azure IoT Suite, Blockchain – What is Blockchain?, How can Blockchain help?, Azure Blockchain Solutions, Its all about data – Data Importance, Evolution of data collection, Smart Hospitals	05

Unit-2	Understanding Blockchain Cryptocurrency history – Era of Gold coins, FIAT Currency, Using Checks, Promises of E-Wallet, The Financial Crises Broke the Trust – Blessings in Disguise: Bitcoin, What is Bitcoin, Blockchain, Block?, Blockchain benefits, Ethereum, Smart Contracts, Types of Blockchains	05
Unit-3	Making Predictions with Machine Learning(ML) What is Machine Learning?, Problems that ML solves – classification, regression, anomaly detection, clustering, Types of ML, Building an ML model: data collection, preprocessing, feature definition, splitting data, applying an ML algorithm, Model Training, Model Evaluation, Model Deployment	05
Unit-4	Blockchain as a Service and IoT Enterprise Ethereum alliance – Smart contracts, developing smart contracts, Understanding Ethereum jargons, Setting up Ethereum, IoT: History, IoT devices, Network Connectivity, Use case: Home Automation, Configuring and Deploying a single IoT Device, Azure IoT Suite – IoT Solution Architecture, Preconfigured Solutions, Azure IoT Hub	05
Unit-5	Capturing, Analyzing and visualizing Real Time Data Stream Analytics, Performing IoT Stream data analytics, Data Visualization – Introduction, various ways to visualize data, Problem Solving: Real Time Dengue Outbreak Detection	05
Unit-6	Building Smarter Applications Building AI 2.0 – Use case: Centralized Patient Monitoring: The problem and the solution, Understanding Cognitive APIs – What are Cognitive Systems?, Microsoft Cognitive Services, Creating IoT Hub, Device Identities, Simulated Device and Solution Backend, Writing an IoT Application for rpi	05
	Total	30

Text Book:

1. Nishith Pathak and Anurag Bhandari, “IoT, AI, and Blockchain for .NET: Building a Next-Generation Application from the Ground Up”, (2018) ISBN:978-1-4842-3765-6.

Reference Books:

1. Khaled Salah, M. Habib Ur Rehman, Nishara Nizamuddin and Ala Al-Fuqaha, “Blockchain for AI: Review and Open Research Challenges”, IEEE Access (2019) ISBN: N/A.
2. Ahmed Banafa, “Blockchain Technology and Applications”, River Publishers (2022) ISBN:978-87-7022-045-6.
3. Stein Smith, “Blockchain, Artificial Intelligence and Financial Services”, Springer International Publishing (2020) ISBN:978-3-030-29762-5.
4. Kai Wang, Jiaqing Dong, Ying Wang and Hao Yin, “Securing Data with Blockchain and AI”, IEEE Access (2019).
5. Ruonan Wang, Min Luo, Yihong Wen, Lianhai Wang, Kim-Kwang Raymond Choo and Debiao He, “The Applications of Blockchain in Artificial Intelligence”, Security and Communication Networks (2021).

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA05	Machine Learning Lab	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Machine Learning Lab by being able to do each of the following:

1. To understand various key paradigms for machine learning approaches.
2. To familiarize with the mathematical and statistical techniques used in machine learning.
3. To understand and differentiate among various machine learning techniques.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Machine Learning so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 7SA02 – Machine Learning Syllabus.

Software Tools:

Python (Anaconda) / Jupyter Notebook / Google Colab / Scikit-learn / NumPy / Pandas / Matplotlib / Seaborn / TensorFlow / Keras / PyTorch / VS Code / Spyder / R-Studio / R-Programming.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA06	Computer Skill Laboratory - 4	00	00	02	01

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Modern Tools and Technology Lab by being able to do each of the following:

1. To provide practical exposure to the theoretical concepts of the chosen elective subject through hands-on experiments and simulations.
2. To develop the technical skills necessary to apply subject-specific tools, algorithms, and frameworks in real-world problem-solving.
3. To strengthen analytical thinking by engaging students in lab-based assignments, mini-projects, or case studies.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Use his / her understanding / knowledge of Modern Emerging Tools and Technology so as to design / conduct experimentation related to given aim / objective
2. Use Computer Hardware / Software and other concern resources for conduction of practical.
3. Interpret results, formulate findings, draw suitable conclusion and respond to inquiries, related to given practical.

List of Experiment:

Minimum 8 to 10 practical's are to be conducted based on subject 7SA03PE4 A / B / C – Program Elective Course – 3 or 7SA04PE5 A / B / C – Program Elective Course – 3 Syllabus or Cloud Computing or Modern Emerging Tools and Technology.

Software Tools:

Emerging Latest Software Tools and Technology to be used for Practical's.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA07	Research Methodology	00	00	04	02

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Research Methodology by being able to do each of the following:

1. Develop practical skills for conducting research in AI & Data Science.
2. Learn how to identify research problems and formulate hypotheses.
3. Gain hands-on experience in literature review, experimentation, and reporting.
4. Use modern tools for data analysis, experimentation, and documentation.
5. Prepare students for final-year projects, publications, and higher studies.

Course Outcomes:

After successfully completing the course, students will be able to-

1. Identify and define a research problem in Artificial Intelligence and Data Science.
2. Perform structured literature reviews using academic and indexing databases.
3. Design experiments and apply scientific methods to evaluate AI/DS models.
4. Apply statistical and analytical techniques to interpret research data.
5. Write technical reports and research papers and present research findings effectively.
6. Identify authentic journals and research sources using DOI, ISSN, ORCID, and distinguish them from predatory journals.

List of Practicals (Experiments / Activities):

Module 1: Research Problem Identification

1. Selection of a research domain (e.g., NLP, Computer Vision, Time Series)
2. Problem statement drafting and refinement
3. Defining objectives and scope of the study

Module 2: Literature Review

4. Search and review papers from sources like
 - IEEE
 - Springer
 - Science Direct / Elsevier
 - ACM

- Google Scholar
- 5. Summarizing 10–20 research papers
- 6. Identifying research gaps and forming research questions

Module 3: Research Identifiers & Metadata

- 7. Understanding and identifying DOI using examples from journals
 - Study of DOI (Digital Object Identifier)
 - Extract DOI from research papers and verify using official resolver
- 8. Understanding journal identification system
 - Study of ISSN (International Standard Serial Number)
 - Difference between ISSN (print) and e-ISSN
- 9. Hands-on: Validate DOI and ISSN of selected papers

Module 4: Journal Quality & Authenticity Check

- 10. Identifying genuine vs predatory journals
- 11. Verification of journals using:
 - SHERPA/RoMEO (for publisher policies & indexing)
 - Directory of Open Access Journals (DOAJ listing check)
 - Scopus (indexing verification)
 - Web of Science
- 12. Check journal impact and indexing claims
- 13. Case study: Analyze 2 journals (one genuine, one predatory)
- 14. Creating and understanding researcher profiles:
 - ORCID
 - Web of Science / PUBLON
 - SCOPUS
- 15. Linking publications to ORCID and verifying author identity

Module 5: Ethics & Plagiarism Awareness

- 16. Identifying plagiarism and self-plagiarism
- 17. Use of plagiarism detection tools (Turnitin alternatives if needed)
- 18. Understanding publication ethics and copyright

Module 6: Research Design

- 19. Formulation of hypothesis
- 20. Selection of dataset (open datasets such as Kaggle/UCI)

21. Choosing methodology (ML/DL/statistical approach)

Module 7: Experimentation

22. Data preprocessing and cleaning

23. Implementation of baseline models

24. Model evaluation using appropriate metrics (accuracy, F1-score, RMSE, etc.)

25. Comparative analysis of multiple models

Module 8: Statistical Analysis

26. Hypothesis testing (t-test, chi-square test)

27. Visualization of results using graphs and charts

28. Interpretation of experimental results

Module 9: Research Tools & Documentation

29. Reference management using any of the following

- Mendeley
- Zotero
- JabRef
- Paperguide AI
- Sciwheel
- Endnote

30. Writing report using LaTeX / MS Word

31. Plagiarism checking and citation formatting

Module 10: Research Paper Writing

32. Structuring a research paper (Abstract, Introduction, Methodology, Results, Conclusion)

33. Drafting a short research paper (4–6 pages)

34. Formatting as per IEEE/ACM/Springer guidelines

Module 11: Presentation & Viva

35. Preparing research presentation (PPT/poster)

36. Oral presentation and defense

Assessment Scheme

A. Assessment (Practical Work) and Practical Evaluation: **25 Marks**

B. Seminar Report Preparation and Presentation: **25 Marks**

(Seminar report Preparation: 10 Marks + Presentation & Viva: 15 Marks)

Total Marks = A + B = 50 Marks.

Recommended Tools & Platforms

- Programming: Python (NumPy, Pandas, Scikit-learn, TensorFlow/PyTorch) / R Language.
- Visualization: Matplotlib, Seaborn
- Documentation: LaTeX, MS Word
- Collaboration: GitHub

Suggested Seminar Report Preparation (Compulsory)

Each student (or group) must:

- Select a real-world AI/DS problem
- Conduct literature review
- Implement and evaluate at least 2–3 models
- Prepare and submit a research-style paper
- Present findings in form of Seminar Presentation

Suggested Domains (But not limited to ...)

- Natural Language Processing
- Computer Vision
- Healthcare Analytics
- Financial Forecasting
- Recommender Systems
- Artificial General Intelligence / Generative Artificial Intelligence.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SA08	Project	00	00	12	06

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding by designing and developing project by being able to do each of the following:

1. Identify and formulate real-world problems in Artificial Intelligence and Data Science domains through Literature Review and Requirement Analysis.
2. Apply Engineering, Mathematical, Statistical, and Artificial Intelligence / Data Science concepts to design innovative and feasible solutions.
3. Develop Intelligent Systems using Machine Learning, Deep Learning, Data Analytics, Cloud Computing, and related technologies.
4. Utilize modern software development tools, programming frameworks, datasets, and testing methodologies for project implementation.
5. Demonstrate teamwork, project management, ethical considerations, and effective communication skills during project execution.
6. Analyze, evaluate, document, and present project outcomes professionally through reports, demonstrations, and technical presentations.

Course Outcomes:

After successfully completing the course, students will be able to

1. Define and analyze complex Artificial Intelligence and Data Science problems by identifying objectives, constraints, datasets, and performance measures.
2. Design Artificial Intelligence / Data Science based solutions using appropriate algorithms, architectures, and technologies to address real-world challenges.
3. Develop intelligent models, applications, or systems using suitable programming tools and frameworks.
4. Evaluate system performance through experimentation, testing, validation, and comparative analysis of results.
5. Evaluate and manage project resources, timelines, and team responsibilities for successful execution of engineering projects.
6. Create professional technical documentation and communicate project outcomes effectively through presentations, reports, demonstrations, and viva-voce examinations.

Project Evaluation Scheme (7AD08 PROJECT)

A. Internal Assessment (100 Marks)

The student batch size for project may be preferably 04. The project shall be internally evaluated (for 100 Internal Marks) broadly in three phases based on the progress of the project work. The scheme for Internal Assessment of Project is as follows:

Phase	Evaluation Description	Marks
Phase I:	Problem Definition and Design	30
Phase II:	Problem Implementation and Testing	30
Phase III	Project Demonstration & Report Submission	40
Total		100 Marks

B. External Evaluation (100 Marks)

The external evaluation of the project shall be based on demonstration of the project and viva-voce by external examiner. (100 Marks).

Recommended Project Guidelines

- ✓ **Batch Size:** Preferably 04 students.
- ✓ Project should address a real-world problem in AI, Data Science, Machine Learning, Deep Learning, Computer Vision, NLP, Generative AI, Healthcare AI, Smart Systems, Cybersecurity Analytics, IoT Analytics, or related domains.
- ✓ Students shall maintain a Project Diary and Progress Record.
- ✓ Publication of research paper, patent filing, prototype development, or participation in competitions may be encouraged.

B.Tech. Seventh Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
7SAH	Data Engineering	03	00	00	03

Course Prerequisite: Data Structures & Algorithms, Data Analytics and Database Management Systems.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Engineering by being able to do each of the following:

1. Understand the fundamentals of data engineering, its lifecycle, roles, responsibilities, and organizational impact.
2. Analyze data architectures, distributed systems, and modern data engineering technologies for scalable data solutions.
3. Apply data engineering concepts and techniques to manage, process, and serve data for analytics and machine learning applications.

Course Outcomes: After successful completion of this course, the student will be able to:

1. Explain basics and need of data science
2. Describe proficiency with statistical analysis of data.
3. Demonstrate loading of data and its manipulation for data science
4. Perform linear and multiple linear regression analysis.
5. Develop the ability to build and assess classification-based models
6. Evaluate outcomes and make decisions based on data.

	Subject: (7SAH) Data Engineering	L
Unit-1	Data Engineering Definition, The Data Engineering Lifecycle, Evolution of the Data Engineer, Data Engineering and Data Science, Data Engineering Skills and Activities, Data Maturity and the Data Engineer, The Data Lifecycle Versus the Data Engineering Lifecycle, Generation: Source Systems, Undercurrents across the Data Engineering Lifecycle.	07
Unit-2	The Background and Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities, The Continuum of Data Engineering Roles, Data Engineers Inside an Organization, Internal-Facing Versus External-Facing Data	07

	Engineers, Data Engineers and Other Technical Roles, Data Engineers and Business Leadership	
Unit-3	Data Architecture Enterprise Architecture Defined, Data Architecture Defined, “Good” Data Architecture, Principles of Good Data Architecture, Major Architecture Concepts, Domains and Services, Distributed Systems, Scalability, and Designing for Failure	07
Unit-4	Tight Versus Loose Coupling Tiers, Monoliths, and Micro services, User Access: Single Versus Multitenant, Event-Driven Architecture, Brownfield Versus Greenfield Projects, Examples and Types of Data Architecture. Decentralized: Block chain and the Edge, Monolith Versus Modular, Serverless Versus Servers, Server Versus Serverless evaluation	07
Unit-5	Data Engineering Today Versus the Future Immutable Versus Transitory Technologies: Hybrid Cloud, Multicloud. Data Generation in Source Systems: Sources of Data: How Is Data Created? Source Systems: Main Ideas, Files and Unstructured Data, APIs Application Databases (OLTP Systems), Online Analytical Processing System, Change Data Capture Logs Database Logs, CRUD, Insert-Only Messages and Streams Types of Time	07
Unit-6	Serving Data for Analytics, Machine Learning, and Reverse ETL Analytics, Business Analytics, Operational Analytics Embedded Analytics, Machine Learning, What a Data Engineer Should Know About ML, Ways to Serve Data for Analytics and ML, File Exchange, Streaming Systems Query Federation Data Sharing Semantic and Metrics Layers Serving Data in Notebooks Reverse ETL	07
	Total	42

Text Book:

1. Joe Reis and Matt Housley, “Fundamentals of Data Engineering”, O’Reilly Media (2023) ISBN:978-1-098-10730-0.
2. Mark Treveil and Dataiku Team, “Introducing MLOps: How to Scale Machine Learning in the Enterprise”, O’Reilly Media (2020) ISBN:978-1-098-10801-7.

Reference Books:

1. Carlo Verrellis, “Business Intelligence: Data Mining and Optimization for Decision Making”, Wiley Publications (2009) ISBN:978-0-470-51138-1.
2. Seema Acharya and Subhasini Chellappan, “Big Data and Analytics”, Wiley Publications (2015) ISBN:978-81-265-5548-8.
3. DT Editorial Services, “Big Data Black Book”, Dreamtech Press (2015) ISBN:978-93-5119-757-4.
4. Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann Publishers (2006) ISBN:978-1-55860-901-3.
5. Mark Gardener, “Beginning R: The Statistical Programming Language”, Wrox Publications (2012) ISBN:978-1-118-16430-3.

B.Tech. Eighth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
8SA01	Deep Learning	03	00	00	03

Course Prerequisite: Artificial Neural Networks, Data Science, Machine Learning, Probability and Statistics, Data Structure and Algorithms, Linear Algebra and Python Programming.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Deep Learning by being able to do each of the following:

1. To know the fundamental concepts of Deep Learning.
2. To explore tools and practices for working with Deep Learning.
3. To know about the research that requires.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Explain the concepts of deep learning and neural network architectures.
2. Apply deep learning techniques using Keras for predictive modeling.
3. Analyze CNN and RNN models for vision and sequence-processing tasks.
4. Evaluate the effectiveness of deep learning models using appropriate performance measures.
5. Design advanced deep learning solutions for real-world applications.
6. Assess the limitations and emerging trends in deep learning.

	Subject: (8SA01) Deep Learning	L
Unit-1	Artificial intelligence, machine learning, and deep learning, A brief history of machine learning, why deep learning? Why now? Neural network, Data representations for neural networks, The gears of neural networks: tensor operations, The engine of neural networks: gradient-based optimization.	07
Unit-2	Anatomy of a neural network, Introduction to Keras, Setting up a deep-learning workstation, Classifying movie reviews: a binary classification example, Classifying newswires: a multiclass classification example, Predicting house prices: a regression example.	07

Unit-3	Deep learning for computer vision, Introduction to convnets, training a convnet from scratch on a small dataset, using a pretrained convnet, visualizing what convnets learn.	07
Unit-4	Deep learning for text and sequences, working with text data, Understanding recurrent neural networks, Advanced use of recurrent neural networks, Sequence processing with convnets.	07
Unit-5	Advanced deep-learning, going beyond the Sequential model: the Keras functional API, Inspecting and monitoring deep-learning models using Keras call-backs and Tensor Board, Generative deep learning, Text generation with LSTM 271.	07
Unit-6	Key concepts in review, the limitations of deep learning, the future of deep learning, Staying up to date in a fast moving field	07
	Total	42

Text Book:

1. Francois Chollet, "Deep Learning with Python", Manning Publications Co., USA (2018) ISBN: 978-1-61729-443-3.

Reference Books:

1. Nikhil Ketkar, "Deep Learning with Python: A Hands-on Introduction", Apress (2017) ISBN: 978-1-4842-2765-7
2. Abhijit Ghatak, "Deep Learning with R", Springer Nature Singapore Pte Ltd. (2019) ISBN: 978-981-13-5849-4
3. Taweh Beysolow II, "Introduction to Deep Learning Using R: A Step-by-Step Guide to Learning and Implementing Deep Learning Models Using R", Apress (2017) ISBN: 978-1-4842-2733-6
4. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing (2018) ISBN: 978-3-319-94462-3.

B.Tech. Eighth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
8SA02PE6A	Basics of Ethical Hacking	03	00	00	03

Course Prerequisite: Computer Networks, Operating Systems, Fundamentals of Cyber Security and Basics of Linux.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Basics of Ethical Hacking by being able to do each of the following:

1. Understand the principles of ethical hacking, cybersecurity threats, vulnerabilities, and security testing methodologies.
2. Learn techniques for information gathering, network scanning, vulnerability assessment, penetration testing, and system security analysis.
3. Develop the ability to identify, analyze, and mitigate cyber-attacks on networks, web applications, databases, wireless systems, and enterprise infrastructures.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Explain ethical hacking concepts and security fundamentals.
2. Apply information gathering and scanning techniques.
3. Analyze vulnerabilities and cyber-attacks on systems and networks.
4. Evaluate security risks in web, database, wireless, and mobile environments.
5. Design defensive mechanisms using security tools and technologies.
6. Assess cryptographic methods and security practices for cyber defense.

	Subject: (8SA02PE6A) Basics of Ethical Hacking	L
Unit-1	An Introduction to Ethical Hacking: Security Fundamental, Security testing, Hacker and Cracker, Test Plans-keeping It Legal, Ethical and Legality The Technical Foundations of Hacking: The Attacker's Process, The Ethical Hacker's Process, Security and the Stack	07

Unit-2	Footprinting and Scanning: Information Gathering, Determining the Network Range, Identifying Active Machines, Finding Open Ports and Access Points, OS Fingerprinting Services, Mapping the Network Attack Surface	07
Unit-3	Enumeration and System Hacking: Enumeration, System Hacking, Vulnerability Assessment and Penetration Testing: Need of vulnerability assessment, risk Prevention, Compliance requirement.	07
Unit-4	Malware Threats: Viruses and Worms, Trojans, Covert Communication, Keystroke Logging and Spyware, Malware Counter measures. Sniffers, Session Hijacking, and Denial of Service: Sniffers, Session Hijacking, Denial of Service and Distributed Denial of Service	07
Unit-5	Web Server Hacking, Web Applications, and Database Attacks: Web Server Hacking, Web Application Hacking, Database Hacking. Wireless Technologies, Mobile Security, and Attacks: Wireless Technologies, Mobile Device Operation and Security, Wireless LANs.	07
Unit-6	IDS, Firewalls, and Honeypots: Intrusion Detection Systems, Firewalls, Honeypots. Cryptographic Attacks and Defenses: Functions of Cryptography, Public Key Infrastructure, Protocols, Applications, and Attacks.	07
	Total	42

Text Book:

1. Michael Gregg, “Certified Ethical Hacker”, Pearson IT Certification (2019) ISBN: 978-0-7897-6565-9
2. Roger Grimes, “Hacking the Hacker: Learn from the Experts Who Take Down Hackers”, Wiley (2021) ISBN: 978-1-119-39721-2.

Reference Books:

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press (2017) ISBN: 978-1-138-64227-6
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, “Cryptography and Network Security”, McGraw Hill Education, 2nd Edition (2010) ISBN: 978-0-07-070208-0
3. Zaid Sabih, “Learn Ethical Hacking from Scratch: Your Stepping Stone to Penetration Testing”, Packt Publishing (2018) ISBN: 978-1-78961-180-3
4. Himanshu Kumar, “Learning Nessus for Penetration Testing”, Packt Publishing (2017) ISBN: 978-1-78646-018-3.

B.Tech. Eighth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
8SA02PE6B	Ethics in Data Science	03	00	00	03

Course Prerequisite: Data Science fundamentals, Artificial Intelligence / Machine Learning basics, Probability and Statistics, and Database Management Systems.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Basics of Ethics in Data Science by being able to do each of the following:

1. Understand ethical principles, privacy concerns, fairness, and accountability issues arising in data science applications.
2. Analyze ethical challenges encountered during data collection, preprocessing, modeling, evaluation, and deployment of data-driven systems.
3. Apply ethical frameworks and responsible data science practices to develop fair, transparent, and trustworthy solutions.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Explain the ethical principles, privacy concerns, and fairness issues in data science.
2. Apply ethical practices in data collection, preprocessing, and model development.
3. Analyze bias, discrimination, and privacy risks in data-driven systems.
4. Evaluate data science models based on fairness, transparency, and accountability.
5. Design ethical and responsible data science solutions for real-world applications.
6. Assess the societal impact and governance requirements of deployed data science systems.

	Subject: (8SA02PE6B) Ethics in Data Science	L
Unit-1	Introduction to Data Science Ethics: The Rise of Data Science (Ethics), Why Care?, Right and Wrong, Data Science, Data Science Ethics Equilibrium, The FAT Flow Framework for Data Science Ethics.	07

Unit-2	Ethical Data Gathering: Privacy as a Human Right, Regulations, Privacy Mechanisms, Cautionary Tales: Backdoors and Messaging Encryption, Bias, Cautionary Tales: Bumps, Gorillas, and Resumes, Human Experimentation.	07
Unit-3	Ethical Data Preprocessing: Defining and Measuring Privacy, Cautionary Tales: Re-identification, Defining and Selecting Variables, Cautionary Tale: Pregnancy and Face Recognition, Fair Relabelling, Cautionary Tale: Biased Language.	07
Unit-4	Ethical Modelling: Privacy-Preserving Data Mining, Discrimination-Aware Modelling, Predicting Recidivism and Redlining, Comprehensible Models and Explainable AI, Explaining Webpage Classifications, Including Ethical Preferences: Self-Driving Cars.	07
Unit-5	Ethical Evaluation: Ethical Measurement, Ethical Interpretation of the Results, Ethical Reporting, Cautionary Tale of Diederik Stapel.	07
Unit-6	Ethical Deployment: Access to the System, Different Treatments for Different Predictions, Censoring Search and Face Recognition, Honesty and DeepFake, Governance, Unintended Consequences.	07
	Total	42

Text Book:

1. David Martens, “Data Science Ethics: Concepts, Techniques and Cautionary Tales”, Oxford University Press (2020) ISBN: 978-0-19-886547-8.

Reference Books:

1. Mike Loukides, Hilary Mason, and DJ Patil, “Ethics and Data Science: Doing Good Data Science”, O’Reilly Media (2018) ISBN: 978-1-492-04394-0.
2. Charles E. Harris, Michael S. Pritchard, and Michael J. Rabins, “Engineering Ethics: Concepts and Cases”, Cengage Learning (2009) / Thomson Learning (2000) ISBN: 978-0-495-66795-6.
3. Govindarajan M. Natarajan, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2nd Edition (2010) ISBN: 978-81-203-4032-5.

B.Tech. Eighth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
8SA02PE6C	Safe and Responsible Use of AI	03	00	00	03

Course Prerequisite: Fundamentals of Artificial Intelligence / Machine Learning, Data Science, Probability and Statistics, and Database Management Systems.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Safe and Responsible Use of AI by being able to do each of the following:

1. Understand the core concepts of Artificial Intelligence and Responsible AI, including autonomy, adaptability, interaction, and their societal implications.
2. Recognize and interpret ethical principles, moral theories, and decision-making approaches used in evaluating AI systems.
3. Apply responsible AI design principles such as accountability, transparency, fairness, inclusion, and value-based thinking in AI systems.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Explain the fundamental concepts of Artificial Intelligence and Responsible AI, including autonomy, adaptability, and interaction.
2. Identify ethical issues in AI systems using ethical theories and decision-making frameworks.
3. Analyze the impact of AI systems on society, including responsibility, bias, and value-based design considerations.
4. Evaluate AI systems based on accountability, transparency, inclusion, and responsible governance principles.
5. Design responsible AI solutions incorporating ethical reasoning, fairness, and value-sensitive design principles.
6. Assess AI governance models, codes of conduct, and future implications of AI including super-intelligence and societal impact.

	Subject: (8SA02PE6C) Safe and Responsible Use of AI	L
Unit-1	Introduction to Artificial Intelligence and Responsible AI: Introduction, What is Artificial Intelligence?, The Background of AI, Autonomy, Adaptability, Interaction	07
Unit-2	Ethical Decision-Making in AI: Ethical Decision-Making, Ethical Theories, Values, Ethics in Practice, Implementing Ethical Reasoning	07
Unit-3	Responsibility and Value-Based AI Design: Taking Responsibility, Responsible Research and Innovation, The ART of AI: Accountability, Responsibility and Transparency, Design for Values	07
Unit-4	Ethical Behavior of AI Systems: Can AI Systems Be Ethical?, What is an Ethical Action?, Approaches to Ethical Reasoning by AI, Designing Artificial Moral Agents, Implementing Ethical Deliberation, Levels of Ethical Behaviour	07
Unit-5	Responsible AI Governance and Practice: Ensuring Responsible AI in Practice, Governance for Responsible AI, Codes of Conduct, Inclusion and Diversity, The AI Narrative	07
Unit-6	Future of Responsible AI:- Looking Further, AI and Society, Super-intelligence, Responsible Artificial Intelligence	07
	Total	42

Text Book:

1. Virginia Dignum, “Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way”, Springer (2019) ISBN: 978-3-030-30318-0.

Reference Books:

1. Stuart Russell, “Human Compatible: Artificial Intelligence and the Problem of Control”, Viking (2019) ISBN: 978-0-525-55861-3.
2. Shannon Vallor, “Technology and the Virtues: A Philosophical Guide to a Future Worth Wanting”, Oxford University Press (2016) ISBN: 978-0-19-049851-3.
3. Mark Coeckelbergh, “AI Ethics”, MIT Press (2020) ISBN: 978-0-262-53951-6.
4. Luciano Floridi, “The Ethics of Artificial Intelligence: Principles, Challenges, and Opportunities”, Oxford University Press (2021) ISBN: 978-0-19-885780-3.
5. Andreas Sudmann (Ed.), “The Democratization of Artificial Intelligence: Net Politics in the Era of Learning Algorithms”, Transcript Verlag (2019) ISBN: 978-3-8376-5027-7.

B.Tech. Eighth Semester (Artificial Intelligence and Data Science)

Course Code	Course Title	L	T	P	C
8SAH1	Deep Learning and its Applications	03	00	00	03

Course Prerequisite: Artificial Neural Networks, Data Science, Machine Learning, Probability and Statistics, Basics of Deep Learning, Data Structure and Algorithms, Linear Algebra and Python Programming.

Course Learning Objectives: Throughout the course, students will be expected to demonstrate their understanding of Deep Learning and its Applications by being able to do each of the following:

1. Understand the fundamental concepts, architectures, and learning mechanisms of deep neural networks.
2. Analyze and implement deep learning models such as Feedforward Networks, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Deep Generative Models.
3. Apply deep learning techniques to solve real-world problems in image processing, speech recognition, and natural language processing.

Course Outcomes: After Successful completion of this course, the student will be able to:

1. Explain the fundamentals of deep learning and neural networks.
2. Apply deep learning techniques to develop neural network models.
3. Analyze the performance of feedforward and deep neural network architectures.
4. Evaluate CNNs, RNNs, and generative models for different applications.
5. Design deep learning solutions for image, speech, and text processing tasks.
6. Assess the effectiveness of deep learning models in real-world applications.

	Subject: (8SAH1) Deep Learning and its Applications	L
Unit-1	Introduction to Deep Learning: Basics Biological Neuron, Idea of computational units, McCulloch–Pitts Neural Model, Linear Perceptron, Perceptron Learning, Feed Forward and Back Propagation Networks.	07

Unit-2	Feedforward Networks: Multilayer Perceptron, Activation Functions -Sigmoid, Tanh, ReLU, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders.	07
Unit-3	Convolutional Networks: The Convolution Operation, Variants of the Basic Convolution Function, Structured Outputs, Efficient Convolution Algorithms, Random or Unsupervised Features, LeNet, AlexNet.	07
Unit-4	Recurrent Neural Networks: Bidirectional RNNs, Deep Recurrent Networks Recursive Neural Networks, the Long Short-Term Memory and Other Gated RNNs	07
Unit-5	Deep Generative Models: Boltzmann Machines, Restricted Boltzmann Machines, Introduction to MCMC and Gibbs Sampling, Gradient computations in RBMs, Deep Belief Networks, Deep Boltzmann Machines.	07
Unit-6	Applications of Deep Learning- Image Processing, Speech Recognition, Natural Language Processing.	07
	Total	42

Text Book:

1. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2nd Edition (2021) ISBN: 978-1-61729-686-4.

Reference Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, MIT Press (2016) ISBN: 978-0-262-03561-3
2. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress (2018) ISBN: 978-1-4842-3515-7
3. Nikhil Buduma and Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms”, O’Reilly Media (2017) ISBN: 978-1-4919-2546-4.