File Ref.No.233344/GA - IV - J1/2021/Admn

UNIVERSITY OF CALICUT

Abstract

General & Academic IV - Faculty of Science - Scheme and Syllabus of BSc Artificial Intelligence Honours Programme-in tune with the CUFYUGP Regulations 2024, with effect from 2024 admission - Approved-Subject to ratification by the Academic Council-Implemented- Orders Issued

G & A - IV - J

U.O.No. 9930/2024/Admn Dated, Calicut University.P.O, 22.06.2024

Read:-1. U.O.No. 3103/2024/Admn dated 22/02/2024.

2. Minutes of the online meeting of the Board of Studies in Computer Science and Application UG held on 29/05/2024

3. Remarks of the Dean, Faculty of Science dated 20/06/2024.

4. Orders of the Vice Chancellor in the file of even No and dated 22/06/2024.

ORDER

1. The Regulations of the Calicut University Four Year UG Programmes (CUFYUGP Regulations 2024) for Affiliated Colleges, has been implemented with effect from 2024 admission , vide paper read as (1).
2. The Board of Studies in Computer Science and Application UG in the meeting held on 29/05/2024, vide paper read as (2), has approved the Scheme and Syllabus of BSc Artificial Intelligence Honours Programme in tune with CUFYUGP Regulations 2024 with effect from 2024 admission.
3. The Dean, Faculty of Science vide paper read as (3), has approved the minutes of the meeting of the Board of Studies in Computer Science and Application UG held on 29/05/2024.
4. Considering the urgency, the Vice Chancellor has approved the minutes of the meeting of Board of Studies in Computer Science and Application UG held on 29/05/2024 and accorded sanction to implement the Scheme and Syllabus of BSc Artificial Intelligence Honours Programme in tune with CUFYUGP Regulations 2024 with effect from 2024 admission, subject to ratification by the Academic Council.
5. The Scheme and Syllabus of BSc Artificial Intelligence Honours Programme in tune with CUFYUGP Regulations 2024 is thus implemented with effect from 2024 admission, subject to ratification by the Academic Council.

Orders are issued accordingly. (Syllabus appended)

Ajayakumar T.K

Assistant Registrar

To

Principals of all Affiliated Colleges

Copy to: Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE II/JCE IV/DoA/EX and EG Sections/GA I F/CHMK Library/SUVEGA/SF/DF/FC

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT

THENHIPALAM, CALICUT UNIVERSITY P.O

DEGREE OF

BACHELOR OF SCIENCE (B.Sc.)

HONOURS IN

ARTIFICIAL INTELLIGENCE

(FOUR YEAR UNDERGRADUATE PROGRAMME CURRICULUM)

UNDER THE FACULTY OF SCIENCE

SYLLABUS

(FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2024 – '25 ONWARDS)

BOARD OF STUDIES IN COMPUTER SCIENCE (UG)

THENHIPALAM, CALICUT
UNIVERSITY P.O., KERALA,
673635, INDIA

APRIL 2024

UNIVERSITY OF CALICUT

B.Sc. ARTIFICIAL INTELLIGENCE HONOURS

(MAJOR, MINOR AND GENERAL FOUNDATION COURSES)

SYLLABUS & MODEL QUESTION PAPERS

(w.e.f. 2024 admission onwards)

(CUFYUGP Regulations 2024)

B.Sc. ARTIFICIAL INTELLIGENCE HONOURS

(MAJOR, MINOR AND GENERAL FOUNDATION COURSES)

SYLLABUS

PROGRAMME OUTCOMES (PO):

At the end of the graduate programme at Calicut University, a student would:

Knowledge Acquisition:	
PO1	Demonstrate a profound understanding of knowledge trends and their impact on the chosen discipline of study.
Communication, Collaboration, Inclusiveness, and Leadership:	
PO2	Become a team player who drives positive change through effective communication, collaborative acumen, transformative leadership, and a dedication to inclusivity.
Professional Skills:	
PO3	Demonstrate professional skills to navigate diverse career paths with confidence and adaptability.
Digital Intelligence	
PO4	Demonstrate proficiency in varied digital and technological tools to understand and interact with the digital world, thus effectively processing complex information.
Scientific Awareness and Critical Thinking:	
PO5	Emerge as an innovative problem-solver and impactful mediator, applying scientific understanding and critical thinking to address challenges and advance sustainable solutions.
Human Values, Professional Ethics, and Societal and Environmental Responsibility:	
PO6	Become a responsible leader, characterized by an unwavering commitment to human values, ethical conduct, and a fervent dedication to the well-being of society and the environment.
Research, Innovation, and Entrepreneurship:	
PO7	Emerge as a researcher and entrepreneurial leader, forging collaborative partnerships with industry, academia, and communities to contribute enduring solutions for local, regional, and global development.

PROGRAMME SPECIFIC OUTCOMES (PSO):

At the end of the BSc Artificial Intelligence (Honours) programme at Calicut University, a student would:

PSO1	Understand the theoretical and mathematical foundations of Artificial Intelligence
PSO2	Understand the concepts of system architecture, hardware, software and network configuration
PSO3	Acquire logical thinking and problem-solving skills to find solutions in the software domain
PSO4	Design, analyse and develop code-based solutions for the algorithms
PSO5	Address the industry demands and assimilate technical, logical and ethical skills needed for the industry
PSO6	Adapt to emerging trends and tackle the challenges in the field of AI.

MINIMUM CREDIT REQUIREMENTS OF THE DIFFERENT PATHWAYS IN THE THREE-YEAR PROGRAMME IN CUFYUGP

Sl. No.	Academic Pathway	Major	Minor/ Other Disciplines	Foundation Courses AEC: 4 MDC: 3 SEC: 3 VAC: 3	Intern -ship	Total Credits	Example
		Each course has 4 credits		Each course has 3 credits			
1	Single Major (A)	68 (17 courses)	24 (6 courses)	39 (13 courses)	2	133	Major: Artificial Intelligence + six courses in different disciplines in different combinations
2	Major (A) with Multiple Disciplines (B, C)	68 (17 courses)	12 + 12 (3 + 3 = 6 courses)	39 (13 courses)	2	133	Major: Artificial Intelligence + Mathematics and Physics
3	Major (A) with Minor (B)	68 (17 courses)	24 (6 courses)	39 (13 courses)	2	133	Major: Artificial Intelligence Minor: Electronics
4	Major (A) with Vocational Minor (B)	68 (17 courses)	24 (6 courses)	39 (13 courses)	2	133	Major: Artificial Intelligence Minor: Data Science/Web Technology
5	Double Major (A, B)	A: 48 (12 courses) B: 44 (11 courses)	- The 24 credits in the Minor stream are distributed between the two Majors. 2 MDC, 2 SEC, 2 VAC and the Internship should be in Major A. Total credits in Major A should be 48 + 20 = 68 (50% of 133) 1 MDC, 1 SEC and 1 VAC should be in Major B. Total credits in Major B should be 44 + 9 = 53 (40% of 133)	12 + 18 + 9	2	133	Artificial Intelligence and Statistics Double Major
Exit with UG degree / Proceed to fourth year with 133 credits							

B.Sc. ARTIFICIAL INTELLIGENCE (HONOURS) PROGRAMME

COURSE STRUCTURE FOR PATHWAYS 1 – 4

1. Single Major
2. Major with Multiple Disciplines
3. Major with Minor
4. Major with Vocational Minor

Semester	Course Code	Course Title	Total Hours	Hours/ Week	Credits	Marks		
						Internal	External	Total
1	AIN1CJ101/ AIN1MN100	Fundamentals of Computers & Computational Thinking	75	5	4	30	70	100
	XXX1MNXXX	Minor Course 1	75	5	4	30	70	100
	XXX1MNXXX	Minor Course 2	75	5	4	30	70	100
	ENG1FA101 (2)	Ability Enhancement Course 1	60	4	3	25	50	75
	XXX1FA102 (2)	Ability Enhancement Course 2	45	3	3	25	50	75
	XXX1FM105	Multi-Disciplinary Course 1	45	3	3	25	50	75
		Total		**25**	**21**			**525**
2	AIN2CJ101/ AIN2MN100	Computational Logic for Artificial Intelligence	75	5	4	30	70	100
	XXX1MNXXX	Minor Course 3	75	5	4	30	70	100
	XXX1MNXXX	Minor Course 4	75	5	4	30	70	100
	ENG2FA103 (2)	Ability Enhancement Course 3	60	4	3	25	50	75
	XXX2FA104 (2)	Ability Enhancement Course 4	45	3	3	25	50	75
	XXX2FM106	Multi-Disciplinary Course 2	45	3	3	25	50	75
		Total		**25**	**21**			**525**
3	AIN3CJ201	Mathematical Foundation for Artificial Intelligence	60	4	4	30	70	100
	AIN3CJ202/ AIN3MN200	Data Structures and Algorithm	75	5	4	30	70	100
	XXX1MNXXX	Minor Course 5	75	5	4	30	70	100
	XXX1MNXXX	Minor Course 6	75	5	4	30	70	100
	XXX3FM107 (2)	Multi-Disciplinary Course 3 – Kerala Knowledge System	45	3	3	25	50	75
	ENG3FV108 (2)	Value-Added Course 1	45	3	3	25	50	75
		Total		**25**	**22**			**550**
4	AIN4CJ203	Object Oriented Programming in java	75	5	4	30	70	100

	AIN4CJ204	Data Base Management System	75	5	4	30	70	100
	AIN4CJ205	Foundations of Artificial Intelligence and Machine learning	75	5	4	30	70	100
	ENG4FV109 (2)	Value-Added Course 2	45	3	3	25	50	75
	XXX4FV110(2)	Value-Added Course 3	45	3	3	25	50	75
	ENG4FS111 (2)	Skill Enhancement Course – 1 (P)	60	4	3	25	50	75
		Total		**25**	**21**			**525**
5	AIN5CJ301	Python Programming	75	5	4	30	70	100
	AIN5CJ302	Operating System	75	5	4	30	70	100
	AIN5CJ303	Expert system and Fuzzy logic	60	4	4	30	70	100
	AIN5EJ305	Elective Course 1 in Major	60	4	4	30	70	100
	AIN5EJ306	Elective Course 2 in Major	60	4	4	30	70	100
	AIN5FS112	Skill Enhancement Course 2 - Introduction to Digital Marketing	45	3	3	25	50	75
		Total		**25**	**23**			**575**
6	AIN6CJ304/ AIN8MN304	Automation and Robotics	75	5	4	30	70	100
	AIN6CJ305/ AIN8MN305	Fundamentals of Data Science	75	5	4	30	70	100
	AIN6CJ306/ AIN8MN306	Machine Learning Algorithms	60	4	4	30	70	100
	AIN6CJ311	Elective Course 3 in Major	60	4	4	30	70	100
	AIN6CJ312	Elective Course 4 in Major	60	4	4	30	70	100
	AIN6FS113	Skill Enhancement Course 3 - Project Implementation	45	3	3	25	50	75
	AIN6CJ349	Internship in Major (Credit for internship to be awarded only at the end of Semester 6)	60		2	50	-	50
		Total		**25**	**25**			**625**
Total Credits for Three Years					**133**			**3325**
7	AIN7CJ401	Natural Language Processing	75	5	4	30	70	100
	AIN7CJ402	Knowledge Engineering	60	4	4	30	70	100
	AIN7CJ403	Soft Computing	60	4	4	30	70	100
	AIN7CJ404	Introduction to Generative Models	60	4	4	30	70	100

	AIN7CJ405	Data Science Programming using R	75	5	4	30	70	100
		Total		**25**	**20**			**500**
8	AIN8CJ406	Data Mining	60	4	4	30	70	100
	AIN8CJ407	Block chain Technology	60	4	4	30	70	100
	AIN8CJ408	Deep learning	60	4	4	30	70	100
	OR (instead of Core Courses AIN8CJ406, AIN8CJ407 and AIN8CJ408 in Major)							
	AIN8CJ449**	Project (in Honours programme)	360	13	12	90	210	300
	AIN8CJ499**	Research Project (in Honours with Research programme)	360	13	12	90	210	300
	AIN8EJXXX*/ AIN8MN40	Elective course 5	60	4	4	30	70	100
	AIN8EJXXX*/ AIN8MN407	Elective course 6	60	4	4	30	70	100
	AIN8EJXXX*/ AIN8MN408	Elective course 7	60	4	4	30	70	100
	OR (instead of Elective Course 7 in Major, in the case of Honours with Research Programme)							
	AIN8CJ 489	Research Methodology	60	4	4	30	70	100
		Total		**25**	**24**			**600**
Total Credits for Four Years					**177**			**4425**

Choose any four elective courses (two in fifth and two in sixth semester) from the basket of electives with specialization

Choose three elective courses in semester 8 from elective basket with no specialization

CREDIT DISTRIBUTION FOR PATHWAYS 1 – 4

1. Single Major
2. Major with Multiple Disciplines
3. Major with Minor
4. Major with Vocational Minor

Semester	Major Courses	Minor Courses	General Foundation Courses	Internship/ Project	Total
1	4	4 + 4	3 + 3 + 3	-	21
2	4	4 + 4	3 + 3 + 3	-	21
3	4 + 4	4 + 4	3 + 3	-	22
4	4 + 4 + 4	-	3 + 3 + 3	-	21
5	4 + 4 + 4 + 4 + 4	-	3	-	23
6	4 + 4 + 4 + 4 + 4	-	3	2	25
Total for Three Years	**68**	**24**	**39**	**2**	**133**
7	4 + 4 + 4 + 4 + 4	-	-	-	20
8	4 + 4 + 4	4 + 4 + 4	-	12	24
Total for Four Years	**88 + 12 = 100**	**36**	**39**	**2**	**177**

DISTRIBUTION OF MAJOR COURSES IN ARTIFICIAL INTELLIGENCE FOR PATHWAYS 1 – 4

1. Single Major
2. Major with Multiple Disciplines
3. Major with Minor
4. Major with Vocational Minor

Semester	Course Code	Course Title	Hours/ Week	Credits
1	AIN1CJ101/ AIN1MN100	Fundamentals of Computers & Computational Thinking	5	4
2	AIN2CJ101/ AIN2MN100	Computational Logic for Artificial Intelligence	5	4
3	AIN3CJ201	Mathematical Foundation for Artificial Intelligence	4	4
	AIN3CJ202/ AIN3MN200	Data Structures and Algorithms	5	4
4	AIN4CJ203	Object Oriented Programming in java	5	4
	AIN4CJ204	Data Base Management System	5	4

	AIN4CJ205	Foundations of Artificial Intelligence and Machine learning	5	4
5	AIN5CJ301	Python Programming	5	4
	AIN5CJ302	Operating System	5	4
	AIN5CJ303	Expert system and Fuzzy logic	4	4
	AIN5EJ305	Elective Course 1	4	4
	AIN5EJ306	Elective Course 2	4	4
6	AIN6CJ304/ AIN8MN304	Automation and Robotics	5	4
	AIN6CJ305/ AIN8MN305	Fundamentals of Data Science	5	4
	AIN6CJ306/ AIN8MN306	Machine Learning Algorithms	4	4
	AIN6EJ311	Elective Course 3	4	4
	AIN6EJ312	Elective Course 4	4	4
	AIN6CJ349	Internship in Major	-	2
Total for the Three Years				**70**
7	AIN7CJ401	Natural Language Processing	5	4
	AIN7CJ402	Knowledge Engineering	4	4
	AIN7CJ403	Soft Computing	4	4
	AIN7CJ404	Introduction to Generative Models	4	4
	AIN7CJ405	Data Science Programming using R	5	4
8	AIN8CJ406	Data Mining	4	4
	AIN8CJ407	Block chain Technology	4	4
	AIN8CJ408	Deep learning	4	4
	OR (instead of Core Courses AIN8CJ406, AIN8CJ407 and AIN8CJ408 in Major)			
	AIN8EJXXX* / AIN8MN40	Elective course 5	4	4
	AIN8EJXXX* / AIN8MN407	Elective course 6	4	4
	AIN8EJXXX* / AIN8MN408	Elective course 7	4	4
	AIN8CJ449*	Project Work (in Honours Programme)/ Project with Research	13	12
	AIN8CJ499**	Research Project (in Honours with Research Programme)	13	12
	OR (instead of Elective Course 7 in Major, in the case of Honours with Research			

	Programme)			
	AIN8CJ 489	Research Methodology	4	4
Total for the Four Years				**114**

ELECTIVE COURSES IN ARTIFICIAL INTELLIGENCE WITH SPECIALISATION

Group No.	Sl. No.	Course Code	Title	Semester	Total Hrs	Hrs/ Week	Credits	Marks		
								Internal	External	Total
1		**Image Processing**								
	1	AIN5EJ 301(1)	Fundamentals of Digital Image Processing	5	60	4	4	30	70	100
	2	AIN5EJ 302(1)	Pattern Recognition	5	60	4	4	30	70	100
	3	AIN6EJ 301(1)	Advanced Digital Image Processing and Vision	6	60	4	4	30	70	100
	4	AIN6EJ 302(1)	Applied Digital Image Processing	6	60	4	4	30	70	100
2		**Cloud Computing**								
	1	AIN5EJ 303(2)	Cloud Computing	5	60	4	4	30	70	100
	2	AIN5EJ 304(2)	Security and Privacy in Cloud	5	60	4	4	30	70	100
	3	AIN6EJ 303(2)	Storage Technologies	6	60	4	4	30	70	100
	4	AIN6EJ 304(2)	Virtualization	6	60	4	4	30	70	100
	ELECTIVES without Specialization									
	1	AIN8EJ401	System Software	8	60	4	4	30	70	100
	2	AIN8EJ402	Digital and Mobile forensic	8	60	4	4	30	70	100
	3	AIN8EJ403	Ethical Hacking	8	60	4	4	30	70	100
	4	AIN8EJ404	Big Data Analytics	8	60	4	4	30	70	100

	5	AIN8EJ405	Modern Cryptography	8	60	4	4	30	70	100
	6	AIN8EJ406	Mixed Reality	8	60	4	4	30	70	100

DISTRIBUTION OF GENERAL FOUNDATION COURSES IN ARTIFICIAL INTELLIGENCE

Semester	Course Code	Course Title	Total Hours	Hours/ Week	Credits	Marks		
						Internal	External	Total
1	AIN1FM105	Data Analysis and Visualization Through Spread Sheet	45	3	3	25	50	75
2	AIN2FM106	Digital Empowerment Through Ethical Standards	45	3	3	25	50	75
3	AIN3FV108	Introduction to cyber laws	45	3	3	25	50	75
4	AIN4FV109	Professional Skill Development for IT Career Excellence	45	3	3	25	50	75
5	AIN5FS112	Introduction to Digital Marketing	45	3	3	25	50	75
6	AIN6FS113	Project Implementation	45	3	3	25	50	75

COURSE STRUCTURE FOR BATCH A1(B2)
IN PATHWAY 5: DOUBLE MAJOR

A1: 68 credits in ARTIFICIAL INTELLIGENCE (Major A) ***B1: 68 credits in Major B***
A2: 53 credits in ARTIFICIAL INTELLIGENCE (Major A) ***B2: 53 credits in Major B***
The combinations available to the students: (A1 & B2), (B1 & A2)

Note: Unless the batch is specified, the course is for all the students of the class

Semester	Course Code	Course Title	Total Hours	Hours/ Week	Credits	Marks		
						Internal	External	Total
1	AIN1CJ101 / AIN1MN101	Fundamentals of Computers & Computational Thinking	75	5	4	30	70	100
	XXX1CJ101	Core Course 1 in Major B –	60/ 75	4/ 5	4	30	70	100

	AIN1CJ102 / AIN2CJ102 / AIN4CJ203*	Object Oriented Programming in java	75	5	4	30	70	100
	ENG1FA101 (2)	Ability Enhancement Course 1	60	4	3	25	50	75
	XXX1FA102(2)	Ability Enhancement Course 2	45	3	3	25	50	75
	AIN1FM105	Multi-Disciplinary Course 1 – Data Analysis and Visualization Through Spreadsheets	45	3	3	25	50	75
		Total		**24/ 25**	**21**			**525**
2	AIN2CJ101 / AIN2MN101	Computational Logic for Artificial Intelligence	75	5	4	30	70	100
	XXX2CJ101	Core Course 2 in Major B –	60/ 75	4/ 5	4	30	70	100
	XXX2CJ102 / XXX1CJ102	Core Course 3 in Major B – (for batch B2 only)	60/ 75	4/ 5	4	30	70	100
	ENG2FA103 (2)	Ability Enhancement Course 3	60	4	3	25	50	75
	XXX2FA108(2)	Ability Enhancement Course 4	45	3	3	25	50	75
	AIN2FM106	Multi-Disciplinary Course 2 – Digital Empowerment Through Ethical Standards	45	3	3	25	50	75
		Total		**23 – 25**	**21**			**525**
3	AIN3CJ201	Mathematical Foundation for Artificial Intelligence	60	4	4	30	70	100
	AIN3CJ202	Data Structures and Algorithms	75	5	4	30	70	100
	XXX3CJ201	Core Course 4 in Major B	60/ 75	4/ 5	4	30	70	100
	XXX3CJ202	Core Course 5 in Major B	60/ 75	4/ 5	4	30	70	100
	XXX3FM106	Multi-Disciplinary Course 1 in B –	45	3	3	25	50	75
	AIN3FV108	Value-Added Course 1 Introduction to cyber laws	45	3	3	25	50	75
		Total		**23 – 25**	**22**			**550**
4	AIN4CJ204	Data Base Management System	75	5	4	30	70	100
	XXX4CJXXX	Core Course 6 in Major B	60/ 75	4/ 5	4	30	70	100

	AIN4CJ205	Foundations of Artificial Intelligence and Machine learning	75	5	4	30	70	100
	AIN4FV109	Value-Added Course 2 Professional Skill Development for IT Career Excellence	45	3	3	25	50	75
	XXX4FV110	Value-Added Course 1 in B	45	3	3	25	50	75
	AIN5FS112/ AIN4FS100	Skill Enhancement Course 1 Introduction to Digital Marketing	45	3	3	25	50	75
		Total		**23/ 24**	**21**			**525**
5	AIN5CJ301	Core Course 8 in Major – Python Programming	75	5	4	30	70	100
	XXX5CJXXX	Core Course 7 in Major B –	60/ 75	4/ 5	4	30	70	100
	AIN5CJ303	Core Course 9 in Major – Expert system and Fuzzy logic	60	4	4	30	70	100
	AIN5EJ305	Elective Course 1 in Major	60	4	4	30	70	100
	XXX5CJXXX	Elective Course 1 in Major B	60	4	4	30	70	100
	XXX5FSXXX	Skill Enhancement Course 1 in B	45	3	3	25	50	75
		Total		**24/ 25**	**23**			**575**
6	AIN6CJ305/ AIN8MN305	Core Course 10 in Major – Fundamentals of Data Science	75	5	4	30	70	100
	XXX6CJXXX	Core Course 8 in Major B –	60/ 75	4/ 5	4			
	XXX6CJXXX	Core Course 9 in Major B – (for batch B2 only)	60	4	4	30	70	100
	AIN6EJ306	Elective Course 2 in Major	60	4	4	30	70	100
	XXX6EJXXX	Elective Course 2 in Major B	60	4	4	30	70	100
	AIN6FS113	Skill Enhancement Course 3 – Project Implementation	45	3	3	25	50	75
	AIN6CJ349	Internship in Major Artificial Intelligence (Credit for internship to be awarded only at the end of Semester 6)	60		2	50	-	50
		Total		**24/ 25**	**25**			**625**
Total Credits for Three Years					**133**			**3325**

For batch A1(B2), the course structure in semesters 7 and 8 is the same as for pathways 1 – 4, except that the number of the core and elective courses is in continuation of the number of courses in the two categories completed at the end of semester 6.

* The course code of the same course as used for the pathways 1 – 4

CREDIT DISTRIBUTION FOR BATCH A1(B2)
IN PATHWAY 5: DOUBLE MAJOR

Semester	Major Courses in Artificial Intelligence	General Foundation Courses in Artificial Intelligence	Internship/ Project in Artificial Intelligence	Major Courses in B	General Foundation Courses in B	AEC	Total
1	4 + 4	3	-	4	-	3 + 3	21
2	4	3	-	4 + 4	-	3 + 3	21
3	4 + 4	3	-	4 + 4	3	-	22
4	4 + 4	3 + 3	-	4	3	-	21
5	4 + 4 + 4	-	-	4 + 4	3	-	23
6	4 + 4	3	2	4 + 4 + 4	-	-	25
Total for Three Years	**48**	**18**	**2**	**44**	**9**	**12**	**133**
	68			**53**		**12**	**133**
	Major Courses in Artificial Intelligence	Minor Courses					
7	4 + 4 + 4 + 4 + 4	-			-	-	20
8	4 + 4 + 4	4 + 4 + 4	12		-	-	24
Total for Four Years	**88 + 12 = 100**	**12**					**177**

COURSE STRUCTURE FOR BATCH B1(A2)
IN PATHWAY 5: DOUBLE MAJOR

A1: 68 credits in Artificial Intelligence (Major A) ***B1: 68 credits in Major B***

A2: 53 credits in Artificial Intelligence (Major A) ***B2: 53 credits in Major B***

The combinations available to the students: (A1 & B2), (B1 & A2)

Note: Unless the batch is specified, the course is for all the students of the class

Semester	Course Code	Course Title	Total Hours	Hours/ Week	Credits	Marks		
						Internal	External	Total
1	**XXX**1CJ101	Core Course 1 in Major B –	75	5	4	30	70	100
	AIN1CJ101	Fundamentals of Computers & Computational Thinking	75	5	4	30	70	100
	XXX1CJ 102 / XXX2CJ 102	Core Course 2 in Major B – (for batch B1 only)	60/ 75	4/ 5	4	30	70	100
	ENG1FA101(2)	Ability Enhancement Course – 1 (P) (E)	60	4	3	25	50	75
	XXX1FA102(2)	Ability Enhancement Course – 2 (AL)	45	3	3	25	50	75
	XXX1FM 105	Multi-Disciplinary Course 1 in B – (for batch B1 only)	45	3	3	25	50	75
		Total		**23 – 25**	**21**			**525**
2	XXX2CJ101	Core Course 2 in Major B –	75	5	4	30	70	100
	AIN2CJ101	Computational Logic for Artificial Intelligence	75	5	4	30	70	100
	AIN2CJ 102 / AIN1CJ 102 / AIN3CJ 204*	Data Base Management System	75	5	4	30	70	100
	ENG2FA107(2)	Ability Enhancement Course – 3 (P) (E)	60	4	3	25	50	75
	XXX2FA108(2)	Ability Enhancement Course – 4 (AL)	45	3	3	25	50	75

	XXX2FM 106 / XXX3FM 106	Multi-Disciplinary Course 1	45	3	3	25	50	75
		Total		**24/ 25**	**21**			**525**
3	XXX3CJ203	Core Course 4 in Major B	60	4	4	30	70	100
	XXX3CJ202	Core Course 5 in Major B	75	5	4	30	70	100
	AIN3CJ201	Mathematical Foundation for Artificial Intelligence	60	4	4	30	70	100
	AIN3CJ202	Data Structures and Algorithms	75	5	4	30	70	100
	XXX3FM 106 / XXX2FM 106	Multi-Disciplinary Course 2 in B –	45	3	3	25	50	75
	XXX3FV 108	Value-Added Course 1 in B – (for batch B1 only)	45	3	3	25	50	75
		Total		**23 – 25**	**22**			**550**
4	AIN4CJ205	Core Course 6 in Major A Foundations of Artificial Intelligence	75	5	4	30	70	100
	XXX4CJXXX	Core Course 6 in Major B	60/ 75	4/ 5	4	30	70	100
	XXX4CJXXX	Core Course 7 in Major B – (for batch B1 only)	60/ 75	4/ 5	4	30	70	100
	AIN4FV 109	Value-Added Course 1 Professional Skill Development for IT Career Excellence	45	3	3	25	50	75
	XXX4FV 110	Value-Added Course 2 in B –	45	3	3	25	50	75
	AIN4FS 100 / AIN5FS112	Skill Enhancement Course Introduction to Digital Marketing	45	3	3	25	50	75
		Total		**22 – 24**	**21**			**525**
5	AIN5CJ 302	Core Course 7 in Major A Operating System	75	5	4	30	70	100
	XXX5CJXXX	Core Course 8 in Major B –	60/ 75	4/ 5	4	30	70	100

	XXX5CJXXX	Core Course 9 in Major B – (for batch B1 only)	60	4	4	30	70	100
	AIN5EJ305	Elective Course 1 in Major A	60	4	4	30	70	100
	XXX5EJXXX	Elective Course 1 in Major B	60	4	4	30	70	100
	XXX5FS 112 / XXX4FS 112	Skill Enhancement Course 1 in B	45	3	3	25	50	75
		Total		**24/ 25**	**23**			**575**
6	AIN6CJ 304/ AIN8MN304	Core Course 8 in Major A Automation and Robotics	75	5	4	30	70	100
	XXX6CJXXX	Core Course 10 in Major B –	60/ 75	4/ 5	4	30	70	100
	AIN6CJ 306/ AIN8MN306	Core Course 9 in Major A Machine Learning Algorithms	60	4	4	30	70	100
	AIN6EJ311	Elective Course 2 in Major A	60	4	4	30	70	100
	XXX6EJXXX	Elective Course 2 in Major B	60	4	4	30	70	100
	XXX6FS 113	Skill Enhancement Course 2 in B (for batch B1 only)	45	3	3	25	50	75
	XXX6CJ 349	Internship in Major B (Credit for internship to be awarded only at the end of Semester 6)	60		2	50	-	50
		Total		**24/ 25**	**25**			**625**
Total Credits for Three Years					**133**			**3325**

To continue to study Artificial Intelligence in semesters 7 and 8, batch B1(A2) needs to earn additional 15 credits in Artificial Intelligence to make the total credits of 68. Suppose this condition is achieved, and the student of batch B1(A2) proceeds to the next semesters to study Artificial Intelligence Artificial Intelligence. The course structure in semesters 7 and 8 is the same as for pathways 1 – 4, except that the number of the core and elective courses is in continuation of the number of courses in the two categories completed at the end of semester 6, taking into account the number of courses in Artificial Intelligence taken online to earn the additional 15 credits.

* The course code of the same course as used for the pathways 1 – 4

CREDIT DISTRIBUTION FOR BATCH B1(A2) IN PATHWAY 5: DOUBLE MAJOR

Semester	Major Courses in B	General Foundation Courses in B	Internship/ Project in B	Major Courses in Artificial Intelligence	General Foundation Courses in Artificial Intelligence	AEC	Total
1	4 + 4	3	-	4	-	3 + 3	21
2	4	-	-	4 + 4	3	3 + 3	21
3	4 + 4	3 + 3	-	4 + 4	-	-	22
4	4 + 4	3	-	4	3 + 3	-	21
5	4 + 4 + 4	3	-	4 + 4	-	-	23
6	4 + 4	3	2	4 + 4 + 4	-	-	25
Total for Three Years	**48**	**18**	**2**	**44**	**9**	**12**	**133**
	68			**53**		**12**	**133**
	Major Courses in B	Minor Courses					
7	4 + 4 + 4 + 4 + 4	-			-	-	20
8	4 + 4 + 4	4 + 4 + 4	12		-	-	24
Total for Four Years	**88 + 12 = 100**	**12**					**177**

EVALUATION SCHEME

1. The evaluation scheme for each course contains two parts: internal evaluation (about 30%) and external evaluation (about 70%). Each of the Major and Minor courses is of 4-credits. It is evaluated for 100 marks, out of which 30 marks is from internal evaluation and 70 marks, from external evaluation. Each of the General Foundation course is of 3-credits. It is evaluated for 75 marks, out of which 25 marks is from internal evaluation and 50 marks, from external evaluation.
2. The 4-credit courses (Major and Minor courses) are of two types: (i) courses with only theory and (ii) courses with 3-credit theory and 1-credit practical.

- In 4-credit courses with only theory component, out of the total 5 modules of the syllabus, one open-ended module with 20% content is designed by the faculty member teaching that course, and it is internally evaluated for 10 marks. The internal evaluation of the remaining 4 theory modules is for 20 marks.
- In 4-credit courses with 3-credit theory and 1-credit practical components, out of the total 5 modules of the syllabus, 4 modules are for theory and the fifth module is for practical. The practical component is internally evaluated for 20 marks. The internal evaluation of the 4 theory modules is for 10 marks.

3. All the 3-credit courses (General Foundational Courses) in Artificial Intelligenceare with only theory component. Out of the total 5 modules of the syllabus, one open-ended module with 20% content is designed by the faculty member teaching that course, and it is internally evaluated for 5 marks. The internal evaluation of the remaining 4 theory modules is for 20 marks.

Sl. No.	Nature of the Course		Internal Evaluation in Marks (about 30% of the total)		External Exam on 4 modules (Marks)	Total Marks
			Open-ended module / Practical	On the other 4 modules		
1	4-credit course	only theory (5 modules)	10	20	70	100
2	4-credit course	Theory (4 modules) + Practical	20	10	70	100
3	3-credit course	only theory (5 modules)	5	20	50	75

1. MAJOR AND MINOR COURSES

1.1. INTERNAL EVALUATION OF THEORY COMPONENT

Sl. No.	Components of Internal Evaluation of Theory Part of a Major / Minor Course	Internal Marks for the Theory Part of a Major / Minor Course of 4-credits			
		Theory Only		Theory + Practical	
		4 Theory Modules	Open-ended Module	4 Theory Modules	Practical
1	Test paper/ Mid-semester Exam	10	4	5	-

2	Seminar/ Viva/ Quiz	6	4	3	-
3	Assignment	4	2	2	-
		20	10	10	20*
	Total	30		30	

* Refer the table in section 1.2 for the evaluation of practical component

1.2. EVALUATION OF PRACTICAL COMPONENT

The evaluation of practical component in Major and Minor courses is completely by internal evaluation.

- Continuous evaluation of practical by the teacher-in-charge shall carry a weightage of 50%.
- The end-semester practical examination and viva-voce, and the evaluation of practical records shall be conducted by the teacher in-charge and an internal examiner appointed by the Department Council.
- The process of continuous evaluation of practical courses shall be completed before 10 days from the commencement of the end-semester examination.
- Those who passed in continuous evaluation alone will be permitted to appear for the end-semester examination and viva-voce.

The scheme of continuous evaluation and the end-semester examination and viva-voce of practical component shall be as given below:

Sl. No.	Evaluation of Practical Component of Credit-1 in a Major / Minor Course	Marks for Practical	Weightage
1	Continuous evaluation of practical/ exercise performed in practical classes by the students	10	50%
2	End-semester examination and viva-voce to be conducted by teacher-in-charge along with an additional examiner arranged internally by the Department Council	7	35%
3	Evaluation of the Practical records submitted for the end semester viva–voce examination by the teacher-in-charge and additional examiner	3	15%
	Total Marks	20	

1.3. EXTERNAL EVALUATION OF THEORY COMPONENT

External evaluation carries 70% marks. Examinations will be conducted at the end of each semester. Individual questions are evaluated in marks and the total marks are converted into grades by the University based on 10-point grading system (refer section 5).

PATTERN OF QUESTION PAPER FOR MAJOR AND MINOR COURSES

Duration	Type	Total No. of Questions	No. of Questions to be Answered	Marks for Each Question	Ceiling of Marks
2 Hours	Short Answer	10	8 – 10	3	24
	Paragraph/ Problem	8	6 – 8	6	36
	Essay	2	1	10	10
				Total Marks	70

2. INTERNSHIP

- All students should undergo Internship of 2-credits during the first six semesters in a firm, industry or organization, or training in labs with faculty and researchers of their own institution or other Higher Educational Institutions (HEIs) or research institutions.
- Internship can be for enhancing the employability of the student or for developing the research aptitude.
- Internship can involve hands-on training on a particular skill/ equipment/ software. It can be a short project on a specific problem or area. Attending seminars or workshops related to an area of learning or skill can be a component of Internship.
- A faculty member/ scientist/ instructor of the respective institution, where the student does the Internship, should be the supervisor of the Internship.

2.1. GUIDELINES FOR INTERNSHIP

1. Internship can be in Artificial Intelligence or allied disciplines.
2. There should be minimum 60 hrs. of engagement from the student in the Internship.
3. Summer vacations and other holidays can be used for completing the Internship.
4. In BSc. Artificial Intelligence(Honours) programme, institute/ industry visit or study tour is a requirement for the completion of Internship. Visit to minimum one national research institute, research laboratory and place of scientific importance should be part of the study tour. A brief report of the study tour has to be submitted with photos and analysis.

5. The students should make regular and detailed entries in to a personal log book through the period of Internship. The log book will be a record of the progress of the Internship and the time spent on the work, and it will be useful in writing the final report. It may contain experimental conditions and results, ideas, mathematical expressions, rough work and calculation, Computer file names etc. All entries should be dated. The Internship supervisor should periodically examine and countersign the log book.
6. The log book and the typed report must be submitted at the end of the Internship.
7. The institution at which the Internship will be carried out should be prior-approved by the Department Council of the college where the student has enrolled for the UG (Honours) programme.

2.2. EVALUATION OF INTERNSHIP

- The evaluation of Internship shall be done internally through continuous assessment mode by a committee internally constituted by the Department Council of the college where the student has enrolled for the UG (Honours) programme.
- The credits and marks for the Internship will be awarded only at the end of semester 6.
- The scheme of continuous evaluation and the end-semester viva-voce examination based on the submitted report shall be as given below:

Sl. No.	Components of Evaluation of Internship		Marks for Internship 2 Credits	Weightage
1	Continuous evaluation of internship through interim presentations and reports by the committee internally constituted by the Department Council	Acquisition of skill set	10	40%
2		Interim Presentation and Viva-voce	5	
3		Punctuality and Log Book	5	
4	Report of Institute Visit/ Study Tour		5	10%
5	End-semester viva-voce examination to be conducted by the committee internally constituted by the Department Council	Quality of the work	6	35%
6		Presentation of the work	5	
7		Viva-voce	6	
8	Evaluation of the day-to-day records, the report of internship supervisor, and final report submitted for the end semester viva–voce examination before the committee internally constituted by the Department Council		8	15%

	Total Marks	50	

3 MINI PROJECT WORK (Skill Enhancement Course 3 - AIN6FS113

A mandatory mini-project (SEC 3) is scheduled in the VI Semester of the BSc AI (Honours) program. It is designed to cultivate students' research and software development skills. It will serve as a capstone experience, allowing students to bridge the gap between theoretical knowledge acquired in the classroom and its practical application to real-world problems.

3.1 Project Selection and Approval:

- Student groups (at most four members) can propose projects in AI or related disciplines.
- Projects can be experimental (building a prototype), theoretical (a research paper), or computational (implementing an algorithm).
- Project proposals must be submitted for **prior approval** from the Department Council.
- Each project team will be assigned a project supervisor for guidance.

Project Duration:

- The mini-project duration is one semester.
- **Minimum engagement:** 90 hours per student.

Project Deliverables**:**

- Two hard copies and one softcopy of a well-structured typed report outlining:
    - Project objectives and requirements analysis
    - System design and architecture
    - Implementation details (including sample code snippets)
    - Test cases and results
    - Conclusion and future work
- A signed undertaking by the student declaring the originality of the work and the absence of plagiarism.
- A certificate from the project supervisor confirming the same.

3.2 Evaluation Criteria and Rubrics:

1. **Internal Evaluation (25 Marks)** - Conducted by the project supervisor throughout the semester. This could involve:
    - **Project Proposal and Planning**
        - Clarity of project goals and objectives.
        - Feasibility of the chosen approach.
        - Quality of system study/literature review and proposed methodology.
        - Clarity of project schedule and division of tasks within the team.
    - **Project Progress and Implementation**
        - Regular code reviews and adoption of feedback provided by the supervisor.
        - Attendance and active participation in project meetings.
        - Completion of project milestones as planned.
        - Quality of code documentation and adherence to coding standards.

- **Interim Presentations**
  - Effectiveness of communication and presentation skills.
  - Clarity of technical details and progress made.
  - Ability to answer questions about the project effectively.

Sl. No	Components of Evaluation of Project	Marks for the Internal Evaluation of Mini project
1	Project Proposal and Planning	5
2	Project Progress and Implementation	10
3	Interim Presentations	10
	Total Marks	25

2. **External Evaluation (50 Marks)** - Conducted by an external examiner appointed by the University. This will take place at the end of the VIth semester:
   - **Project Report:**
     - **Content:** Completeness, organisation, clarity, and technical accuracy.
     - **Structure:** Introduction, System Design/literature review, methodology, implementation details, results, discussion, conclusion, future work, and references.
     - **Presentation:** Quality of writing, grammar, and formatting.
   - **Project Demonstration**
     - **Demonstration:** Ability to showcase the functionality of the project or present the research findings effectively.
   - **Viva-voce**
     - **Viva-voce:** Understanding of project concepts, ability to answer questions confidently, and critical thinking skills.

Sl. No	**Components of Evaluation of Project**	**Marks for the End Semester Evaluation of Mini project**
1	**Project Report**	**15**
2	**Project Demonstration**	**20**
3	**Viva-voce**	**15**
Total Marks		**50**

4. PROJECT

4.1. PROJECT IN HONOURS PROGRAMME

- In Honours programme, the student has the option to do a Project of 12-credits instead of two Core Courses in Major in semester 8.
- The Project can be done in the same institution or any other higher educational institution (HEI) or research centre.
- A faculty member of the respective institution, where the student does the Project, should be the supervisor of the Project.

4.2. PROJECT IN HONOURS WITH RESEARCH PROGRAMME

- Students who secure 75% marks and above (equivalently, CGPA 7.5 and above) cumulatively in the first six semesters are eligible to get selected to Honours with Research stream in the fourth year.
- In Honours with Research programme, the student has to do a mandatory Research Project of 12-credits in semester 8.
- The approved research centres of University of Calicut or any other university/ HEI can offer the Honours with Research programme. The departments in the affiliated colleges under University of Calicut, which are not the approved research centres of the University, should get prior approval from the University to offer the Honours with Research programme. Such departments should have minimum one faculty member with Ph.D., and they should also have the necessary infrastructure to offer Honours with Research programme.
- A faculty member of the University/ College with a Ph.D. degree can supervise the research project of the students who have enrolled for Honours with Research. One such faculty member can supervise maximum four students in Honours with Research stream.

4.3. GUIDELINES FOR THE PROJECT IN HONOURS PROGRAMME AND HONOURS WITH RESEARCH PROGRAMME

1. Project can be in Artificial Intelligenceor allied disciplines.
2. Project should be done individually.
3. Project work can be of experimental/ theoretical/ computational in nature.

4. There should be minimum 240 hrs. of engagement from the student in the Project work in Honours programme.
5. There should be minimum 360 hrs. of engagement from the student in the Project work in Honours with Research programme.
6. The various steps in project works are the following:
    - Wide review of a topic.
    - Investigation on a problem in systematic way using appropriate techniques.
    - Systematic recording of the work.
    - Reporting the results with interpretation in a standard documented form.
    - Presenting the results before the examiners.
7. During the Project the students should make regular and detailed entries in to a personal log book through the period of investigation. The log book will be a record of the progress of the Project and the time spent on the work, and it will be useful in writing the final report. It may contain experimental conditions and results, ideas, mathematical expressions, rough work and calculation, Computer file names etc. All entries should be dated. The Project supervisor should periodically examine and countersign the log book.
8. The log book and the typed report must be submitted at the end of the Project. A copy of the report should be kept for reference at the department. A soft copy of the report too should be submitted, to be sent to the external examiner in advance.
9. It is desirable, but not mandatory, to publish the results of the Project in a peer reviewed journal.
10. The project report shall have an undertaking from the student and a certificate from the research supervisor for originality of the work, stating that there is no plagiarism, and that the work has not been submitted for the award of any other degree/ diploma in the same institution or any other institution.
11. The project proposal, institution at which the project is being carried out, and the project supervisor should be prior-approved by the Department Council of the college where the student has enrolled for the UG (Honours) programme.

4.4. EVALUATION OF PROJECT

- The evaluation of Project will be conducted at the end of the eighth semester by both internal and external modes.

- The Project in Honours programme/ Honours with Research programme will be evaluated for 300 marks. Out of this, 90 marks is from internal evaluation and 210 marks, from external evaluation.
- The internal evaluation of the Project work shall be done through continuous assessment mode by a committee internally constituted by the Department Council of the college where the student has enrolled for the UG (Honours) programme. 30% of the weightage shall be given through this mode.
- The remaining 70% shall be awarded by the external examiner appointed by the University.
- The scheme of continuous evaluation and the end-semester viva-voce of the Project shall be as given below:

Components of Evaluation of Project	Marks for the Research Project(Honours)/ (Honours with Research) 12 Credits	Weightage
Continuous evaluation of project work through interim presentations and reports by the committee internally constituted by the Department Council	90	30%
End-semester viva-voce examination to be conducted by the external examiner appointed by the university	150	50%
Evaluation of the day-to-day records and project report submitted for the end-semester viva–voce examination conducted by the external examiner	60	20%
Total Marks	300	

INTERNAL EVALUATION OF PROJECT

Sl. No	Components of Evaluation of Project	Marks for the Research Project (Honours programme) /(Honours with Research programme) 12 credits
1	Skill in doing project work	30

2	Interim Presentation and Viva-Voce	20
3	Punctuality and Log book	20
4	Scheme/ Organization of Project Report	20
	Total Marks	90

EXTERNAL EVALUATION OF PROJECT

Sl. No	Components of Evaluation of Project	Marks for the Research Project (Honours programme) / (Honours with Research programme) 12 credits
1	Content and relevance of the Project, Methodology, Quality of analysis, and Innovations of Research	50
2	Presentation of the Project	50
3	Project Report (typed copy), Log Book and References	60
4	Viva-Voce	50
	Total Marks	210

5. GENERAL FOUNDATION COURSES

- All the General Foundation Courses (3-credits) in Artificial Intelligenceare with only theory component.

5.1. INTERNAL EVALUATION

Sl. No.	Components of Internal Evaluation of a General Foundation Course in AI	Internal Marks of a General Foundation Course of 3-credits in AI	
		4 Theory Modules	Open-ended Module
1	Test paper/ Mid-semester Exam	10	2
2	Seminar/ Viva/ Quiz	6	2
3	Assignment	4	1
		20	5
	Total	25	

5.2. EXTERNAL EVALUATION

External evaluation carries about 70% marks. Examinations will be conducted at the end of each semester. Individual questions are evaluated in marks and the total marks are converted into grades by the University based on 10-point grading system (refer section 5).

PATTERN OF QUESTION PAPER FOR GENERAL FOUNDATION COURSES

Duration	Type	Total No. of Questions	No. of Questions to be Answered	Marks for Each Question	Ceiling of Marks
1.5 Hours	Short Answer	10	8 – 10	2	16
	Paragraph/ Problem	5	4 – 5	6	24
	Essay	2	1	10	10
				Total Marks	50

6. LETTER GRADES AND GRADE POINTS

- Mark system is followed for evaluating each question.
- For each course in the semester letter grade and grade point are introduced in 10-point indirect grading system as per guidelines given below.
- The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester.
- The Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study.
- Only the weighted grade point based on marks obtained shall be displayed on the grade card issued to the students.

LETTER GRADES AND GRADE POINTS

Sl. No.	Percentage of Marks (Internal & External Put Together)	Description	Letter Grade	Grade Point	Range of Grade Points	Class
1	95% and above	Outstanding	O	10	9.50 – 10	First Class with Distinction
2	Above 85% and below 95%	Excellent	A+	9	8.50 – 9. 49	
3	75% to below 85%	Very Good	A	8	7.50 – 8.49	
4	65% to below 75%	Good	B+	7	6.50 – 7.49	First Class
5	55% to below 65%	Above Average	B	6	5.50 – 6.49	
6	45% to below 55%	Average	C	5	4.50 – 5.49	Second Class
7	35% to below 45% aggregate (internal and external put together) with a minimum of 30% in external valuation	Pass	P	4	3.50 – 4.49	Third Class
8	Below an aggregate of 35%	Fail	F	0	0 – 3.49	Fail

	or below 30% in external evaluation					
9	Not attending the examination	Absent	Ab	0	0	Fail

- When students take audit courses, they will be given Pass (P) or Fail (F) grade without any credits.
- The successful completion of all the courses and capstone components prescribed for the three-year or four-year programme with 'P' grade shall be the minimum requirement for the award of UG Degree or UG Degree (Honours) or UG Degree (Honours with Research), as the case may be.

6.1. COMPUTATION OF SGPA AND CGPA

- The following method shall be used to compute the Semester Grade Point Average (SGPA):
  The SGPA equals the product of the number of credits (Ci) with the grade points (Gi) scored by a student in each course in a semester, summed over all the courses taken by a student in the semester, and then divided by the total number of credits of all the courses taken by the student in the semester,

$$\text{i.e. SGPA (Si)} = \Sigma i\ (Ci \times Gi) / \Sigma i\ (Ci)$$

  where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course in the given semester. Credit Point of a course is the value obtained by multiplying the credit (Ci) of the course by the grade point (Gi) of the course.

$$\text{SGPA} = \frac{\text{Sum of the credit points of all the courses in a semester}}{\text{Total credits in that semester}}$$

ILLUSTRATION – COMPUTATION OF SGPA

Semester	**Course**	**Credit**	**Letter Grade**	**Grade point**	**Credit Point** (Credit x Grade)
I	Course 1	3	A	8	3 x 8 = 24
I	Course 2	4	B+	7	4 x 7 = 28
I	Course 3	3	B	6	3 x 6 = 18
I	Course 4	3	O	10	3 x 10 = 30
I	Course 5	3	C	5	3 x 5 = 15
I	Course 6	4	B	6	4 x 6 = 24
	Total	20			139
	SGPA				139/20 = 6.950

- The Cumulative Grade Point Average (CGPA) of the student shall be calculated at the end of a programme. The CGPA of a student determines the overall academic level of the student in a programme and is the criterion for ranking the students.

  CGPA for the three-year programme in CUFYUGP shall be calculated by the following formula.

$$\text{CGPA} = \frac{\text{Sum of the credit points of all the courses in six semesters}}{\text{Total credits in six semesters (133)}}$$

  CGPA for the four-year programme in CUFYUGP shall be calculated by the following formula.

$$\text{CGPA} = \frac{\text{Sum of the credit points of all the courses in eight semesters}}{\text{Total credits in eight semesters (177)}}$$

- The SGPA and CGPA shall be rounded off to three decimal points and reported in the transcripts.
- Based on the above letter grades, grade points, SGPA and CGPA, the University shall issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

Major Courses

Programme	BSc AI				
Course Code	AIN1CJ101/ AIN1MN100				
Course Title	Fundamentals of Computers and Computational Thinking				
Type of Course	Major				
Semester	I				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	2	-	75
Pre-requisites	1. Fundamentals of electronic components 2. Basic mathematical operations				
Course Summary	This course provides a comprehensive overview of computing, covering historical milestones, hardware components, software systems, and computational thinking principles. Students will explore the evolution of computing systems, from early pioneers to modern processors and quantum units. The curriculum delves into hardware intricacies, software distinctions, and essential concepts in computer science, emphasizing problem-solving skills and algorithmic thinking. Practical aspects include hands-on experiences with hardware assembling, operating system installation, algorithm and flowchart visualization.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Develop a foundational knowledge of computing systems, encompassing their historical development, evolutionary milestones, and the notable contributions of key figures in the field.	U	F	Instructor-created exams / Quiz
CO2	Acquire familiarity with diverse hardware components constituting a computer system.	U	C	Practical Assignment / Observation of Practical Skills
CO3	Gain practical expertise by engaging in hands-on activities focused on the installation and configuration of diverse hardware components within a computer system.	Ap	P	Practical Assignment / Observation of Practical Skills
CO4	Explore the spectrum of software types, and actively participate in the partitioning, installation, and configuration of operating systems to cultivate a comprehensive understanding of software systems.	Ap	P	Practical Assignment / Observation of Practical Skills
CO5	Develop a foundational understanding of computer science as a discipline, examining problems through the lens of computational thinking and cultivating	An	C	Instructor-created exams / Quiz

	analytical skills to address challenges in the field.			
CO6	Represent complex problems using algorithmic approaches and enhance problem-solving skills by visualizing solutions through the utilization of various software tools.	Ap	P	Practical Assignment / Observation of Practical Skills
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
I	**History and Evolution of Computing System**		**10**	**15**
	1	**Evolution of Computers** – History, Generations	2	
	2	**Overview of Computer System**- Von Neumann Model, Number Systems (Binary, Hexa, Octal, Decimal)	2	
	3	**Number Conversion and Digital Codes** - Conversion from one number system to another, Digital Codes (Gray, Excess-3, BCD)	2	
	4	**Pioneers and Contributors of Computing Systems** - First Mechanical computer - Charles Babbage, Stored-Program Architecture - John von Neumann, Turing machine - Alan Turing, First General-Purpose Electronic Digital Computer - John Mauchly and J. Presper Eckert, Artificial Intelligence- John McCarthy (Contributions only).	2	
	5	**Computing Systems: Past to Present** - Single Core, Dual-Core and Multi-Core Processors, Graphics Processing Unit (GPU), Accelerated Processing Unit, Quantum Processing Units (QPU) (Concept only).	2	
II	**Hardware**		**11**	**20**
	6	**Electronic Components** – Active Components - Diode, Transistor, Integrated Circuits (Definition, Symbol and Function).	1	
	7	**Electronic Components** - Passive Components – Resistors, Capacitors, Inductors (Definition, Symbol and Function).	1	
	8	**Motherboard Components –** CPU and Cooling Fan, RAM, Expansion Slots (PCIe), Input/Output Ports, Chipset (Concept only).	2	
	9	**Motherboard Components –** BIOS/UEFI Chip, SATA/NVMe Slots, Network Interface, Ports- Ethernet, VGA, HDMI, USB (Concept only).	3	
	10	**Computer Components** – SMPS, Motherboard, Storage Devises (HDD, SSD, NVMe (Concept only).	2	
	11	**Computer Components** – RAM (DRAM, SRAM, DDR SDRAM), ROM, Cache (Concept only).	2	
III	**Software**		**12**	
	12	**Software** - Application Software, System Software, Examples	2	
	13	**Operating System** – Need of OS, Types – Proprietary and Open Source, Hardware Software Compatibility, POST, Booting.	4	

	14	**OS Installation –** Bootable Media, UEFI/Legacy BIOS, Disk Partitioning, Dual Booting, Boot Manager – BOOTMGR, Grub, File Systems- FAT, NTFS, ext4.	4	**15**
	15	**Device Drivers –** Need of Device Drivers, Driver Interactions (Basic concept only).	2	
IV	**Computer Science and Computational Thinking**		**15**	
	16	**Computer Science**- Role of Computer Science in the Modern Era.	1	
	17	**Problem Solving -** Defining the Problem, Systematic Approach.	2	**20**
	18	**Computational Thinking** – Problem Decomposition, Pattern Identification, Abstraction, Generalization.	2	
	19	**Logical Thinking** – Inductive and Deductive Reasoning, Logical Expressions.	2	
	20	**Algorithmic Thinking** – Intuition vs Precision, Defining algorithms.	2	
	21	**Algorithm** – Need of Algorithm, Qualities of a Good Algorithm, Examples.	3	
	22	**Flowchart** - Flowchart Symbols, Examples. Raptor.	3	
V	**Open Ended Module**		**12**	
		Strictly do the following activities from the Lab. 1. Identify, categorize and list out specifications of given **electronic components**. 2. Identify and list out specifications of given **motherboard components**. 3. Identify and Describe various **ports and connectors on motherboard**. 4. Installation of various **components on motherboard** (Processor, Fan, Heat Sink, RAM etc.) 5. Hands-on experience in **assembling and disassembling** a computer system (SMPS, Motherboard, Storage Device etc.). 6. Accessing and configuring the **Basic Input/Output System (BIOS) or Unified Extensible Firmware Interface (UEFI)** settings. 7. Preparation of **Bootable media** with software like ***Rufus***. 8. Check the hardware compatibility and **Install operating system** (single booting) on given computer. 9. Check the hardware compatibility and **Install operating systems** (dual booting – Windows and Linux) on given computer. **Develop algorithms and implement** the solutions using ***RAPTOR*** flowchart execution tool for the following problems. 10. Read and print a number. 11. Read the price of three items and print the total bill amount. 12. Read ages of two persons and print the elder one. 13. Read the number of units of electricity consumed and print the bill amount for various slabs. 14. Read a year and check whether it is a leap year. 15. Print first N numbers (using loop).		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	3	-	-	-	1						
CO 2	1	3	-	-	1	-						
CO 3	1	3	-	-	2	2						
CO 4	1	3	-	-	2	2						
CO 5	2	1	3	1	1	-						
CO 6	2	1	3	2	2	1						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4		✓	✓	✓
CO 5		✓		✓
CO 6	✓	✓	✓	✓

References:

1. Gary B. Shelly, Thomas J. Cashman, and Misty E. Vermaat. “Introduction to

Computers", Cengage Learning, 2008.

2. Pradeep K. Sinha and Priti Sinha, Computer Fundamentals: Concepts, Systems & Applications. BPB Publications.

3. Kevin Wilson, Computer Hardware: The Illustrated Guide to Understanding Computer Hardware. Amazon Digital Services LLC – KDP, 2018.

4. John Hanna, OS Installation 101: A Step-by-Step Approach for Newbies.

5. David Riley and Kenny Hunt, Computational thinking for modern solver, Chapman & Hall/CRC, 2014.

6. R.G. Dromey, How to solve it by Computer, PHI, 2008.

Programme	BSc AI				
Course Code	AIN2CJ101/ AIN2MN100				
Course Title	Computational Logic for Artificial Intelligence				
Type of Course	Minor				
Semester	II				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	No pre-requisites required				
Course Summary	This course provides a foundational understanding of essential concepts that are fundamental to computer science and various branches of mathematics. The course explores topic related to Propositional Logic, Sets and Relations, Graphs and Trees. This helps the students to equip with the analytical and problem-solving skills necessary for applications in computer science and algorithm design.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Acquire a comprehensive understanding of propositional logic and its applications, with a focus on constructing and interpreting truth tables.	U	C	Instructor- created exams / Quiz/Assignment/ Seminar
CO2	Able to proficiently define and manipulate sets, analyse relations and functions and their representation by Venn diagrams	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO3	Acquire a basic understanding of graph theory including representations, types of graphs, their properties such as connectivity, cycles, paths and degrees.	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO4	Able to demonstrate a deep understanding of advanced graph theory concepts, focusing on Euler's graph, Hamiltonian graphs, Isomorphism and Homeomorphism.	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO5	Able to proficiently understand the tree data structures, spanning trees and associated algorithms for solving problems such as Prim's and Kruskal.	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar

CO6	Represent various mathematical problems using algorithmic approaches and enhance problem-solving skills by visualizing solutions through the utilization of software tools.	U, Ap	C, P	Practical Assignment / Observation of Practical Skills
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Contents	Hrs (45+30)	Mark
I		**Mathematical Logic**	**09**	**17**
	1	Propositional Logic: Definition, Logical Operators (Negation, Disjunction, Conjunction, Implication, Biconditional), Truth Table	2	
	2	Law of Logic: Tautology, Contradiction, Contingency, Logical equivalence	2	
	3	Algebra of Propositions, Solving logic with and without truth table	2	
	4	Validity of Arguments, Logical implication	2	
	5	Quantifiers: Universal and Existential	1	
II		**Set Theory and Relations**	**10**	**17**
	6	Set Theory: Definition, Concept of Set Theory, Cardinality, Types of sets	1	
	7	Properties of Set: Subsets, Power set, Venn Diagrams, Set operations, Partition	2	
	8	Relation: Definition and Examples, Type of Relations with example,	2	
	9	Equivalence relation, Equivalence Class and Di-Graph and problems	3	
	10	Functions: Introduction, type of function, Composition function	1	
	11	One-to-one function, Onto function, One-to-one correspondence	1	
III		**Introduction to Graphs**	**15**	**20**
	12	Graph: Definition, Properties of Graph, Simple Graph, Regular Graph, Null Graph, Subgraph and Isomorphism	2	
	13	Walk, Path, Trail, Circuit, Cycle, Complete Graph, Hand-Shaking Theorem	2	

	14	Connected Graph, Complete Graph, Euler Graph, Hamiltonian graph, Travelling Sales Man Problem, Operations on Graph, Homeomorphism	3	
	15	Planar Graph, Kuratowski's two graph, Matrix Representation of Graph	3	
	16	Bi-Partite Graph, Graph coloring, Chromatic number	2	
	17	Basic theorems on Graph: Hand-Shaking Theorem	3	
IV	**Trees and Applications**		**11**	
	18	Tress: Definition, Properties, Pendant vertex, Distance, Eccentricity and Center of Tress	2	**16**
	19	Rooted Tress, Binary Tress and Its Properties	2	
	20	Basic Theorems on Tress	3	
	21	Minimum Spanning Tree: Definition, Prim's Algorithm and Kruskal's Algorithm (Algorithm and Problem Based)	2	
	22	Cut-Set and Cut-Vertices, Connectivity of Graph and Weighted Graph	2	
V	**Lab Activities (Use Sci Lab or any other Alternative tools)**		**30**	**30**
	1	Define logical operators and truth tables to evaluate the truth values of the formulas		
		Implement a function to determine whether a given logical expression is a tautology, contradiction, or contingency.		
		Define predicates, quantifiers, and rules of inference, then perform inference steps.		
		Develop a SciLab script to perform set operations such as union, intersection, and complement for two given sets.		
		Create a SciLab program to determine if a given relation is reflexive, symmetric, transitive, or an equivalence relation.		
		Define matrices or lists to represent graphs		
		Write a SciLab function to verify the Hand-Shaking Theorem for a given graph.		
		Implement algorithms to color graphs with the minimum number of colors (e.g., greedy coloring).		
		Implement Prim's algorithm to find minimum spanning trees of given graphs.		

		Implement Kruskal's algorithm to find minimum spanning trees of given graphs.		
	2	Case Study		
	3	Demonstrate Practical application theory in various domain of Computer Science from social networks and web search to network security and bioinformatics. They challenge students to apply their knowledge of graph theory to solve complex, real-world problems and to gain a deeper understanding of its relevance in modern computing environments.		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	1	1	-	-						
CO 2	2	-	2	2	-	-						
CO 3	2	-	2	2	-	-						
CO 4	2	-	2	2	-	-						
CO 5	2	-	2	2	-	-						
CO 6	2	-	2	2	-	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓	✓	✓

References:

1. C L Liu, D P Mohapatra, "Elements of Discrete Mathematics", McGraw Hill Education (India) Private Limited, 2008.
2. Seymour Lipscutz, Marc Lars Lipson, " Discrete Mathematics", Tata McGraw Hill Education Private Limited, 2015.
3. Kenneth A Ross, Charles R B Wright, "Discrete Mathematics", 5th Edition, Pearson Education India, 2012.
4. Swapan Kumar Sarkar, "Discrete Mathematics", 9th Edition, S Chand & Co Ltd, 2016.
5. Elements of Discrete Mathematics, C. L. Liu, TMH Edition
6. Discrete Mathematical Structures with applications to Computer Science, J.K. Tremblay and R Manohar, McGraw Hill
7. Discrete mathematical Structures, Kolman, Busby, Ross, Pearson
8. Graph theory, Harry, F., Addison Wesley.
9. Finite Mathematics, S. Lipchutz, Schaum Series, MGH.

Programme	BSc AI				
Course Code	AIN3CJ201				
Course Title	Mathematical Foundation for Artificial Intelligence				
Type of Course	Major				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic Mathematics is required (Algebra, Arithmetic)				
Course Summary	This course provides a fundamental exploration of mathematical concepts essential for Artificial Intelligence.. Students will explore key topics including Linear Algebra, Differential and Integral Calculus. The course aims to equip students with the mathematical tools and reasoning skills necessary for creating and analyzing algorithms, understanding and solving computational problems in various areas of Artificial Intelligence.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Reflect the concept of matrices and determinants as a way to depict and streamline mathematical ideas to perform basic operations.	U	C	Instructor- created exams / Quiz/Assignment/ Seminar
CO2	Able to find the inverse of square matrices using different methods and demonstrate a solid understanding of eigen values.	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO3	Proficiency in solving linear equations using different techniques and understanding the geometric interpretation of solutions.	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO4	Gain proficiency in representing vectors geometrically and algebraically, understanding vector addition, dot and cross products.	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar

CO5	Able to apply differential and integral calculus to various functions encountered in computer applications such as polynomials, exponentials and logarithmic functions.	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO6	Represent various mathematical problems using algorithmic approaches and enhance problem-solving skills by visualizing solutions through the utilization of software tools.	U, Ap	C, P	Practical Assignment / Observation of Practical Skills

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Contents	Hrs (48+12)	Marks
I		**Matrices and Determinants**	**14**	**18**
	1	Matrices: Definition, Order of a matrix, Types of matrices	2	
	2	Operations on matrices: Addition, Subtraction, Multiplication	3	
	3	Properties of matrix: Various kind of Matrices, Transpose of a matrix	2	
	4	Elementary Transformations of Matrices and Rank of Matrices	2	
	5	Symmetric and Skew Symmetric Matrices	2	
	6	Determinants, Minors, Cofactors, Inverse of a matrix	3	
II		**Linear Algebra and Vector Calculus**	**12**	**18**
	7	Linear Independence: Characteristic equations,	1	
	8	Eigen values, Eigen Vector	2	
	9	Solving system of linear equations: Gauss Elimination Method, Gauss Jordan method, Gauss Siedel Methods	3	
	10	Vectors: Definition Magnitude of a vector, Types of Vectors, Vector addition	2	
	11	Dot products and Cross products	2	
	12	Vectors in 2- and 3-space	2	
III		**Differentiation**	**11**	**17**
	13	Limits; Definition (concept only), Derivative of a Point, Derivative at Function	2	

	14	Differentiation: Definition, Differentiation from first principle, Differentiation of important function	2	
	15	Product rule, Quotient rule	3	
	16	Derivative of function of a function	2	
	17	Logarithmic differentiation	2	
IV		**Integration**	**11**	**17**
	18	Integration: Integral as Anti-derivative, Indefinite integral & constant of integration	2	
	19	Fundamental theorems, Elementary Standard results	2	
	20	Integral of different functions, Integration by Substitution	3	
	21	Definite Integrals, Properties of definite integrals	2	
	22	Evaluation of Definite Integrals by Substitution	2	
V		**Open Ended Module – Application Level**	**12**	
	1	Discuss topics from the following: • Differential Equation. • Concept of First Order ODE's. • Concept of Second Order ODE's. • Application of Logarithm. • Combinatorics. • Trigonometric concept. • Applications of Matrices in various field of computer like image processing, cryptography etc. • Real-world examples for using eigen values and eigen vectors. • Vectors assist in GPS technology to provide accurate navigation data. • 3D vectors enhancement in virtual reality experiences. • Discuss the importance of differentiation and integration in various computer fields, such as Machine Learning, Robotics, Quantum Computing, etc.	10	
	2	Case Study	2	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	1	1	-	-						
CO 2	2	-	2	2	-	-						

CO 3	2	-	2	2	-	-						
CO 4	2	-	2	2	-	-						
CO 5	2	-	2	2	-	-						
CO 6	2	-	2	2	-	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓	✓	✓

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley
2. Higher Engineering Mathematics, John Bird, Elsevier Direct
3. Skills in Mathematics: Algebra, S.K.Goyal
4. Higher Engineering Mathematics, B S Grewal, Khanna Publishers
5. Higher Engineering Mathematics, Ramana, Tata McGraw Hill
6. Engineering Mathematics, P Kandasamy, S. Chand Group

Programme	BSc AI				
Course Code	AIN3CJ202/ AIN3MN200				
Course Title	Data Structures and Algorithm				
Type of Course	Major/Minor				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamental Mathematics Concepts: Set, Functions, Logic				
Course Summary	This course explores implementations of linked list and array-based data structures, delving into the inner workings of basic data structures including lists, stacks, queues, trees, and graphs.				

Course Outcomes (CO)

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Differentiate basic data structures (arrays, linked lists, stacks, queues) based on their characteristics, operations, and real-world applications.	U	C	Instructor-created exams / Quiz
CO2	Perform basic operations (e.g., insertion, deletion, search) on fundamental data structures using a chosen programming language.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Identify the properties and applications of advanced data structures (trees, graphs).	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	Investigate the properties of various searching and sorting Techniques	U	C	Practical Assignment / Seminar
CO5	Demonstrate critical thinking and problem-solving skills by applying data structures and algorithms to address complex computational challenges.	Ap	P	Viva Voce/ Observation of Practical Skills
CO6	Implement and analyse different data structure algorithms (to solve practical problems.	Ap	P	Case study/ Project
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs (45+30)	Marks
I	**Introduction to Data Structures and Basic Algorithms**		**9**	**15**
	1	Introduction to Data Structures: Definition, Classification of data structures -Linear and Non- Linear, Static and Dynamic, Data Structure Operations, Applications of Data Structures	1	
	2	Introduction to Arrays: Definition, Types (1 Dimensional, 2 Dimensional, Multi-Dimensional, Sparse matrix), Different Array Operations with Algorithm (insertion, deletion, traversal)	3	
	3	Structures and Self-referential structures	1	
	4	Introduction to Linked list: Definition, Types (Single linked list, Doublelinked list, Circular linked list- concept only).	2	
	5	Singly Linked List Operations with Algorithm (insertion, deletion, traversal)	2	
II	**Stack and Queue**		**10**	**20**
	6	Introduction to Stack: Definition, stack operations with Algorithm, Applications: recursion, infix to postfix - example and Algorithm	3	
	7	Implementation of Stack: using array (overflow & underflow) and Linkedlist (with algorithm)	2	
	8	Introduction to Queue: Definition, queue operations with Algorithm, Types: Double ended queue (Input Restricted and Output restricted), Circularqueue, Applications	2	
	9	Implementation of Queue: using array and Linked list (with algorithm)	3	
III	**Non- Linear Data Structures**		**16**	**20**
	10	Introduction to Trees: Basic terminology, Types (Binary tree- complete,full, skewed etc., Expression Tree)	2	
	11	Properties of Binary tree, Applications.	2	
	12	Binary tree representations- using array and linked list	2	
	13	Operations on Binary tree- Insertion, Deletion, Traversal- inorder, preorder, postorder - (concepts with examples)	3	
	14	Algorithm of non-recursive Binary tree traversal	3	
	15	Introduction to Graph: Definition, Basic terminology, Types (Directed, Undirected, Weighted).	2	
	16	Graph representation –Adjacency list and Adjacency Matrix, Applications.	2	
IV	**Sorting and Searching**		**10**	**15**
	17	Introduction to Sorting: Definition, Classification (Internal, External)	1	
	18	Internal Sorting Algorithms: Selection sort- Selection sort algorithm, Exchange sort- Bubble sort algorithm	2	
	19	External Sorting Algorithms: Merge sort- Demonstrate with example (NoAlgorithm needed)	1	
	20	Advanced sorting Algorithm-: Quick sort- Demonstrate with example. (NoAlgorithm needed)	1	

	21	Introduction to Searching: Linear search and Binary search (Algorithm needed) with example.	2	
	22	Hashing: Hash Tables, Hash Functions, Different Hash Functions – Division method, Multiplication method, Mid square method, Folding Method	2	
V	**Hands-on Programming in Data Structures: Practical Applications, Case Study and Course Project**		**30**	
	1	**Implement the following using C Language** **1.** Basic Operations in a single linked list (Menu driven) **2.** Stack using array. **3.** Queue using Array **4.** Sorting algorithms- Selection, Bubble Sort **5.** Searching Algorithms- Linear and Binary search	25	
	2	Project/ Case study	5	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	1	-	-	-						
CO 2	2	1	2	3	-	-						
CO 3	2	1	2	3	-	-						
CO 4	2	-	2	3	-	-						
CO 5	1	1	2	3	1	-						
CO 6	1	1	3	3	1	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5		✓		✓
CO 6			✓	

References:

1. Seymour Lipschutz, “Data Structures with C”, McGraw Hill Education (Schaum'sOutline Series).
2. Reema Thareja, “Data Structures Using C”, Oxford University Press.

Programme	BSc AI				
Course Code	AIN4CJ203				
Course Title	Object Oriented Programming in Java				
Type of Course	**Major** /Minor				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Knowledge in basic programming 2. Knowledge in OOP Concepts				
Course Summary	The aim of this course is to provide students with an understanding of the basic concepts in Java programming. This course will help students create GUI applications in Java and establish database connectivity.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the concepts and features of Object-Oriented Programming (OOPs)	U	C	Practical Assignment / Instructor-created exams / Quiz
CO2	To practice programming in Java	Ap	P	Practical Assignment / Instructor-created exams / Quiz
CO3	To learn java's exception handling mechanism, I/O operations and multithreading.	Ap	P	Practical Assignment / Instructor-created exams / Quiz
CO4	To learn java's O operations and multithreading.	Ap	P	Practical Assignment / Instructor-created exams / Quiz
CO5	Implement programs using Java Database Connectivity	Ap	P	Practical Assignment / Instructor-created exams / Quiz
CO6	Students will be capable of developing Graphical User Interface (GUI) applications using Swing, understanding layout management, and implementing basic event handling.	Ap	P	Practical Assignment / Instructor-created exams / Quiz

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (45+30)	Marks
I	**Review of OOPs and Introduction to Java**		**17**	**20**
	1	Overview of OOPs Concept	1	
	2	History of Java and Java Virtual Machine	1	
	3	Basic Structure of Java Programming: Data Types, Operators, Expression and Control Statement	2	
	5	Arrays and String: One Dimensional Array, Multidimensional Array, String Operations	2	
	6	Scanner, Type Conversion and Casting	2	
	7	Introduction to Class and Objects: Definition of Class and Objects, Access Modifier	2	
	8	Constructor and Inheritance: Types of Constructors, Types of Inheritance, use of extends, super, final, this keyword	3	
	9	Method Overriding, Method Overloading and Dynamic Method Dispatch: Programming implementation of Method Overriding and Overloading	2	
	10	Interface, Abstract Class and Packages; Programming implementation of Interface, Abstract class and Packages	2	
II	**Exception and I/O Operations**		**8**	**15**
	11	Exception: Baic Concept of exception and Exception Hierarchy	2	
	12	Managing Exception: Use of try….catch ….. finally blocks, throw and throws keyword	2	
	13	Managing Input/Output files in Java: Importance of I/O Operations, BufferedInputStream, BufferedOutputStream	2	
	14	File Operations: Programming implementation of FileInputStream, FileOutputStream, FileReader, FileWriter	2	
III	**Multithreading and Database Connectivity**		**9**	**20**
	15	Thread: Concept of Thread and Thread state	2	
	16	Programming Implementation of Thread: Using extending thread class and Runnable interface, Thread Priorities	2	

	17	Database Programming: Basic Concept of Database and JDBC Driver, Connecting with Database	2	
	18	Querying Database: Programming implementation of creating table, insert and update values to the table using preparedStatement, Statement object and querying the values using ResultSet and ResultSetMetadata	3	
IV	**GUI Programming**		**11**	**15**
	19	Introduction to GUI Application: AWT Basics, Introduction to IDE	2	
	20	Swing Programming: Introduction of Model-View-Controller Pattern	2	
	21	Introduction to layout Management: Fundamental controls used in SWING	4	
	22	Event Handling: Basic Knowledge of Event Handling (Event Class and Event Listener)	3	
V	**Hands-on Programming in Java(Using IDE NetBeans, Eclipse, VSCode):**		**30**	**30**
	Practical Applications, Case Study and Course Project			
	1	Implement the following:		
		1. String and Arrays:	20	
		Write a program to perform various String operations in Java (Hint: charAt, substring, concat, equals,, isEmpty..)		
		Write a program to implement Multi-Dimensional Array (Hint : Matrix multiplication)		
		2. Object Oriented Programming Concept:		
		Write a program to implement the concept of class and object (Hint: Complex Number addition)		
		Write a program to demonstrate the order in which constructors are invoked in multilevel inheritance.		
		Write a program to implement method overloading		
		Write a program to implement method overriding.		
		3. Exception Handling and Multithreading:		
		Write a program to implement try…cacth, finally block (Hint: Arithmetic and ArrayOutOfBound Exception)		
		Write a multi thread java program for displaying odd numbers and even numbers up to a limit (Hint: Create thread by inheriting Thread class).		
		Write a multi thread java program for displaying odd numbers and even numbers up to a limit (Hint: Implement thread using Runnable interface).		
		4. GUI Application with Database:		
		Write a swing program to track mouse & key events		

		Write a swing program to fetch data from TextFiled and display it in Label		
		Write a swing program to perform form validation		
		Write a swing program to display data in tabular form		
		Write a simple login program without database connectivity		
		Write a swing program to create a registration form (Hint: Create table student in any database and link the registration form with database using JDBC)		
	2	Case Study	2	
	3	**Project:** Build a application for shop management system (Eg: Admin Login, Product registration, stock management, product selling, employee salary)	8	

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	3	3	-	-						
CO 2	1	-	3	3	-	-						
CO 3	-	-	3	3	2	3						
CO 4	-	-	2	3	-	-						
CO 5	-	-	3	3	2	3						
CO 6			3	3	3							

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4		✓		✓
CO 5		✓		✓

References:

1. Herbert Scheldt, Java: The Complete Reference, 12th Edition, Tata McGraw-Hill Edition, ISBN: 9781260463415.

2. C. Thomas Wu, An introduction to Object-oriented programming with Java, 5e, McGraw-Hill, 2009.
3. Y. Daniel Liang, Introduction to Java programming, Comprehensive Version, 10e, Prentice Hall India, 2013.
4. K. Arnold, J. Gosling, David Holmes, The JAVA programming language, 4e, Addision- Wesley, 2005.

Programme	BSc AI				
Course Code	AIN4CJ204				
Course Title	Database Management System				
Type of Course	Major				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Discrete Mathematics, Data structures and Programming Basics				
Course Summary	This course introduces database management systems. The topics covered include the concept of Database Management System, ER Model, Relational model, SQL, Database design, Transactions, concepts of other data model-NoSQL and practical session to implement Database Concepts.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	A comprehensive understanding of fundamental concepts in database management systems and its application	U	C	Instructor-created exams / Quiz
CO2	Understand concepts of Relational Data Model and Normalization Techniques	U	C	Instructor-created exams / Quiz
CO3	Apply principles of entity-relationship modeling and normalization techniques to design efficient and well-structured databases that meet specified requirements.	Ap	P	Practical Assignment / Observation of Practical Skills
CO4	Acquire expertise in crafting and executing SQL queries for the retrieval, updating, and manipulation of data, showcasing adept skills in database querying and data manipulation	Ap	p	Practical Assignment / Observation of Practical Skills
CO5	Comprehend and apply strategies for managing transactions and implementing mechanisms for controlling concurrency, ensuring the database's consistency and reliability in environments with multiple users.	Ap	P	Practical Assignment / Observation of Practical Skills
CO6	Explore and analyze recent trends in database management systems, with a focus on unstructured databases, NoSQL technologies	An	P	Practical Assignment / Observation of Practical Skills

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (45+30)	Mark
I	**Database System- Concept**		**10**	**15**
	1	Introduction, Characteristics of the Database Approach	2	
	2	Actors on the Scene, Workers behind the Scene, Advantages of Using the DBMS Approach, File system vs Database	2	
	3	Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence	3	
	4	Database Languages and Interfaces	2	
	5	Structured, Semi Structured and Unstructured Database	1	
II	**Database Design**		**14**	**20**
	6	ER Model- Basic concepts, entity set & attributes, notations	2	
	7	Relationships and constraints, cardinality, participation, notations, weak entities	2	
	8	Relational Model Concepts-Domains, Attributes, Tuples, and Relations, Values and NULLs in the Tuple	2	
	9	Relational Model Constraints and Relational Database Schemas	2	
	10	Relational Database Design- Atomic Domain and Normalization	2	
	11	INF, 2NF,3NF, BCNF	4	
III	**Query Languages**		**11**	**20**
	12	SQL-, introduction to Structured Query Language (SQL)	1	
	13	Data Definition Language (DDL), Table definitions and operations	2	
	14	SQL DML (Data Manipulation Language) - SQL queries on single and multiple tables	4	
	15	Nested queries (correlated and non-correlated), Aggregation and grouping, Views, assertions, Triggers, SQL data types.		
	16	Introduction to NoSQL Databases	2	
	17	Main characteristics of Key-value DB (examples from: Redis), Document DB (examples from: MongoDB)	2	
IV	**Transaction Processing, Concurrency Control**		**10**	**15**
	18	Transaction Processing: Introduction, Transaction and System Concepts	3	
	19	Desirable Properties of Transactions	1	
	20	Characterizing Schedules Based on Recoverability & Serializability	2	
	21	Transaction Support in SQL.	1	
	22	Introduction to Concurrency Control: Two-Phase Locking Techniques	3	
V	**DBMS LAB**		**30**	
	1	Students should decide on a case study and formulate the problem statement.	3	
	2	Based on Identified problem Statement, Design ER Diagram (Identifying entities, attributes, keys and relationships between	3	

		entities, cardinalities, generalization, specialization etc.) Note: Student is required to submit a document by drawing ER Diagram to the Lab teacher.		
	3	Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys) Note: Student is required to submit a document showing the database tables created from ER Model.	2	
	4	Normalization -To remove the redundancies and anomalies in the above relational tables, Normalize up to Third Normal Form	3	
	5	Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables	3	
	6	Practicing DML commands-Insert, Select, Update, Delete	2	
	7	Experiment 7: Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc.	2	
	8	Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi).	2	
	9	Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping.	4	
	10	Install and Configure MongoDB to execute NoSQL Commands.	6	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	-	-	-	-						
CO 2	2	2	1	-	-	-						
CO 3	-	-	2	3	-	-						
CO 4	-	-	-	3	3	-						
CO 5	-	-	-	3	3	-						
CO 6	2	-	-	-	2	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3		✓	✓	✓
CO 4		✓	✓	✓
CO 5	✓	✓		✓
CO 6		✓	✓	✓

References:

1. Database System Concepts (Sixth Edition) Avi Silberschatz, Henry F. Korth, S. Sudarshan McGraw-Hill 2011 ISBN 978-0071325226/ 0-07-352332-1.

2. Database Management Systems, Third Edition Raghu Ramakrishnan and Johannes Gehrke McGraw-Hill ©2003.

Programme	BSc AI				
Course Code	AIN4CJ205				
Course Title	Foundations of Artificial Intelligence and Machine learning				
Type of Course	Major				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamental Mathematics Concepts: Sets 2. Fundamentals of Python Programming				
Course Summary	This course introduces the ideas, techniques, and applications of artificial intelligence (AI) is given in this course. The fundamentals of knowledge representation, machine learning, and problem solving will be taught to the students.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Differentiate various knowledge representation methods, AI operations, Machine learning approaches and real-world applications.	U	C	Instructor-created exams / Quiz
CO2	Master Problem-Solving Techniques (search algorithms, heuristic approaches, and informed search strategies). Analyse and evaluate its efficiency.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Investigate the properties and applications of various machine learning techniques	Ap	C	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Evaluate Artificial Intelligence Search algorithms and Machine learning approaches' efficiency.	U	C	Instructor-created exams / Home Assignments
CO5	Implement and analyse Machine learning algorithms to solve practical problems.	Ap	P	Writing assignments/ Exams
CO6	Apply Concepts in Real-World Projects	Ap	P	Case Study/ mini Project
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks (70)
I	**Introduction to Artificial Intelligence & Problem Solving and Searching**		**15**	**20**
	1	Introduction to AI – AI problems, AI Techniques	2	
	2	Various AI Domains (Introduction only)	1	
	3	Problem Solving Techniques - Search Algorithms, Knowledge representation and reasoning, constraint satisfaction problems, Game playing, Machine learning, Simulated Annealing (Concepts only)	3	
	4	Uninformed search algorithms (breadth-first, depth-first)	3	
	5	Informed search algorithms (A*, heuristic search-Generate and Test, Hill Climbing, Best First Search)	6	
II	**Knowledge Representation & Reasoning**		**10**	**15**
	6	Knowledge representation using Propositional & Predicate Logic	3	
	7	Semantic Networks & Frames	3	
	8	Rule based system & Introduction to Expert System (Concepts only)	2	
	9	Reasoning- Forward Vs Backward reasoning & logics for non-monotonic Reasoning	2	
III	**Introduction to Neural Networks**		**8**	**15**
	10	Introduction to Artificial Neural Network	1	
	11	Understanding Brain & Perceptron Model	1	
	12	Single Layer Perceptron Model & Learning in Single layer Perceptron Model	2	
	13	Multi-Layer Perceptron Model & Learning in Multi-layer Perceptron Model	2	
	14	Introduction to python packages- keras & sklearn	2	
IV		**Machine Learning Fundamentals**	**12**	**20**
	15	Introduction to Machine learning- Applications of Machine Learning	1	
	16	Supervised Machine learning- Classification & regression algorithms (Introduction: Linear Regression, Decision tree)	2	
	17	Unsupervised Machine Learning-Clustering & Dimensionality Reduction (Introduction: K means Clustering, PCA)	2	
	18	Reinforcement Learning: Elements of Reinforcement Learning	2	
	19	Feature Engineering & Feature Selection	2	
	20	Building a classification model by training with data	1	
	21	Classification model evaluation- Introduction to	1	

		confusion matrix		
	22	Practical implementation to set up a machine learning model	1	
V	**Hands-on Artificial Intelligence & Machine Learning using Python: Practical Applications, Case Study and Course Project**		**30**	
	1	Implement the following: **1. Search algorithms** BFS DFS **2. Neural Network** Building a single layer perceptron using Keras **3. Multi-layer Neural Network** Setting up a multi-layer perceptron model **4. Supervised machine learning** Linear regression Decision tree **5. Unsupervised machine learning** K means clustering PCA **6. Feature Engineering** Feature selection from a dataset	20	
	2	Case study – AI tools / Use of AI in any movie	3	
	3	**Implementation of Comparison of any two machine learning algorithms on a dataset**	7	

References

- Elaine Rich, Kevin Knight, Shivsankar B Nair, "Artificial Intelligence", Third Edition, Tata McGraw Hill Publisher
- Tom M. Mitchell, Machine Learning, McGraw-Hill, 1st Ed.
- Ethem Alpaydin, Introduction to Machine Learning- 3rd Edition, PHI.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	1	1	1	2	1						
CO 2	3	1	2	3	2	2						
CO 3	3	1	2	3	2	3						
CO 4	3	-	1	2	-	-						
CO 5	3	-	2	3	3	3						

CO 6	3	-	3	3	3	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓	✓	✓
CO 6	✓	✓	✓	

Programme	BSc AI				
Course Code	AIN5CJ301				
Course Title	Python Programming				
Type of Course	Major				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge in Fundamentals of Programming				
Course Summary	This course explores the versatility of Python language in programming and teaches the application of various data structures using Python. The course also introduces fundamental concepts of object-oriented programming and insights into leveraging Python packages.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the basic concepts of Python programming language.	U	C	Instructor-created exams / Quiz
CO2	Apply problem-solving skills using the basic constructs in Python programming	Ap	P	Coding Assignments/ Code reading and review
CO3	Apply modular programming using functions in Python	Ap	P	Coding Assignments/ Code reading and review
CO4	Analyze the various data structures and operations on it using Python	An	C	Instructor-created exams / Case studies
CO5	Apply various packages available in Python	Ap	P	Coding Assignments/ Case studies
CO6	Apply visualization tools in Python	Ap	P	Coding Assignments/ Case studies
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs (45+30)	Marks
I	**Introduction to Python and Control Flow Statements**		**10**	**15**
	1	Tokens in Python	2	
	2	Operators Precedence & Associativity & Type Conversion	1	
	3	Built-in functions	1	
	4	Decision-making Structures	3	
	5	Looping Structures	3	
I	**Introduction to Functions & Modules**		**12**	**20**
I	6	Introduction to functions	2	
	7	Scope and lifetime of variables	1	
	8	Types of arguments	3	
	9	Types of functions – recursive, anonymous, returning more than onevalue	3	
	10	Introduction to Modules	1	
	11	User-defined modules and packages	2	
III			**12**	**20**
	12	Introduction to Strings and traversal	2	
	13	Slicing, splitting, and joining methods on Strings	1	
	14	Introduction to Lists and traversal	1	
	15	List methods	2	
	16	Introduction to Dictionaries and traversal	1	
	17	Dictionaries methods	2	
IV	**Introduction to Scientific Computing in Python**		**11**	**15**
	18	Basics of NumPy Arrays	2	
	19	Computation on NumPy Arrays	2	
	20	Basics of Pandas objects	3	
	21	Basics of Matplotlib	1	
	22	Plotting in Matplotlib	3	
V	**Hands-on Data Structures: Practical Applications, Case Study and Course Project**		**30**	
	1	**Introduction to Python** • Running instructions in Interactive interpreter and a PythonScript. • Generate output with print statements • Read input, including casting that input to the appropriate type • Perform calculations involving integers and floating point numbers using Python operators like +, -, *, /, //, %, and ** • Call functions residing in the math module	20	

	2	**If Statement** • Make a decision with an if statement • Select one of two alternatives with an if-else statement • Select from one of several alternatives by using an if-elif or if-elif-else statement Construct a complex condition for an if statement that includes theBoolean operators and, or and not		
	3	**Loops** • Iterate over a sequence using a for loop		
		• Use the range () function in a form loop • Create a while loop to repeat a block of code • Use the break and continue statement • Nested loops For loop with else clause • While loop with else clause		
	4	**Function** • Define a function for later use • Pass one or more values into a function • Perform a complex calculation within a function • Return one or more results from a function • Call a function that you have defined previously		
	5	**Strings** • Create a string • String Indexing • Looping through a String • String Slicing		
	6	**Lists** • Create a list • List Indexing • Looping through a list • Adding items to a list • Modifying items of a list • Removing elements • List Slicing		
	7	**Tuples** • Create a tuple • Tuple Indexing • Looping through a tuple • Adding items to a tuple • Tuple Slicing		
	8	**Dictionary** • Create a dictionary and access values with key • Adding a key-value pair • Adding to an empty dictionary • Modifying values in a dictionary • Removing key-value pair • Looping through a dictionary- Looping through all key-valuepairs, Looping through all the keys, Looping through all the values		

	9	**NumPy** • Create NumPy(1 D, 2D, and 3D) arrays from a sequence • Create NumPy Arrays using functions • Arithmetic Computations using Universal Functions • Broadcasting • Fancy Logic		
	10	**Pandas** • Create a data frame from a dictionary • Create an explicitly indexed series object from an array or list • Create Index objects of various types		
		• Perform set operations on Index objects		
	11	**Matplotlib** • Create and format a simple line plot • Create and format a simple scatter plot • Create and format a simple histogram • Create and format a contour plot		
	12	Case study	3	
	13	Capstone (/Course) Project: Build a practical application using any onepackage and implement the visualization tools	7	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	-	-	-	-						
CO2	1	-	2	-	1	-						
CO3	1	-	2	1	-	-						
CO4	1	-	1	-	-	-						
CO5	3	2	2	2	2	2						
CO6	3	2	2	-	2	2						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam

- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4		✓		✓
CO 5		✓		✓
CO 6			✓	

References:

1. Jose, Jeeva. Taming Python by Programming. Khanna Book Publishing, 2017. Print.

2. S, Gowrishankar, and A, Veena. Introduction to Python Programming. Chapman & Hall/CRC Press, 2018.

3. Downey, Allen. Think Python. Green Tea Press, 2nd ed. 2009

4. VanderPlas, Jake. Python Data Science Handbook: Essential Tools for Working with Data. United States, O'Reilly Media, 2016.

5. Stephenson, Ben. The Python Workbook. SPRINGER INTERNATIONAL PU, 2016

.

Programme	BSc AI				
Course Code	AIN5CJ302				
Course Title	Operating System				
Type of Course	**Major**				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge in Basic System Architecture				
Course Summary	This course provides students with a comprehensive understanding of the fundamental principles, design concepts, and practical implementation aspects of operating systems. The course covers key topics such as Process Management, CPU Scheduling, Memory Management and Linux Shell Programming concepts.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Summarize the History, Objectives and Functions of an operating system	U	C	Instructor-created exams / Quiz
CO2	Understand process management concepts: Process Control Block, States, Scheduling, Operations, Inter process Communication	U	C	Instructor-created exams
CO3	Evaluate various processor scheduling strategies, algorithms	E	P	Seminar Presentation / Group Tutorial Work
CO4	Apply process synchronisation concepts for effective process management	Ap	P	Viva Voce
CO5	Analyse conditions for deadlock occurrence and methods of resolving.	An	C	Instructor-created exams/Assignments
CO6	Describe various memory management techniques, including paging , segmentation and virtual memory	U	C	Instructor-created exams / Home Assignments

CO7	Develop Shell Scripts using Linux	C	P	Practical Assignment / Observation of Practical Skills

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks (70)
I	**Introduction to Operating Systems & Process Management**		**10**	**15**
	1	Operating System: History, Types, Objectives and Functions	2	
	2	Process Concepts: Process States, Process Control Block	2	
	3	Types of Process Schedulers and Operations on Process	2	
	4	Co operating Processes	2	
	5	Inter Process Communication	2	
II	**CPU Scheduling, Process Synchronisation and Deadlocks**		**15**	**20**
	6	Basic Scheduling Concepts, Scheduling Criteria	1	
	7	CPU Scheduling Algorithms	2	
	8	Process Synchronisation: Critical Section	2	
	9	Semaphores	2	
	10	Classical Problems of Synchronisation: Reader Writer, Dining Philosopher	2	
	11	Introduction to Deadlock: Necessary Conditions, Resource Allocation Graph	2	
	12	Handling Deadlocks: Prevention, Avoidance, Detection & Recovery	4	
III	**Memory Management Techniques**		**10**	**20**
	13	Basic Concepts: Physical VS Logical Address, Continuous Memory Allocation	2	
	14	Fragmentation Problem and Solutions	1	
	15	Non contiguous Memory Allocation: Paging	2	

	16	Non contiguous Memory Allocation: Segmentation, Segmentation with Paging	2	
	17	Virtual Memory Concepts: Demand Paging and Page Replacement Algorithms, Thrashing	3	
IV	**Linux Shell Programming**		**10**	**15**
	18	Introduction: Types of Linux Shells, File Directory & File Management Commands:ls, cd,pwd,mkdir,rm,cp,mv, chmod,touch Input/Output Commands: read, echo, Text Processing Commands: grep , cat	2	
	19	Piping and Redirection operators: |,>,<,>>,<< Arithmetic, Logical and Relational Operator	2	
	20	Iterative and Conditional Commands : if, while, for, break, continue, case	2	
	21	Arrays and functions	2	
	22	Command line arguments, Network commands: ipconfig, ping, date and time commands, Informative commands: random, w, ps, free, uptime	2	
V	**Practical Applications using Linux Shell Programming**		**30**	
		Implement the following: 1. Write a Shell Script to find the roots of a quadratic equation. 2. Write a shell script for a menu driven program to perform file management (File creation, display content, remove, write content to a file). 3. Write a shell script to count no of line, words and characters of an input file. 4. Write a shell script to find the average of the number entered as command line arguments. 5. Write a shell script to copy the contents of file to another. Input file names through command line. The copy should not be allowed if second file exists. 6. Write a shell script to check network connectivity. 7. Write a shell script that analyzes a log file, extracting and summarizing relevant information such as error counts ,warning messages, info and debug messages using grep command. 8. Write a shell script to display current date and time, list all user account names, count of logged in user accounts, list all logged in user accounts with login time.	30	

		9. Write a simple game script using random function to implement number guessing game. 10. Write a shell script to display your system details (number of users, current processes, memory usage , system running time). 11. Write a shell script to implement and examine the effectiveness of the First Come First Serve CPU Scheduling algorithm. Find the average waiting time and turnaround time. 12. Write a shell script program to implement Inter Process Communication.		

References

1. Silberschatz, Galvin and Gagne, Operating System Concepts, John Willey & Sons
2. William Stallings, Operating Systems, Internals and Design Principles, PHI

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	1	-	-	-	-						
CO 2	-	2	-	-	-	-						
CO 3	-	3	-	1	-	-						
CO 4	-	2	2	-	-	-						
CO 5	-	3	-	-	-	-						
CO 6	-	3	-	-	-	-						
CO7	-	-	2	2	-	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4		✓		✓
CO 5	✓			✓
CO 6	✓			✓
CO7			✓	

Programme	BSc AI				
Course Code	AIN5CJ303				
Course Title	Expert Systems and Fuzzy Logic				
Type of Course	Major				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Familiarity with basic logic and set theories. 2. Understanding the fundamentals of computer science, such as algorithms and data structures, can be beneficial for the implementation aspects of expert systems. 3. A basic understanding of probability and statistics is often required.				
Course Summary	The Fuzzy logic and expert systems course introduce two interconnected fields in artificial intelligence: fuzzy logic and expert systems. Fuzzy logic deals with reasoning under uncertainty and imprecision, while expert systems involve the development of computer-based systems that emulate human expertise in specific domains.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Explain the fundamental concepts of fuzzy set theory and interpret membership functions and linguistic variables.	U	F	Instructor-created exams / Quiz
CO2	Design and implement fuzzy controllers for decision-making. Develop fuzzy inference systems (FIS) for various applications and apply fuzzy clustering techniques for pattern recognition.	U	C	Practical Assignment / Observation of Practical Skills
CO3	Describe the role of expert systems in artificial intelligence and Understand knowledge representation techniques in expert systems.	Ap	P	Practical Assignment / Observation of Practical Skills

CO4	Explain the functioning of inference engines in rule-based systems.	Ap	P	Practical Assignment / Observation of Practical Skills
CO5	Acquire domain knowledge for expert system development.	An	C	Instructor- created exams / Quiz
CO6	Construct a knowledge base and define rules for an expert system and implement validation and refinement techniques for expert systems.	Ap	P	Practical Assignment / Observation of Practical Skills

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Mark
I	**Introduction to Fuzzy Logic**		**8**	**10**
	1	Overview of Fuzzy Logic	1	
	2	Fuzzy Sets and Membership Functions	2	
	3	Fuzzy Operations (Union, Intersection, Complement)	2	
	4	Basic principles of fuzzy logic. Fuzzification and defuzzification.	2	
	5	Linguistic variables and terms.	1	
II	**Fuzzy Inference Systems (FIS) and Fuzzy Logic Applications**		**12**	**20**
	6	Mamdani FIS-Rule-based systems in fuzzy logic, Rule base and implication methods.	2	
	7	Sugeno FIS-Structure and operation of Sugeno FIS.	2	
	8	Basic structure of fuzzy logic controllers (FLCs)	3	
	9	Rule-based systems and fuzzy inference	3	
	10	Applications of fuzzy logic controllers	2	
III	**oduction to Expert Systems and Rule-Based Systems**		**12**	**20**
	11	Definition and characteristics of expert systems.	2	
	12	Knowledge representation and reasoning.	3	
	13	Expert system components: knowledge base, inference engine, user interface. Examples and applications of expert systems	3	
	14	Rule-based systems and production rules, Forward and backward chaining.	2	
	15	Inference mechanisms in expert systems, Examples of rule-based expert systems.	2	
IV	**Introduction to SCILAB/MATLAB**		**16**	**20**

	Programming			
	16	SCILAB/MATLAB environment and basic navigation, Variables, data types, and basic operations, Script files and running SCILAB/MATLAB code. Introduction to functions and function files.	3	
	17	Introduction to functions and function files, Conditional statements (if, else, elseif), Loop structures (for, while).	2	
	18	Logical operators and relational expressions, Vectorized operations and element-wise operations.	2	
	19	Introduction to arrays, matrices, and vectors, Cell arrays and structures, Indexing and slicing in SCILAB/MATLAB,	2	
	20	Basic file input/output operations Data visualization using plotting functions.	2	
	21	Statistical analysis and plotting techniques, Fuzzy logic toolbox in SCILAB/MATLAB.	2	
	22	Expert system development tools in SCILAB/MATLAB, Building expert systems using SCILAB/MATLAB.	3	
V	**Open end**		**12**	
		Case Studies: Real-world applications and their impact. Technological Challenges: Addressing the limitations and exploring new solutions. Future Prospects: Predictions and potential advancements in the field.		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	3	-	-	-	1						
CO 2	1	3	-	-	1	-						
CO 3	1	3	-	-	2	2						
CO 4	1	3	-	-	2	2						
CO 5	2	1	3	1	1	-						

CO 6	2	1	3	2	2	1						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4		✓	✓	✓
CO 5		✓	✓	✓
CO 6	✓	✓	✓	✓

References:

1. "Fuzzy Logic with Engineering Applications" by Timothy J. Ross
2. "Expert Systems: Principles and Programming" by Joseph C. Giarratano and Gary D. Riley
3. "Fuzzy Sets and Fuzzy Logic: Theory and Applications" by George J. Klir and Bo Yuan
4. "Expert Systems: Principles and Case Studies" by Efraim Turban, Jay E. Aronson, and Ting-Peng Liang
5. “Introduction to Fuzzy Logic using MATLAB” by S.N. Sivanandam, S. Sumathi, and S. N. Deepa.
6. Nagar, S. (2017). Introduction to Scilab: For Engineers and Scientists. Apress.

Programme	BSc AI				
Course Code	AIN6CJ304/ AIN8MN304				
Course Title	Automation and Robotics				
Type of Course	Major/Minor				
Semester	VI				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	No pre-requisites required				
Course Summary	This course provides a comprehensive overview of automation which includes their production systems, elements, automation functions and usage of discrete and continuous control system. The course also explores the fundamentals of robotics, including anatomy, process control and how these functions could be improved by the integration of Artificial Intelligence.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the production systems and automation, enabling them to analyse, optimize and evaluate the different levels of automation.	U	C	Instructor- created exams / Quiz/Assignment/ Seminar
CO2	Able to recognize the difference between the process industries, manufacturing industries, continuous and discrete control system.	U	C	Instructor- created exams/ Quiz/Assignment/ Seminar
CO3	Proficiency in understanding the various forms of process control which includes the direct digital control, programmable logic control, distributable control systems etc.	U	C	Instructor- created exams/ Quiz/Assignment/ Seminar
CO4	Familiarize with the various hardware components used for automation and process control such as sensors, actuators analog-digital converters etc.	U	C	Instructor- created exams/ Quiz/Assignment/ Seminar
CO5	Understand the present developments in the field of automation and robotics and how integrating artificial intelligence can contribute to the future of these systems.	U	C	Instructor- created exams/ Quiz/Assignment/ Seminar

CO 6	Represent various problems using algorithmic approaches and enhance problem-solving skills by visualizing solutions through the utilization of software tools.	U, Ap	C, P	Practical Assignment / Observation of Practical Skills
* - Remember (R), Understand (U), Apply (Ap), Analyze (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

tailed Syllabus:

Module	Unit	Contents	Hrs (45+30)	Mark
I		**Introduction to Automation**	**11**	**15**
	1	Production systems - Facilities, Manufacturing support systems	2	
	2	Automation in production systems – Automated manufacturing system, Computerized manufacturing support systems, Reasons for automating	3	
	3	Manual labour in production systems	1	
	4	Elements of automation - power to accomplish the process, Program of instructions, control system	3	
	5	Advanced automation functions – safety monitoring, maintenance and repair diagnostics, error detection and recovery	1	
	6	Levels of automation	1	
II		**Control Systems**	**13**	**15**
	7	Process industries versus Discrete manufacturing industries, Continuous versus Discrete control	1	
	8	Continuous control system	3	
	9	Discrete control system	1	
	10	Computer process control, Control requirements, Capabilities of computer control	2	
	11	Forms of computer process control - Computer process monitoring, Direct digital control, Computer numerical control and robotics, Programmable logic controllers, Supervisory control and data acquisition, Distributed control systems	3	

	12	Hardware for automation and process control (Concept only) - Sensors, Actuators, Analog to Digital converters Digital to Analog converters, Input/output devices for discrete data.	3	
III	**Industrial Robotics**		**15**	**25**
	13	Robot anatomy – Joints and links, Common robot configurations, Joint drive systems, Sensors in robotics	4	
	14	Robot control systems – Limited sequence control, Playback with point-to-point control, Playback with continuous path control, Intelligent control	2	
	15	End effectors – Grippers, Tools	1	
	16	Robot Programming – Lead through programming, Powered lead through, Motion programming, Advantages and disadvantages	2	
	17	Discrete process control – logic control, sequence control	4	
	18	Programmable Logic Controllers, Components of PLC	2	
IV	**Automation and Robotics: Present and Future**		**6**	**15**
	19	Machine Intelligence, Computer and Robotics	1	
	20	Flexible automation vs Robotics technology	1	
	21	Artificial Intelligence and Automated Manufacturing, AI and Robotics	2	
	22	Robotics in India, Future of Robotics	2	
V	**Lab Activities**		**30**	
	1	Set up a simulation of a production system using any software tools.	28	
	2	Utilise online simulation tools and platforms that allow students to simulate robot control.		
	3	Utilise online simulation tools and platforms that allow students to simulate automation systems.		
	4	Assign online projects or challenges that require participants to design, program, or simulate automation systems and robotic applications.		
	5	Explore any online virtual reality (VR) applications that simulate manufacturing environments, robotic operations, and automation scenarios.		
	6	Analyze publicly available datasets on platforms like Kaggle, UCI Machine Learning Repository, or Data.gov.		

	7	Experiment with virtual robotics simulations using platforms like V-REP (Virtual Robot Experimentation Platform) or Gazebo.		
	8	Designing and building a simple chatbot using no-code platforms like ChatGPT or Google's Dialogflow.		
	9	Allow students to customize their chatbots by defining conversational flows.		
	10	Provide Programmable Logic Controllers (PLCs) and challenge them to program various control sequences.		
	11	Host a discussion session on the intersection of Artificial Intelligence (AI) and Robotics in automated manufacturing.	2	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	2	-	-	2	-						
CO 3	2	2	-	-	2	-						
CO 4	2	2	-	-	2	-						
CO 5	1	-	-	-	-	1						
CO 6	-	-	2	2	-	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓	✓	✓

References:

1. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 4th edition, Pearson Education, 2017.

2. S.R. Deb, S. Deb " Robotics Technology and flexible automation," Tata McGraw-Hill Education, 2017.

3. Mikell P. Groover, ""Industrial Robots - Technology, Programming and Applications", McGraw-Hill Education, 2017.

Programme	BSc AI				
Course Code	AIN6CJ305/ AIN8MN305				
Course Title	Fundamentals of Data Science				
Type of Course	**Major/Minor**				
Semester	VI				
Academic Level	300-399.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge in fundamental understanding of Fundamentals of Programming Languages and mathematical foundation.				
Course Summary	This course equips students with essential data analytics skills using Excel, enabling them to effectively analyse, visualize, and interpret data for informed decision-making in various business contexts. By covering theoretical concepts alongside practical applications, learners gain a comprehensive understanding of data analytics fundamentals and Excel proficiency.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Proficiency in Excel Basics and Data Handling	U	C	Instructor-created exams / Quiz
CO2	Data Visualization Skills	U	C	Instructor-created exams
CO3	Understanding of Data Analytical Techniques	U	P	Seminar Presentation / Group Tutorial Work
CO4	Data Cleaning and Formatting Proficiency	Ap	P	Viva Voce
CO5	Advanced Excel Operations and Analysis	An	C	Instructor-created exams/Assignments
CO6	Application of Data Analytics in Practical Scenarios	U	C	Instructor-created exams / Home Assignments
CO7	Effective Report Generation and Presentation Skills	C	P	Practical Assignment / Observation of Practical Skills

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks (70)
I	**INTRODUCTION TO DATA ANALYTICS & EXCEL**		**10**	**15**
	1	Application of data modelling in business.	2	
	2	Databases and types of Data variables.	2	
	3	Data analytical techniques, Need of Data Analytics.	2	
	4	Introduction to Excel, Understanding Worksheet Basics.	2	
	5	Perform Functions with Shortcut Keys, Formulas and Functions.	2	
II	**DATA VISUALIZATION**		**15**	**20**
	6	Introduction to Data visualization.	1	
	7	Chart types – Gantt & Milestone Chart.	2	
	8	Smart art & Organization chart.	2	
	9	Get creative with Icons.	2	
	10	3D models.	2	
	11	Digital Inking.	2	
	12	Putting Data in perspective with Pivots.	4	
III	**DATA-DRIVEN TECHNIQUES**		**10**	**20**
	13	Summarize Marketing Data: Slicing and Dicing Marketing Data with PivotTables.	2	
	14	Using Excel Charts to Summarize Marketing Data - Using Excel Functions to Summarize Marketing Data.	1	
	15	Simple Linear Regression and Correlation.	2	
	16	Using Multiple Regression to Forecast Sales.	2	
	17	Copernican Principle to Predict Duration of Future Sales Viral Marketing, Text Mining.	3	
IV	**FORECASTING IN EXCEL**		**10**	**15**
	23	Forecast Sheet, One-click forecasting.	2	
	24	Create Forecast Worksheet.	2	
	25	Customize Forecast using Options.	2	

	26	FORECAST Functions, FORECAST.ETS, FORECAST.ETS.CONFINT, FORECAST.ETS.STAT	2	
	27	What-if Analysis Tools, Scenario Manager, Goal Seek, Data Table, Solver Add-In.	2	
V	**Practical Applications using Excel**		**30**	
		Implement the following: 1. Getting Started with Excel: Creation of spread sheets, Insertion of rows and columns, Drag & Fill, use of Aggregate functions. 2. Working with Data : Importing data, Data Entry & Manipulation, Sorting & Filtering. 3. Working with Data: Data Validation, Pivot Tables & Pivot Charts. 4. Data Analysis Process: Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs. 5. Cleaning Data with Text Functions: use of UPPER and LOWER, TRIM function, Concatenate. 6. Cleaning Data Containing Date and Time Values: use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions. 7. Conditional Formatting: formatting, parsing, and highlighting data in spreadsheets during data analysis. 8. Working with Multiple Sheets: work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports. 9. Create worksheet with following fields: Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent	30	

		Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data. 10. Create worksheet on Inventory Management: Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data. Template for Practical Course and if AEC is a practical Course Annexure-V 11. Create worksheet on Sales analysis of Merchandise Store: data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts. 12. Generation of report & presentation using Autofilter &macro.		

References

1. Manisha Nigam, "Advanced Analytics with Excel 2019", BPB 2019. REFERENCE BOOKS
2. Wanyne. L. Winston, 2014 "Market Analytics Data Driven Technique with Microsoft Excel"
3. David Whigham, 2019, "Business Data Analysis Using Excel", Oxford Publications.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	-	-	-						
CO 2	-	2	-	-	-	-						
CO 3	-	3	-	1	-	-						
CO 4	-	2	2	-	-	-						

CO 5	-	3	-	-	-	-						
CO 6	-	3	-	-	-	-						
CO7	-	-	2	2	-	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4		✓		✓
CO 5	✓			✓
CO 6	✓			✓
CO7			✓	

Programme	BSc AI				
Course Code	AIN6CJ306/ AIN8MN306				
Course Title	Machine Learning Algorithms				
Type of Course	**Major/Minor**				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Understanding of basic mathematics and statistics (linear algebra, calculus, probability)				
Course Summary	This course introduces the fundamental concepts, algorithms, and applications of machine learning				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand basic concepts of machine learning, including supervised learning, unsupervised learning, and reinforcement learning	U	C	Instructor-created exams / Quiz
CO2	Understand the mathematical foundations of machine learning algorithms, including concepts such as optimization, linear algebra, probability, and statistics	U	C	Assignment / Seminar presentations/ Exams
CO3	Demonstrate proficiency in various machine learning algorithms, such as linear regression, logistic regression, decision trees, support vector machines, k-nearest neighbours, clustering algorithms, and neural network	U	P	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Explore techniques for feature engineering and feature selection to improve the performance of machine learning models.	U	P	Instructor-created exams / Home Assignments
CO5	Evaluate machine learning models using appropriate metrics and techniques, including cross-validation, precision, recall, F1 score, ROC curves, and confusion matrices.	Ap	P	Writing assignments/ Exams/ Seminar Presentations
CO6	Develop critical thinking skills to analyse and solve complex problems using machine learning approaches.	Ap	P	Case Study/ Group discussions/

				Presentations

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (48+12)	Marks (70)
I	**Mathematical Foundation for Machine learning**		**14**	**20**
	1	Introduction to key concepts: features, labels, training, and testing	2	
	2	Designing a Learning system	1	
	3	Types of learning; supervised, unsupervised and reinforcement	2	
	4	Introduction to linear algebra- Vector :-Vector operations: addition, subtraction, scalar multiplication	2	
	5	Matrices- Matrix operations	2	
	6	Eigenvalues and Eigenvectors	2	
	7	Foundations of Probability for ML:- Introduction to probability	1	
	8	Random Variable, Probability distributions (Normal and gaussian- basics only), Naïve bayes	2	
II	**Feature Engineering and Preprocessing**		**12**	**15**
	9	Data Preprocessing and Feature Engineering: Data Representation, Data Preprocessing	2	
	10	Features and Types	3	
	11	Dimensionality Reduction – Feature Identification	2	
	12	Feature selection	2	
	13	Feature extraction - Feature Importance	3	
III	**Regression and Classification**		**12**	**20**
	14	Regression: Linear Regression – Non-Linear regression	2	
	15	Evaluation metrics for regression	1	
	16	Classification: Binary, multi-class, and multi-label classification	1	
	17	lazy leaners- (KNN) - tree-based techniques (Decision Tree)- kernel based techniques (SVM) - probabilistic techniques (Naïve bayes)- and ensembled techniques (bagging, boosting, voting)	7	
	18	Evaluation metrics for classification.	1	
IV	**Clustering and Rule Mining**		**10**	**15**
	19	Clustering: Partitioning based (K Means)	2	
	20	Hierarchical based (Divisive)	2	
	21	Rule mining: Apriori algorithm, FB Growth - association rules.	4	
	22	Outlier Detection - LOF	2	
V	**Open Ended Module**		**12**	

	1	Ethical considerations in machine learning	3	
	2	McCulloch-Pitts neurons, Hebb's networks	3	
	3	Hopfield networks, Boltzmann machines	2	
	4	Reinforcement Learning: Markov Decision Processes (MDPs), Q-learning.	4	

References

- Ethem Alpaydin, Introduction to Machine Learning- 3rd Edition, PHI
- Machine Learning by Mitchell, Tom M. (Tom Michael), McGraw-Hill
- Mathematics For Machine Learning, Marc Peter Deisenroth A. Aldo Faisal Cheng Soon Ong
- "Pattern Recognition and Machine Learning" by Christopher M. Bishop.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	-	-	1	-						
CO 2	3	-	-	-	1	-						
CO 3	1	3	1	1	2	3						
CO 4	1	-	1	1	2	3						
CO 5	1	-	-	-	2	3						
CO 6	1	2	2	2	3	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4	✓	✓	✓
CO 5	✓	✓	✓
CO 6		✓	

Programme	BSc AI				
Course Code	AIN7CJ401				
Course Title	Natural Language Processing				
Type of Course	**Major**				
Semester	VII				
Academic Level	400-499.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge in statistics, probability, AI and neural networks				
Course Summary	This course provides students with a comprehensive understanding of the natural language processing, design concepts, and practical implementation aspects of NLP using python.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Application of NLP techniques and key issues	U	C	Instructor-created exams / Quiz
CO2	Different analysis levels used for NLP	U	C	Instructor-created exams
CO3	Feature extraction from texts, feature engineering	E	P	Seminar Presentation / Group Tutorial Work
CO4	Developing text classifier	Ap	P	Viva Voce
CO5	Evaluating performance of model.	An	C	Instructor-created exams/Assignments
CO6	Building pipelines for NLP	U	C	Instructor-created exams / Home Assignments
CO7	Develop NLP techniques using python libraries	C	P	Practical Assignment / Observation of Practical Skills
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks (70)
I	**Introduction to Natural Language Processing (NLP)**		**10**	**15**
	1	Application of NLP techniques and key issues	2	
	2	MT grammar checkers- dictation – document generation	2	
	3	The different analysis level used for NLP: phonology, morphology, lexicon, syntactic, semantic, speech, and pragmatic	4	
	4	Recursive and augmented transition networks	2	
II	**Basic Feature Extraction Methods**		**13**	**20**
	5	Cleaning Text Data-Tokenization	2	
	6	Feature Extraction from Texts, Feature Engineering.	2	
	7	Developing a Text Classifier: Removing Correlated Features	2	
	8	Dimensionality Reduction	2	
	9	Evaluating the Performance of a Model	2	
	10	Building Pipelines for NLP Projects.	3	
III	**Language processing using python**		**11**	**20**
	11	Language Processing and Python introduction	1	
	12	Computing with Language, Lists, Simple Statistics	2	
	13	Making Decisions and Taking Control	2	
	14	automatic Language Understanding, Limitations of NLP	2	
	15	Natural Language Understanding, Language Challenge	2	
	16	Propositional Logic, First Order Logic,	2	
IV	**Natural Language Processing for Chatbots**		**11**	**15**
	17	Natural Language Processing for Chatbots-spaCy	2	
	18	Features of Spacy, SpaCy Models	2	
	19	Fundamental Methods of NLP for Building Chatbots,	3	
	2	Dependency Parsing, Named Entity Recognition	2	
	22	Regular Expressions	2	
V	**Practical Applications using NLP programming using python**		**30**	
		Implement the following: 1. Preprocessing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming) 2. Morphological Analysis 3. N-gram model 4. POS tagging	30	

		5. Chunking 6. Named Entity Recognition 7. Virtual Lab on Word Generator and Word Analysis 8. Morphology 9. N-Grams 10. N-Grams Smoothing 11. Building POS Tagger 12. Building Chunker		

References

Sohom Ghosh, Dwight Gunning," Natural Language Processing Fundamentals", Packt Publishing.

2. Steven Bird, Ewan Klein, Edward Lopper, "Natural Language Processing with Python", O'Reilly, First Edition.

3. Sumit Raj, "Building Chatbots with Python Using Natural Language Processing and Machine Learning", Apress

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	-	-	-						
CO 2	2	-	-	-	-	-						
CO 3	-	-	2	-	-	-						
CO 4	-	-	3	2	3	-						
CO 5	-	-	-	2	-	-						
CO 6	2	-	-	-	-	-						
CO7	-	-	2	2	3	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4		✓		✓
CO 5	✓			✓
CO 6	✓			✓
CO7			✓	

Programme	BSc AI				
Course Code	AIN7CJ402				
Course Title	Knowledge Engineering				
Type of Course	**Major**				
Semester	VII				
Academic Level	400 -499.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Understanding of basic mathematics and statistics 2. Basic understanding of computer science concepts				
Course Summary	This course introduces students to the principles, techniques, and tools used in Knowledge Engineering. It covers the design and development of knowledge-based systems, including knowledge representation, reasoning, and acquisition.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand basics of Knowledge Engineering	U	C	Instructor-created exams / Quiz
CO2	Apply methodologies and modelling for agent design and development	Ap	P	Assignment / Seminar presentations/ Exams
CO3	Design and develop ontologies	Ap	P	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Apply reasoning with ontologies and rules	Ap	P	Instructor-created exams / Home Assignments
CO5	Understand learning and rule learning	U	C	Writing assignments/ Exams/ Seminar Presentations
CO6	Develop theoretical knowledge to design a knowledge based system	Ap	P	Case Study/ Group discussions/ Presentations

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (48+12)	Marks (70)
I	**Reasoning under uncertainity**		**15**	**15**
	1	Understanding the World through Evidence-based Reasoning: - Evidence, Data, and Information, Evidence and Fact, Evidence and Knowledge	2	
	2	Abductive Reasoning	1	
	3	Probabilistic Reasoning: - Enumerative Probabilities: Obtained by Counting, Subjective Bayesian View of Probability	2	
	4	Belief Functions	1	
	5	Baconian Probability, Fuzzy Probability	3	
	6	Evidence-based Reasoning	2	
	7	Artificial Intelligence: - Intelligent Agents, Mixed-Initiative Reasoning	2	
	8	Knowledge Engineering: - An Ontology of Problem-Solving Tasks, Building Knowledge-based Agents	2	
II	**Methodologies and Tools for Agent Design and Development ,Modelling the Problem-Solving Process**		**12**	**20**
	9	A Conventional Design and Development Scenario	2	
	10	Development Tools and Reusable Ontologies	2	
	11	Agent Design and Development Using Learning Technology	2	
	12	Problem Solving through Analysis and Synthesis	1	
	13	Inquiry-driven Analysis and Synthesis for Evidence-based Reasoning	2	
	14	Evidence-based Assessment, Believability Assessment	3	
III	**Ontologies**		**11**	**20**
	15	What Is an Ontology? Concepts and Instances, Generalization Hierarchies	2	
	16	Object Features, Defining Features, Defining Features, Representation of N-ary Features	2	
	17	Transitivity, Inheritance, Ontology Matching	3	
	18	Ontology Design and Development Methodology- Steps in Ontology Development, Domain Understanding and Concept Elicitation, Modeling-based Ontology Specification	4	
IV	**Reasoning with Ontologies and Rules**		**10**	**15**
	19	Production System Architecture	1	
	20	Complex Ontology-based Concepts	1	
	21	Reduction and Synthesis Rules and the Inference Engine, Evidence-based Hypotheses Analysis, Rule for Ontology Matching	4	
	22	Partially Learned Knowledge, Reasoning with Partially Learned Knowledge	4	

V	**Open Ended Module- Learning for Knowledge-based Agents**		**12**	
	1	Generalization and Specialization Rules	4	
	2	Types of Generalizations and Specializations	4	
	3	Analogy-based Generalization	4	

References

- “Knowledge Engineering”, Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum
- "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
- "Knowledge Representation and Reasoning" by Ronald J. Brachman and Hector J. Levesque

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	-	-	1	1						
CO 2	3	-	-	-	1	1						
CO 3	1	3	1	1	2	3						
CO 4	1	-	1	1	2	3						
CO 5	1	-	-	-	2	3						
CO 6	1	2	1	1	3	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4	✓	✓	✓
CO 5	✓	✓	✓
CO 6	✓	✓	

Programme	BSc AI				
Course Code	AIN7CJ403				
Course Title	SOFT COMPUTING				
Type of Course	**Major**				
Semester	VII				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Fundamental Mathematics Concepts: Set, Functions, Logic 2. Fundamentals of Programming				
Course Summary	This course explores implementations of linked list and array-based data structures, delving into the inner workings of basic data structures including lists, stacks, queues, trees, and graphs.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the foundational principles of soft computing and the historical factors influencing its development.	U	C	Instructor-created exams / Quiz
CO2	Analyse the properties of Fuzzy sets and Fuzzy relations	Ap, U	P	Assignment/ Seminar
CO3	Apply fuzzy logic concepts to solve real-world problems, showcasing proficiency in designing and implementing fuzzy systems.	Ap, U	C	Seminar Presentation / Quiz
CO4	Master the concepts of Genetic algorithms and their operations	U	C	Practical Assignment / Seminar
CO5	Design and implement solutions using fuzzy logic, neural networks, and genetic algorithms for diverse applications.	Ap	P	Practical Assignment/ Seminar
CO6	Evaluate and present real-world scenarios where soft computing techniques can be effectively applied	Ap	P	Case study/ Project

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (48+12)	Marks (70)
I	**Introduction to Soft Computing**		**7**	**15**
	1	Overview of Soft computing, Hard Computing, and Hybrid Computing	2	
	2	Areas and Applications of Soft Computing	1	
	3	Basic Tools of Soft Computing- Fuzzy Logic, Neural Networks and Evolutionary computing	2	
	4	Introduction to Fuzzy logic, Neural Networks, Genetic Algorithm, and Hybrid systems (Concepts only)	2	
II	**Introduction to Fuzzy Logic**		**14**	**20**
	6	Introduction to Fuzzy Logic	2	
	7	Fuzzy sets and crisp sets	2	
	8	Fuzzy relations and Crisp relations	2	
	9	Tolerance and Equivalence Relations	2	
	10	Fuzzy membership functions	3	
	11	Fuzzification and Defuzzification	3	
III	**Advanced Fuzzy Logic**		**14**	**20**
	12	Fuzzy Rules and Fuzzy Reasoning	3	
	13	Fuzzy Inference Systems- Mamdani and Sugeno models	4	
	14	Fuzzy Control Systems	3	
	15	Fuzzy Clustering (Concepts only)	2	
	16	Fuzzy Neural Networks (Concepts only)	2	
IV	**Genetic Algorithm**		**13**	**15**
	17	Introduction to Genetic Algorithm	2	
	18	Operators in genetic algorithm - coding - selection - cross over – mutation,	2	
	19	Stopping condition for genetic algorithm flow.	2	
	20	Constraints in Genetic Algorithm	2	
	21	Classification of Genetic Algorithm	3	
	22	Genetic Programming (Concepts)	2	
V	**Open Ended Module**		**12**	
		• Understand the different optimization techniques used. • Explore the real-life applications of soft computing techniques • Discuss hybrid soft computing techniques		

REFERENCES

1. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd
2. D.K. Pratihar, “Soft Computing: Fundamentals and Applications”, Alpha Science International Ltd

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	-	1	1						
CO 2	2	-	-	1	1	1						
CO 3	2	-	-	2	2	1						
CO 4	2	-	-	1	1	1						
CO 5	1	-	2	3	2	3						
CO 6	1	-	3	3	2	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5		✓		✓
CO 6			✓	

Programme	BSc AI				
Course Code	AIN7CJ404				
Course Title	Introduction to Generative Models				
Type of Course	**Major**				
Semester	VII				
Academic Level	400-499.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic understanding of AI				
Course Summary	This course provides a comprehensive introduction to the fundamentals of Generative Models.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand Basics of Generative models.	U	C	Instructor-created exams / Quiz
CO2	Study of tools And practical implementation of models.	Ap	P	Instructor-created exams/ Home Assignments
CO3	Understand the operations of different generative models	U	C	Instructor-created exams
CO4	Learn different applications of Generative models.	U	C	Instructor-created exams
CO5	Understand the future scope and limitations of Generative models.	E	C	Instructor-created exams
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (48+12)	Marks (70)
I	**Introduction to Generative Models**		**12**	**18**

	1	Introduction to Generative Models	3	
	2	Definition and importance of generative models	3	
	3	Applications and use cases	3	
	4	Challenges and Limitations.	3	
II	**Practical Implementation and Tools**		**12**	**18**
	1	Introduction to deep learning frameworks (e.g., Tensor Flow, PyTorch)	3	
	2	Hands-on exercises and coding tutorials	3	
	3	Best practices for training and fine-tuning generative models	2	
	4	Evaluation Metrics for Generative Models Quantitative and qualitative evaluation measures Commonly used metrics such as Inception Score, Frechet Inception Distance, etc.	4	
III	**Generative Models**		**12**	**18**
	1	Generative Adversarial Networks (GANs)	3	
	2	Variational Autoencoders (VAEs)	3	
	3	Autoregressive Models	3	
	4	Other Generative Models	3	
IV	**Applications of Generative Models**		**12**	**16**
	1	Climate Science	3	
	2	Accelerated Materials Discovery and Molecule Design	3	
	3	Engineering Design	3	
	4	Introduction to Creativity, Applications in Music and Visual Art	3	
V	**Open Ended Module- Future Directions and Challenges**		**12**	
	1	Recent advancements in generative modeling		
	2	Ethical considerations and societal impacts		
	3	Open research problems and opportunities for innovation		

References:

1. **Sections of I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, MIT Press, 2016.**

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	-	-	-	-	-						

CO 2	-	-	2	3	-	-						
CO 3	3	-	-	-	-	-						
CO 4	2	-	-	--	-	-						
CO 5	2	-	-	-	-	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓

Programme	BSc AI				
Course Code	AIN7CJ405				
Course Title	Data Science Programming using R				
Type of Course	Major				
Semester	VII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1.Basic knowledge about Data Science 2. Basic knowledge about Programming languages				
Course Summary	The R programming course offers a comprehensive overview of the R language, encompassing fundamental principles and practical abilities essential for data analysis and statistical computing.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Demonstrate how to install and configure RStudio	U	C	Instructor-created exams / Quiz
CO2	Apply OOP concepts in R programming	U	C	Practical Assignment / Group Tutorial Work
CO3	Explain the use of data structure and loop functions	U	C	Practical Assignment / Group Tutorial Work
CO4	Understand the concept of data frames	U	C	Instructor-created exams / Home Assignments
CO5	Implement the DPLYR package and Data Visualization	Ap	P	Practical assignments and practical tests
CO6	Implementation of R Programming concepts	Ap	M	Practical assignments and practical tests

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (45+30)	Marks
I	**Fundamentals Of R**		**10**	**10**
	1	Installation of R & R Studio	2	
	2	Features of Variables, Constants	2	
	3	Operators	2	
	4	Datatypes and R Objects	2	
	5	Accepting Input from keyboard, Important Built-in functions	2	
II	**Vectors, Matrices and Lists**		**15**	**20**
	6	Vectors-Accessing elements of a Vector, Operations on Vectors	3	
	7	Vector Arithmetic	2	
	8	Matrices-Accessing elements of a Matrix	2	
	9	Operations on Matrices, Matrix transpose	3	
	10	Creating lists, manipulating list elements, Merging lists	3	
	11	Converting lists to vectors	2	
III	**Control Statements, Functions and Arrays In R**		**10**	**20**
	12	If statement, if…else statement, if else () function, switch () function	1	
	13	repeat loop, while loop, for loop, break statement, next statement	2	
	14	Formal and Actual arguments, Named arguments	1	
	15	Global and local variables, Argument and lazy evaluation of functions	2	

	16	Recursive functions, String and string functions	2	
	17	Creating arrays, Accessing array elements, Calculations across array elements	2	
IV	**Data Manipulation -Dplyr Package And Data Visualization In R**		**10**	**20**
	18	R factors and Data Frames, Load data into dataframe	2	
	19	Viewing the data Selecting columns, selecting rows, Reordering the rows	2	
	20	Pipe operator, Group operations	2	
	21	Data Visualization-Bar plot, Plotting categorical data, Stacked bar plot, Histogram	2	
	22	Plot () function and line plot, pie chart / 3D pie chart, Scatter plot, Box plot	2	
V	**Practical Applications**		**30**	
	Implement the following: • Implementation of Vectors, Matrices and Lists • Implementation of Control statements, functions and Arrays • Usage of DPLYR package and data Visualization • Analyze the mtcars dataset by selecting specific columns and visualizing the data using bar plots, histograms, and scatter plots. • Perform vector and matrix operations, including element access, arithmetic operations, and transposition. • Implement control statements and loops to check number properties and iterate through sequences. • Define and use functions with named arguments, handle global and local variables, and create a recursive function to calculate factorials. • Utilize the dplyr package for data manipulation with the iris dataset and perform various list operations including merging and converting lists to vectors. Case Study with any Data Set (MNIST/IRIS)		30	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	-	-	-	-						
CO 2	1	2	1	-	-	-						
CO 3	2	2	2	2	-	1						
CO 4	2	2	2	2	1	2						
CO 5	3	3	2	2	2	2						
CO6	3	3	3	3	3	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1		✓		

CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5			✓	
CO6			✓	

References:

1. “The Book of R” by Tilman M. Davies, no starch press (San Francisco)

2. “The Art of R programming” by Norman Matloff, no starch press (San Francisco)

Programme	BSc AI				
Course Code	AIN8CJ406				
Course Title	Data Mining				
Type of Course	**Major**				
Semester	VIII				
Academic Level	400 - 499.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Basics of statistics				
Course Summary	This course provides an introduction to the principles, techniques, and applications of data mining.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamental concepts and principles of data mining.	U	C	Instructor-created exams / Quiz
CO2	Demonstrate proficiency in preprocessing techniques such as cleaning, transformation, and reduction of data.	U	P	Assignment / Seminar presentations/ Exams
CO3	Understand popular data mining algorithms and models, such as decision trees, k-means clustering, and association rule algorithms.	U	P	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Explore various methods to Evaluate and interpret the results of data mining models using appropriate performance metrics.	U	C	Instructor-created exams / Home Assignments
CO5	Understand the role of data mining in extracting patterns and knowledge from large datasets.	U	P	Writing assignments/ exams/ Seminar
CO6	Apply data mining techniques to real-world problems and datasets, emphasizing practical applications in various domains	Ap	P	Case Study

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (48+12)	Marks (70)
I	**Introduction to Data Mining**		**10**	**15**
	1	Introduction- Data mining defining, KDD vs Data mining, DBMS vs data mining	2	
	2	What kind of data can be mined? - database data, data warehouse, transactional data, other types	2	
	3	What kind of patterns can be mined? - Class/Concept Description: Characterization and Discrimination, Mining Frequent Patterns, Associations, and Correlations, Classification and Regression for Predictive Analysis, cluster analysis, outlier analysis	3	
	4	Technologies used- statistics, machine learning, data base systems and ware house, information retrieval (Introduction only)	3	
II	**Data Preprocessing**		**14**	**20**
	5	Data Preprocessing: An Overview	2	
	6	Data Cleaning- missing value, noisy data, Data Cleaning as a Process	2	
	7	Data Integration- Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Data Value Conflict Detection and Resolution	3	
	8	Data Reduction - Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Regression and Log-Linear Models: Parametric Data Reduction, Histograms,	4	
	9	Data Transformation and and Data Discretization- Data Transformation by Normalization, Discretization by Binning	3	
III	**Association Rule Mining & Classification**		**10**	**15**
	10	Introduction to Association Rule Mining Frequent Itemset, Closed Itemset, and Association Rules	1	
	11	Frequent Itemset Mining Apriori Algorithm, Generating Association Rules from Frequent Itemsets	1	
	12	Introductio to classification: Decision tree	2	
	13	Attribute Selection measures in decision tree	2	
	14	Bayes Classification methods	2	
	15	Techniques to Improve Classification Accuracy	2	
IV	**Clustering, Outlier detection**		**14**	**20**
	16	Introduction to unsupervised techniques: challenges	2	
	17	Clustering- K Means	2	
	18	Variants of k- Means	2	
	19	Hierarchical clustering	2	
	20	Density Based clustering- DBScan	2	

	21	Introduction to outliers and novelty detection	2	
	22	Recommender system	2	
V	**Open Ended Module: Case Studies**		**12**	
	1	• **Real-world applications of data mining** • **Case studies and projects** • **Ethical considerations in data mining**		

References

- "Han, J., Kamber, M., & Pei, J. (2011). Data mining: Concepts and techniques. Morgan Kaufmann."
- Data Mining Techniques - Arun K. Pujari
- Jiawei Han and Micheline Kamber, Data Mining Concepts & Techniques, Second Edition, Elsevier.
- Pang Ning Tan, Michael Steinbach and Vipin Kumar, Introduction To Data Mining, Pearson Education, 2007.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	1						
CO 2	1	-	-	-	1	1						
CO 3	1	-	2	-	2	2						
CO 4	1	-	1	-	1	1						
CO 5	1	-	1	-	1	1						
CO 6	-	-	1	1	2	2						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)

- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4	✓	✓	✓
CO 5	✓	✓	✓
CO 6	✓	✓	

Programme	BSc AI				
Course Code	AIN8CJ407				
Course Title	BLOCKCHAIN TECHNOLOGY				
Type of Course	Major				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Strong programming skills in at least one popular language, such as Java or Python. Knowledge of cryptography and data structures (like linked lists and arrays). Good understanding of networking concepts				
Course Summary	The syllabus is prepared with the view of preparing the Graduates to create awareness and understanding among students on the foundation of blockchain technology. The course introduces the cryptographic principles behind blockchain and helps the students understand concepts like consensus, crypto-currency, smart contracts, use cases etc.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	aluation Tools used
CO1	Understand the basics of cryptographic building blocks in blockchain technology.	U	C	Instructor-created exams / Quiz
CO2	Explain the fundamental concepts of blockchain technology.	U	C	Instructor-created exams / Quiz
CO3	Summarize the classification of consensus algorithms	U	P	Instructor-created exams / Quiz
CO4	Explain the concepts of first decentralized cryptocurrency bitcoin	U	C	Instructor-created exams / Case studies
CO5	Describe the use of smart contracts and its use cases	U	P	Instructor-created exams / Quiz Case studies
CO6	Develop simple block chain applications	U	P	Instructor-created exams / Quiz / Case

				studies

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
I		**Fundamentals of Cryptography**	**12**	**15**
	1	Introduction to Cryptography, Symmetric cryptography – AES. Asymmetric cryptography –RSA. Elliptic curve cryptography,	3	
	2	Digital signatures – RSA digital signature algorithms.	2	
	3	Secure Hash Algorithms – SHA-256.	2	
	4	Applications of cryptographic hash functions – Merkle trees	3	
	5	Distributed hash tables	2	
II		**Fundamentals of Blockchain Technology**	**12**	**15**
	6	Blockchain – Definition, architecture, elements of blockchain, benefits and limitations.	2	
	7	Types of blockchain	1	
	8	Consensus – definition, types, consensus in blockchain,	3	
	9	Decentralization – Decentralization using blockchain	3	
	10	Methods of decentralization, Routes to decentralization,	1	
	11	Blockchain and full ecosystem decentralization	2	
III		**Consensus Algorithms and Bitcoin**	**12**	**20**
	12	Consensus Algorithms, Crash fault-tolerance (CFT) algorithms – Paxos, Raft. Byzantine fault tolerance(BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT),.	2	
	13	Proof of work (PoW),Proof of stake (PoS), Types of PoS	2	
	14	Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses	2	
	15	Transactions –Lifecycle, Coinbase transactions, transaction validation Blockchain – The genesis block.	2	
	16	Mining – Tasks of miners, mining algorithm, hash rate	2	
	17	Wallets – Types of wallets..	2	
IV		**Smart Contracts and Use cases**	**12**	**20**
	18	Smart Contracts – Definition, Smart contract templates, Deploying smart contracts	2	
	19	Oracles, Types of oracles.	2	
	20	Decentralization terminology – Decentralized applications, Decentralized Autonomous Organizations	3	

	21	Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management.	2	
	22	Blockchain and allied technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence	3	
V	**Open Ended Module**		**12**	
	CASE STUDY: BLOCKCHAIN TECHNOLOGY Solidity language Ethereum platform			

Reference Books:

1.Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus

protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, Packt Publishing,

Third edition, 2020.

2. Ritesh Modi, Solidity Programming Essentials: A beginner's guide to build smart contracts

for Ethereum and blockchain, Packt Publishing, First edition, 2018.

3. Kumar Saurabh, Ashutosh Saxena, Blockchain Technology: Concepts and Applications,

First Edition, Wiley Publications, First edition, 2020.

4. Chandramouli Subramanian, Asha A George, et al, Blockchain Technology, Universities

Press (India) Pvt. Ltd, First edition, August 2020

5. Lorne Lantz, Daniel Cawrey, Mastering Blockchain: Unlocking the Power of

Cryptocurrencies, Smart Contracts, and Decentralized Applications, O'Reilly Media, First edition, 2020.

Mapping of COs with PSOs and POs :

	PSO1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	2	-	-	-	-						
CO 2	-	2	-	-	-	-						

CO 3	-	2	3	3	-	-						
CO 4	-	2	3	3	1	1						
CO 5	-	1	1	-	2	3						
CO 6	-	1	1	-	2	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4		✓		✓
CO 5		✓		✓
CO 6			✓	

Programme	BSc AI				
Course Code	AIN8CJ408				
Course Title	Deep Learning				
Type of Course	**Major**				
Semester	VIII				
Academic Level	400 - 499.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Introduction to Artificial Intelligence 2. Basic understanding of linear algebra, calculus, and probability. 3. Basics of Machine learning				
Course Summary	The theoretical groundwork for comprehending the fundamentals of deep learning is supplied by this course. Theoretical frameworks, optimisation techniques, and mathematical ideas that support deep neural network building and training will be examined by students.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Master key concepts of machine learning, understanding various layers of neural network.	U	C	Instructor-created exams / Quiz
CO2	Understand and implement the backpropagation algorithm for training neural networks, demonstrating the ability to compute gradients and update weights.	Ap, U	P	Assignment / Seminar presentations/ Exams
CO3	Analyze and compare different activation functions used in neural networks, explaining their role in the learning process.	U	P	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Design and implement feedforward neural networks for various applications, considering aspects such as model architecture, activation functions, and initialization methods.	Ap	C	Instructor-created exams / Home Assignments
CO5	Master the principles of convolutional neural networks, including convolutional layers, pooling layers, and their applications in computer vision. Master various regularization	U	P	Writing assignments/ Exams/ Seminar Presentations

	techniques, such as dropout, batch normalization, and weight regularization, to improve the generalization of neural networks			
CO6	Apply deep learning concepts to solve real-world problems, demonstrating the ability to choose appropriate architectures and hyperparameters.	Ap	P	Case Study
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (48+12)	Marks (70)
I		**Machine Learning Basics**	**10**	**15**
	1	Learning Algorithms -Supervised learning- regression, classification, Unsupervised learning, Reinforcement learning (Introduction only)	2	
	2	Terms - Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimators, Bias and Variance	2	
	3	Maximum Likelihood estimation, Bayesian statistics, Stochastic Gradient Descent	3	
	4	Building a Machine Learning Algorithm	1	
	5	Challenges Motivating Deep Learning	2	
II		**Optimisation and Neural Networks**	**15**	**20**
	6	Neural Networks –Perceptron, Gradient Descent solution for Perceptron, Multilayer perceptron	3	
	7	Activation Functions- Sigmoid, Softmax, Relu, LeakyRelu, ERELU	2	
	8	Chain rule, back propagation- Backpropagation Algorithm	3	
	9	Gradient based learning.	2	
	10	Introduction to optimization– Gradient based optimization, linear least squares. Stochastic gradient descent	2	
	11	Regularisation techniques- Drop out, Batch Normalisation, weight regularisation	3	
III		**Convolutional Neural Network**	**12**	**20**
	12	Convolutional Neural Networks – convolution operation, motivation	2	
	13	Pooling	2	
	14	Variants of convolution functions	2	
	15	Structured outputs, data types	2	
	16	CNN Architecture- Alexnet, VGG16	4	

IV	**Deep learning Architectures**		**11**	**15**
	17	Sequence Modelling: Recurrent and Recursive Nets- Basics of Recurrent Neural Networks	2	
	18	Encoder – Decoder Sequence to Sequence Architectures,	2	
	19	Deep Recurrent Networks, Recursive Neural Networks	2	
	20	The Long Short-Term Memory	2	
	21	GRU	2	
	22	Basics of transfer learning techniques (Concept only)	1	
V	**Open ended Module**		**12**	
	1	• Master students Basics of Mathematics required for Machine learning and deep learning- Linear Algebra (Scalars, Vectors, Matrices and Tensors, Eigen values, Eigen Vectors)- concepts only • Probability awareness- Why probability, random variable, probability distributions)- concepts only • Discuss advanced topics in deep learning, including transfer learning, autoencoders, adversarial training, and stay informed about recent developments in the field.)- concepts only		

References

- "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
- Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, “Dive into Deep Learning”, August 2019.
- Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal. Springer.1st edition, 2018.
- "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron.

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	2	3						

CO 2	2	-	1	1	2	3						
CO 3	2	-	-	-	2	1						
CO 4	2	-	1	1	2	2						
CO 5	2	-	2	1	2	3						
CO 6	2	-	2	1	2	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4		✓	✓
CO 5		✓	✓
CO 6		✓	

Programme	BSc AI				
Course Code	AIN8CJ489				
Course Title	**Research Methodology**				
Type of Course	Major				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Knowledge of Planning a research project, problem formulation, framing objectives				
Course Summary	This course introduces and discusses approaches, strategies, and data collection methods relating to research. Students will consider how to select the appropriate methodology for use in a study to be performed. Additionally, these students will learn how to collect data based on different data collection methods, construct these tools, and pilot them before they become ready for use. To culminate this final stage, students will learn to write a comprehensive research proposal that may be conducted in the future				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the psychology of research which includes different perspectives and necessity of research.	U	C	Instructor- created exams / Quiz
CO2	Apply the research knowledge to formulate a suitable problem statement by adopting different research methods and models	U	C	Instructor-created exams / Quiz
CO3	Understand different methods of Collection, Validation and Testing of Data	U	P	Instructor-Created exams / Quiz
CO4	To understand the data processing and analysis techniques	U	C	Instructor-created exams / Case studies
CO5	Analyze the research outcome by using suitable statistical tool.	U	P	Instructor-created exams / Quiz Case studies

CO6	To write or present a scientific report and research proposal	U	P	Instructor-created exams / Quiz /Case studies
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
I		**Introduction to Research Methodology**	**12**	**15**
	1	Research Methodology: An Introduction to the Meaning of Research and Objectives of Research	2	
	2	Motivation in Research ,Types of Research	2	
	3	Research Approaches	2	
	4	Significance of Research	3	
	5	Research Methods versus Methodology .	3	
II		**Identifying, Defining and Designing Research Problem**	**12**	**15**
	6	Defining the Research Problem What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem	2	
	7	Technique Involved in Defining a Problem	1	
	8	Research Design: Meaning of Research Design, Need for Research Design	3	
	9	Research Methodology, Features of a Good Design	3	
	10	Important Concepts Relating to Research Design	1	
	11	Different Research Designs	2	
III		**Collection, Validation and Testing of Data**	**12**	**20**
	12	Sources of Data: Primary and Secondary, Validation of Data , Data Collection Methods: Questionnaire Designing	2	
	13	Construction Sampling Design & Techniques – Probability Sampling and Non Probability Sampling Scaling Techniques:	2	
	14	Meaning & Types Reliability: Test – Retest Reliability,	2	
	15	Alternative Form Reliability	2	
	16	Internal Comparison Reliability and Scorer Reliability	2	
	17	Validity: Content Validity, Criterion Related Validity and Construct Validity	2	
IV		**Data Processing and Analysis**	**12**	**20**
	18	Processing and Analysis of Data, Processing Operations, Some Problems in Processing, Elements/Types of Analysis	2	
	19	Statistics in Research Measures of Central Tendency	2	
	20	Measures of Dispersion Interpretation and Report Writing	3	
	21	Meaning of Interpretation Why Interpretation? Technique of Interpretation: Precaution in Interpretation	2	
	22	Significance of Report Writing Different Steps in Writing Report Layout of the Research Report	3	
V		**Open Ended Module**	**12**	

	CASE STUDY: RESEARCH METHODOLOGY Methods of Research Applications of Statistical tools & Methods Structure and components of scientific reports	

Reference Books:

1. C.R .Kothari, 'Research Methodology Methods & Techniques', Revised 2 nd Edn., New Age International Publishers.Research Methodology and Scientific Writing by C George Thomas, Ane Books Pvt. Ltd.

2. An Introduction to Research Methodology; Garg B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002., RBSA Publishers.

3. Research Methodology ; Panneerselvam R., PHI, Learning Pvt. Ltd., New Delhi - 2009

4. Research Methodology: Concepts and cases, Chawala D. and N. Sondhi ; Vikas Publishing House Pvt. Ltd.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	-	-	-						
CO2	-	-	1	-	-	-						
CO3	2	2	1	-	1	1						
CO4	2	2	2	2	1	2						
CO5	2	1	2	2	1	2						
CO6	-	-	-	-	-	1						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4		✓		✓
CO 5		✓		✓
CO 6			✓	

Elective Courses

Basket of Electives

1. Image Processing

Programme	BSc AI				
Course Code	AIN5EJ301(1)				
Course Title	Fundamentals of Digital Image Processing				
Type of Course	Elective				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Basic understanding of mathematics concepts involved in digital image processing algorithms and transformations. 2. Familiarity with programming languages such as MATLAB or Python				
Course Summary	This course provides a comprehensive understanding of digital image processing fundamentals, covering topics such as pixel structure, image formation, and types of images. Students will learn a range of image processing techniques including intensity transformations, spatial filtering, and frequency domain filtering, along with their applications in various industries such as medical imaging and multimedia systems.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Develop a comprehensive understanding of the principles underlying digital image processing, including image representation and fundamental processing techniques.	U	C	Assignment / Instructor-created exams / Quiz
CO2	Develop proficiency in basic digital image processing techniques, including intensity transformations, spatial filtering, and histogram processing, to manipulate and enhance digital images effectively.	Ap	C	Practical Assignment / Instructor-created exams / Quiz
CO3	Analyze the components of digital image processing systems and their functions in image sensing and acquisition, including the use of single sensing elements, sensor strips, and sensor arrays	An	C	Practical Assignment / Instructor-created exams / Quiz
CO4	Develop skills in implementing image	Ap	P	Practical

	processing algorithms, including spatial filtering techniques like smoothing and sharpening, as well as frequency domain filtering methods.			Assignment / Instructor-created exams / Quiz
CO5	Analyze and interpret digital images to extract meaningful information and insights, facilitating informed decision-making in diverse application domains.	An	P	Practical Assignment / Instructor-created exams / Quiz
CO6	Explore advanced concepts and emerging trends in digital image processing, fostering a deeper understanding of the field's evolving landscape and potential future directions.	Ap	C	Practical Assignment / Instructor-created exams / Quiz
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
I	**Digital Image and Digital Image Processing**		**10**	**15**
	1	Digital image and Digital image processing system, Pixels, Resolution of an image, Types of Images – Gray Scale, Binary and Color Images	1	
	2	Fundamentals steps in digital image processing	3	
	3	Applications of digital image processing	3	
	4	Image processing system components	3	
II	**Image Sensing and Acquisition**		**12**	**15**
	5	Image acquisition using a single sensing element, Image acquisition using sensor strips, Image acquisition using sensor arrays	3	
	6	A simple image formation model	3	
	7	Basic Concepts in Sampling and Quantization	2	
	8	Representing digital images	2	
	9	Some basic relationships between pixels - neighbors of a pixel, adjacency, connectivity, regions, and boundaries	2	
III	**Intensity Transformation and Spatial Filtering**		**13**	**20**
	10	Basics of intensity transformations and spatial filtering	1	
	11	Some basic intensity transformation functions - Image negatives, Log transformations	1	
	12	Piecewise linear transformation functions - Contrast stretching, Intensity-level slicing	2	
	13	Histogram processing, Histogram equalization	2	
	14	Fundamentals of spatial filtering - The mechanics of linear spatial filtering	1	
	15	Spatial correlation and convolution	2	

	16	Smoothing (lowpass) spatial filters - box filter kernels, order-statistic (nonlinear) filters	2	
	17	Sharpening (highpass) spatial filters – The Laplacian, Unsharp masking and highboost filtering, gradient filter	2	
IV	**Frequency Domain Filtering and Image Restoration**		**13**	**20**
	18	Filtering in Frequency Domain - The Discrete Fourier Transformation (DFT)	1	
	19	Steps for filtering in the frequency domain, Ideal and Butterworth Low pass and High pass filters	2	
	20	Image Restoration - degradation model, Properties	1	
	21	Noise models, Mean Filters – Order Statistics	2	
	22	Inverse Filtering – Wiener filtering	3	
V	**Open Ended Module**		**12**	
	1	• Relationships between pixels • Intensity transforms • Spatial and Frequency Domain Filtering	12	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	1	-	2	2						
CO 2	1	-	1	-	2	2						
CO 3	1	1	1	-	2	2						
CO 4	3	3	2	1	2	1						
CO 5	1	-	1	-	2	2						
CO 6	3	3	1	1	2	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		✓

References:

1. Gonzalez, Rafael C., and Woods, Richard E. "Digital Image Processing." Pearson Education, Inc., 2008.

2. Jain, Anil K. "Fundamentals of Digital Image Processing." Prentice Hall, 1989.

3. Sonka, Milan, Hlavac, Vaclav, and Boyle, Roger. "Image Processing, Analysis, and Machine Vision." Cengage Learning, 2014.

4. Pratt, William K. "Digital Image Processing: PIKS Scientific Inside." John Wiley & Sons, 2007.

5. Burger, Wilhelm, and Burge, Mark J. "Digital Image Processing: An Algorithmic Approach with MATLAB." Springer, 2017.

6. Woods, Richard E., and Eddins, Steven L. "Digital Image Processing using MATLAB." Gatesmark Publishing, 2010.

Programme	BSc AI				
Course Code	AIN5EJ302(1)				
Course Title	Pattern Recognition				
Type of Course	Elective				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Basic understanding of probability theory and statistics. 2. Prior knowledge of data structures and algorithms.				
Course Summary	This course provides a comprehensive overview of pattern recognition, covering fundamental concepts such as statistical decision-making, non-parametric techniques, clustering, and feature selection. Students will develop practical skills in designing and evaluating pattern recognition systems through hands-on implementation of algorithms and analysis of real-world applications.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Demonstrate an understanding of the core principles and concepts of pattern recognition, as well as their diverse applications across various domains.	U	C	Assignment / Instructor-created exams / Quiz
CO2	Apply statistical decision-making methodologies effectively to design and develop robust pattern recognition systems.	Ap	P	Practical Assignment / Instructor-created exams / Quiz
CO3	Implement and evaluate various pattern recognition models, employing statistical measures for performance assessment.	E	P	Practical Assignment / Instructor-created exams / Quiz
CO4	Explore and employ non-parametric decision-making approaches in pattern recognition tasks to enhance system accuracy and adaptability.	U	P	Practical Assignment / Instructor-created exams / Quiz
CO5	Utilize clustering techniques for data grouping and feature selection, optimizing pattern recognition system efficiency.	Ap	P	Practical Assignment / Instructor-created exams / Quiz

CO6	Evaluate the performance of pattern recognition systems through comprehensive analysis of error rates, population composition estimation, and other relevant metrics.	E	P	Practical Assignment / Instructor-created exams / Quiz

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
\# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
I		**Introduction**	**8**	**15**
	1	Pattern Recognition - Basic concepts, Applications	2	
	2	Fundamental problems in pattern recognition system design	2	
	3	Design concepts and methodologies	2	
	4	Simple pattern recognition model	2	
II		**Statistical Decision Making**	**15**	**20**
	5	Statistical Decision Making: Introduction, Baye's theorem	3	
	6	Multiple features, Conditionally independent features	2	
	7	Decision boundaries	2	
	8	Unequal cost of error, Estimation of error rates	2	
	9	Leaving-one-out-techniques	2	
	10	Characteristic curves	2	
	11	Estimating the composition of populations	2	
III		**Non-Parametric Decision Making**	**10**	**15**
	12	Histogram, Kernel and window estimation,	2	
	13	Nearest neighbour classification techniques	2	
	14	Adaptive decision boundaries	2	
	15	Adaptive discriminant functions	2	
	16	Minimum squared error discriminant functions	2	
IV		**Clustering and Feature Selection**	**15**	**20**
	17	Clustering and Feature Selection - Introduction	2	
	18	Aagglomerative clustering algorithm	3	
	19	the single-linkage, Complete-linkage and average-linkage algorithm	3	
	20	K-Means's algorithm	3	
	21	Clustering in feature selection through entropy minimization	2	
	22	Features selection through orthogonal expansion.	2	
V		**Open Ended Module**	**12**	
	1	• Implement a simple pattern recognition model using a programming language/tool (e.g., Python, MATLAB etc.) and write a research paper.	12	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6

CO 1	3	2	2	2	2	1						
CO 2	1	2	1	2	2	1						
CO 3	2	2	2	3	1	1						
CO 4	1	2	2	2	2	1						
CO 5	2	2	2	2	2	1						
CO 6	1	2	2	2	2	1						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		✓

References:

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

2. Theodoridis, S., & Pikrakis, A. Introduction to Pattern Recognition: A Matlab Approach. Academic Press, 2010.

3. Duda, R. O., Hart, P. E., & Stork, D. G. Pattern Classification. Wiley-Interscience, 2000.

4. Murphy, K. P. Machine Learning: A Probabilistic Perspective. MIT Press, 2012.

5. Han, J., Kamber, M., & Pei, J. (2011). Data Mining: Concepts and Techniques. Morgan Kaufmann.

6. Hastie, T., Tibshirani, R., & Friedman, J. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Springer, 2009.

Programme	BSc AI				
Course Code	AIN6EJ301(1)				
Course Title	Advanced Digital Image Processing and Computer Vision				
Type of Course	Elective				
Semester	VI				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Basic understanding of mathematics concepts involved in digital image processing algorithms and transformations. 2. Familiarity with programming languages such as MATLAB or Python				
Course Summary	This course provides a comprehensive understanding of digital image processing fundamentals, covering topics such as pixel structure, image formation, and types of images. Students will learn a range of image processing techniques including intensity transformations, spatial filtering, and frequency domain filtering, along with their applications in various industries such as medical imaging and multimedia systems.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand principles and techniques of morphological image processing.	U	C	Assignment / Instructor-created exams / Quiz
CO2	Gain proficiency in image segmentation methods.	U	P	Practical Assignment / Instructor-created exams / Quiz
CO3	Master thresholding techniques for converting grayscale images into binary images and extracting relevant features.	U	P	Practical Assignment / Instructor-created exams / Quiz
CO4	Acquire knowledge of feature extraction methods for pattern recognition and classification.	U	P	Practical Assignment / Instructor-created exams / Quiz
CO5	Understand fundamentals of color image processing, including color models.	U	C	Practical Assignment / Instructor-created exams /

				Quiz
CO6	Develop proficiency in image compression techniques for reducing storage space and transmission bandwidth while preserving visual quality.	U	C	Practical Assignment / Instructor-created exams / Quiz
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
I	**Morphological Image Processing and Image Segmentation**		**13**	**20**
	1	Morphological Image Processing - Structuring element, Erosion and Dilation	2	
	2	Opening and Closing	2	
	3	Thinning and Thickening	2	
	4	Image Segmentation – Fundamentals, Point, Line, and Edge Detection	3	
	5	Segmentation by Region Growing	2	
	6	Segmentation by Region Splitting and Merging	2	
II	**Thresholding, Feature Extraction and Color Image Processing**		**14**	**20**
	7	Thresholding - Basics of Intensity Thresholding, Basic Global Thresholding	2	
	8	Otsu's algorithm	2	
	9	Feature Extraction – Definition, Statistical Features	2	
	10	Color Image Processing - Color Fundamentals	2	
	11	Color Models – RGB	2	
	12	CMY and CMYK Color Models	2	
	13	Basics of Full-Color Image Processing	2	
III	**Image Compression**		**10**	**15**
	14	Image Compression – Fundamentals	2	
	15	Types of data redundancies - Coding Redundancy, Spatial and Temporal Redundancy, Irrelevant Information	2	
	16	Huffman Coding	2	
	17	Run-length Coding	2	
	18	Neural Networks Machine Learning and Deep Learning (Definitions only)	2	
IV	**Computer Vision**		**11**	**15**
	19	Computer Vision – Introduction to Computer Vision	2	
	20	Feature Detection and Matching – Points and Patches, Edges, Lines	3	
	21	Recognition – Object Detection, Face Recognition	3	
	22	Instance Recognition, Category Recognition, Motion Detection	3	
V	**Open Ended Module**		**12**	
	1	• Image segmentation algorithms • Thresholding algorithms	12	

		• Image Compression methods • Face Recognition methods		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	2	1	2	2	1						
CO 2	1	2	1	2	2	1						
CO 3	1	2	1	2	2	1						
CO 4	3	2	2	2	2	1						
CO 5	1	2	1	2	2	1						
CO 6	2	2	1	2	2	1						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓

CO 5	✓	✓		✓
CO 6	✓	✓		✓

References:

1. Gonzalez, Rafael C., and Woods, Richard E. "Digital Image Processing." Pearson Education, Inc., 2008.

2. Jain, Anil K. "Fundamentals of Digital Image Processing." Prentice Hall, 1989.

3. Sonka, Milan, Hlavac, Vaclav, and Boyle, Roger. "Image Processing, Analysis, and Machine Vision." Cengage Learning, 2014.

4. Pratt, William K. "Digital Image Processing: PIKS Scientific Inside." John Wiley & Sons, 2007.

5. Burger, Wilhelm, and Burge, Mark J. "Digital Image Processing: An Algorithmic Approach with MATLAB." Springer, 2017.

6. Szeliski, R. Computer vision: Algorithms and applications. Springer Science & Business Media, 2010.

7. Forsyth, D. A., & Ponce, J. Computer vision: A modern approach. Prentice Hall, 2011.

Programme	BSc AI				
Course Code	AIN6EJ302(1)				
Course Title	Applied Digital Image Processing				
Type of Course	Elective				
Semester	VI				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Foundation in mathematics and statistics, including linear algebra, calculus, probability theory, and signal processing. 2. Proficiency in programming languages such as MATLAB or Python				
Course Summary	The course covers a comprehensive study of medical, document, forensic, and satellite image processing, including techniques such as multimodal fusion, image registration, reconstruction, and enhancement, emphasizing the role of advanced algorithms and software tools in diagnosis, treatment planning, document analysis, forensic investigations, and geographic information systems applications. Students will gain practical skills in image processing, programming, and analytical thinking, essential for addressing real-world challenges in healthcare, document management, law enforcement, and environmental monitoring.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Develop a comprehensive understanding of various medical imaging modalities and their applications, facilitating informed decision-making in healthcare.	U	C	Assignment / Instructor-created exams / Quiz
CO2	Acquire proficiency in implementing medical image processing techniques to integrate and analyze multiple imaging modalities for enhanced medical image interpretation.	Ap	P	Practical Assignment / Instructor-created exams / Quiz
CO3	Understand the importance of document and text image processing across diverse fields, enhancing productivity and efficiency in information management and retrieval.	U	F	Practical Assignment / Instructor-created exams / Quiz
CO4	Master advanced image processing techniques to enhance clarity and interpretability of digital evidence in forensic investigations.	Ap	P	Practical Assignment / Instructor-created exams / Quiz
CO5	Develop a thorough understanding of	U	C	Practical

	image processing techniques applicable to satellite and aerial imagery, allowing for their effective utilization in diverse applications.			Assignment / Instructor-created exams / Quiz
CO6	Master advanced image processing methods to enhance the quality of satellite and aerial imagery, enabling detailed analysis and interpretation for environmental monitoring, urban planning, and other spatial applications.	Ap	P	Practical Assignment / Instructor-created exams / Quiz
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
I		**Medical Image Processing**	**14**	**20**
	1	Medical Images – Functional Modality - X- Ray, CT, MRI, Ultrasound, Anatomical Modality - fMRI, SPECT, PET (Concept only)	3	
	2	Multimodal Medical Image Fusion, Medical Image Registration	2	
	3	Architecture of CAD System - Image pre-processing, Region(s) of Interest (ROI), Feature Extraction Segmentation and Classification	3	
	4	Image Reconstruction and Enhancement	2	
	5	3D and 4D medical image visualization	2	
	6	Role of Medical Image Processing in diagnosis and treatment planning	2	
II		**Document and Text Image Processing**	**10**	**15**
	7	Importance of Document and Text Image Processing, Document image acquisition, Optical Character Recognition (OCR)	3	
	8	Document structure and layout analysis, Handwriting recognition, Text classification	3	
	9	Document summarization, Content-based document image retrieval, Text indexing	3	
	10	Applications of Document and Text Image Processing.	1	
III		**Forensic Image Processing**	**14**	**20**
	11	Types of forensic images - Physical image, Logical image, Targeted image	2	
	12	Contrast enhancement and Noise reduction, Sharpness and edge enhancement,	2	
	13	Geometric and Photometric corrections of forensic images	2	
	14	Color balancing and Calibration, Foreground and Background Segmentation	2	
	15	Detection of sophisticated tampering, Alterations, and Manipulations	2	
	16	Image metadata, Identification of cloned regions, Splicing, and Retouching, Hidden information analysis	3	

	17	Legal considerations and ethical issues in forensic image processing	1	
IV	**Satellite and Aerial Image Processing**		**10**	**15**
	18	Remote Sensing, Satellites and Image acquisition, Sensors types - optical, radar and LiDAR	2	
	19	Radiometric and Geometric corrections, Orthorectification and georeferencing of aerial and satellite images	2	
	20	Contrast stretching, Histogram equalization and Filtering techniques for noise reduction and feature enhancement	2	
	21	Multiscale image decomposition, Object-based image analysis, Image differencing, image rationing	2	
	22	Geographic Information Systems (GIS)	2	
V	**Open Ended Module**		**12**	
	1	• Write a review paper either from medical image processing or from Document and Text Image Processing or from Forensic Image Processing or from Satellite and Aerial Image Processing or from any other applied image processing area.	12	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	1	1	2	1						
CO 2	2	3	3	2	2	1						
CO 3	2	1	1	1	1	2						
CO 4	2	1	1	1	1	2						
CO 5	2	2	1	1	1	2						
CO 6	2	1	1	1	1	2						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)

- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		✓

References:

1. G.R. Sinha, Bhagwaticharan Patel, Medical Image Processing: Concepts and Applications, PHI Learning private limited.2014

2. KayvanNajarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005

3. Document Image Analysis" by Lawrence O'Gorman and Rangachar Kasturi, 1995, IEEE Computer Society Press.

4. Handbook of Document Image Processing and Recognition" edited by David Doermann, 2014, CRC Press.

5. Digital Image Processing for Forensic Applications" by Rajkumar Kannan and E. Sreekumar, CRC Press, 2013

6. "Forensic Image Processing" by John C. Russ, SPIE Press, 2008.

7. Remote Sensing Digital Image Analysis: An Introduction" by John A. Richards and Xiuping Jia, Springer, 2006.

8. Remote Sensing and Image Interpretation" by Thomas Lillesand, Ralph W. Kiefer, and Jonathan W. Chipman, Wiley, 2014.

2. Cloud Computing

Programme	BSc AI				
Course Code	AIN5EJ303(2)				
Course Title	Cloud Computing				
Type of Course	Elective				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic understanding of computer networks, operating systems, and programming.				
Course Summary	This course introduces students to the fundamental concepts, technologies, and practices of cloud computing. It covers the basics of cloud infrastructure, deployment models, and service models.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand fundamentals of cloud Computing	U	C	Instructor-created exams / Quiz
CO2	Describe and compare Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)	U	C	Assignment / Seminar presentations/ Exams
CO3	Analyze various deployment models such as public, private, and hybrid clouds.	U	P	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Understand the principles of virtualization and its role in cloud computing.	U	C	Instructor-created exams / Home Assignments

CO5	Compare and contrast different virtualization technologies, including hypervisors and containerization.	U	P	Writing assignments/ Exams/ Seminar Presentations
CO6	Explore various cloud platforms in industry	U	F	Case Study/ Exams
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
I	**Introduction to Cloud Computing**		**8**	**12**
	1	Cloud computing in a glance	2	
	2	Historical context and evolution	1	
	3	Building cloud computing environments- Cloud components	2	
	4	Desired features of cloud	2	
	5	Advantages of Cloud	1	
II	**Cloud Computing Architecture**		**14**	**20**
	6	Cloud reference model	4	
	7	Types of cloud- private, public, hybrid, community	3	
	8	Cloud service models (IaaS)	2	
	9	Cloud service models (PaaS)	2	
	10	Cloud service models (SaaS)	2	
	11	Open Challenges	1	
III	**Virtualization Technologies**		**16**	**23**
	12	Virtual machine basics	2	
	13	hypervisor	2	
	14	Virtualisation structure	3	
	15	Implementation levels of virtualisation	2	
	16	Virtualisation types- Full Virtualisation, Para Virtualisation,	3	

		Hardware Virtualisation		
	17	Virtualisation of CPU, Memory	2	
	18	Virtualisation of I/O devices	2	
IV	**Virtualisation Infrastructure & Dockers**		**10**	**15**
	17	Desktop Virtualisation, Network Virtualisation & Storage Virtualisation	2	
	18	Containers vs Virtual Machines	2	
	19	Basics of Dockers	2	
	20	Docker Components	2	
	21	Docker Containers	1	
	22	Docker Images and repositories	1	
V	**Open Ended Module**		**12**	
	1	Cloud platforms in Industry • **Amazon web services**- computation services, storage services, communication services • **Google AppEngine**- Architecture and core concepts • **Microsoft Azure**- Azure core concepts		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	--	2	--	-	1	1						
CO 2	-	2	-	-	1	1						
CO 3	-	1	-	-	1	1						
CO 4	-	1	-	-	2	1						
CO 5	1	1	-	-	2	1						
CO 6	-	1	-	-	2	2						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4		✓	✓
CO 5		✓	✓
CO 6		✓	

References 1. Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments, 2nd Edition, Willey Publications", William Voorsluys, James Broberg, Rajkumar Buyya.

2. "Cloud Computing: A Hands-On Approach" by Arshdeep Bahga and Vijay Madiset.

Programme	BSc AI				
Course Code	AIN5EJ304(2)				
Course Title	Security and Privacy in Cloud				
Type of Course	Elective				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic understanding of computer networks, operating systems, databases, Cloud computing				
Course Summary	This course explores the security and privacy challenges in cloud computing environments. Students will learn about the fundamental principles, technologies, and best practices for ensuring the confidentiality, integrity, and availability of data in the cloud. The course also covers legal and ethical considerations related to privacy in cloud computing.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand fundamentals of security concepts (encryption, decryption)	U	C	Instructor-created exams / Quiz
CO2	Understand security design principles.	U	C	Assignment / Seminar presentations/ Exams
CO3	Analyze various threats to cloud security	U	P	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Understand various cloud security design patterns.	U	C	Instructor-created exams / Home Assignments

CO5	Explore various access control mechanisms and management schemes to ensure security in cloud.	U	P	Writing assignments/ Exams/ Seminar Presentations
CO6	Explore various levels of security in cloud infrastructure	U	F	Case Study/ Exams

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
I	**Fundamentals of Security in Cloud**		**14**	**22**
	1	Overview of Cloud Security- Security services- Confidentiality, Integrity, Authentication, Non repudiation, Access control	2	
	2	Basics of Cryptography	2	
	3	Conventional and public key cryptography	4	
	4	Hash functions	2	
	5	Authentications	2	
	6	Digital Signature	2	
II	**Security Design and Architecture for Cloud**		**12**	**18**
	7	Security design principles for cloud computing- comprehensive data protection, end to end access control	2	
	8	Common attack vectors and threats	1	
	9	Network and storage- Secure Isolation strategies, Virtualisation strategies, inter- tenant network segmentation strategies, data protection strategies	3	
	10	Data retention, detection and archiving procedures for tenant data	2	
	11	Encryption, Redaction, Tokenisation, Obfuscation	2	
	12	PKI and key	2	
III	**Access Control and Identity Management**		**12**	**18**
	13	Access control requirements for Cloud infrastructure- user	2	

		identification, authentication and authorization		
	14	Role based access control- multi-factor authentication, single Sign-on	2	
	15	Identity providers and service consumers	2	
	16	Storage and network access control options- OS Hardening and minimization	3	
	17	Intruder detection and prevention	3	
IV	**Cloud Security Design patterns**		**10**	**12**
	18	Introduction to design patterns	2	
	19	Cloud bursting	2	
	20	Geo-tagging	2	
	21	Secure cloud interfaces	2	
	22	Cloud resource access control	2	
V	**Open Ended Module**		**12**	
	1	Infrastructure security: Network level, host level, application level	4	
	2	Security management in the cloud	4	
	3	Audit and compliance	4	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	2	--	-	1	1						
CO 2	-	2	-	-	1	1						
CO 3	-	1	-	-	1	1						
CO 4	-	1	-	-	2	1						
CO 5	1	1	-	-	2	1						

CO 6	-	1	-	-	2	2						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4		✓	✓
CO 5		✓	✓
CO 6		✓	

References:

1. "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" by Tim Mather, Subra Kumaraswamy, and Shahed Latif.

2. “Cloud computing: Principles and Paradigms”. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Willey Publications.

Programme	BSc AI				
Course Code	AIN6EJ303(2)				
Course Title	Storage Technologies				
Type of Course	Elective				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic knowledge of computer systems and architecture Fundamental understanding of data structures and algorithms				
Course Summary	This course introduces students to various storage technologies, storage network technologies, storage and virtualization technologies. Course also discuss various back up and recovery strategies.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand fundamentals of Information storage	U	C	Instructor-created exams / Quiz
CO2	Examine features of various storage architectures	U	C	Assignment / Seminar presentations/ Exams
CO3	Understand features of Intelligent storage systems	U	P	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Identify features of various Storage technologies	U	C	Instructor-created exams / Home Assignments
CO5	Identify need of backup and recovery and various recovery mechanisms	U	P	Writing assignments/

				Exams/ Seminar Presentations
CO6	Infer security needs and management needs for storage technologies	U	F	Case Study/ Exams

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
I	**Storage System**		**12**	**18**
	1	**Introduction to Information Storage-** Information Storage, Evolution of Storage Architecture	2	
	2	Data Center Infrastructure and characteristics	1	
	3	Third platform technologies- Cloud storage and its characteristics	2	
	4	Cloud services and deployment models	3	
	5	Storage Architectures- Direct-Attached Storage (DAS) Network-Attached Storage (NAS) (Introduction only)	2	
	6	Storage Area Network (SAN) Cloud storage architectures (Introduction only)	2	
II	**Intelligent Storage Systems & RAID**		**12**	**18**
	7	RAID Implementation Methods, RAID Array Components, RAID Techniques	2	
	8	RAID Levels, RAID Impact on Disk Performance	3	
	9	RAID Comparison	1	
	10	Components of an Intelligent Storage System	1	
	11	Storage Provisioning	2	
	12	Types of Intelligent Storage Systems	3	
III	**Storage Networking Technologies - Fibre Channel Storage Area Networks**		**12**	**18**

	13	Block based stored system, File based storage system, object oriented based storage system (Introduction)	2	
	14	Fibre Channel Storage Area Networks- Components of FC SAN,	2	
	15	Fibre Channel Architecture	2	
	16	Fabric Services	2	
	17	FC SAN Topologies	2	
	18	Virtualization in SAN	2	
IV	**Backup and Archive**		**12**	**16**
	19	Backup Purpose, Backup Considerations, Back up Granularity	3	
	20	Recovery Considerations, Backup Methods	3	
	21	Backup Architecture, Backup Topologies	3	
	22	Backup and Restore Operations	3	
V	**Open Ended Module**		**12**	
	1	Storage Security Domains	3	
	2	Security Implementations in Storage Networking	3	
	3	Securing Storage Infrastructure in Virtualized and Cloud Environments	3	
	4	Storage Infrastructure Management Activities	3	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	2	--	-	1	1						
CO 2	-	2	-	-	1	1						
CO 3	-	1	-	-	1	1						
CO 4	-	1	-	-	2	1						
CO 5	1	1	-	-	2	1						

CO 6	2	-	-	-	2	2						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4	✓	✓	✓
CO 5	✓	✓	✓
CO 6	✓	✓	

References

1. Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments, 2nd Edition, Willey Publications

Programme	BSc AI				
Course Code	AIN6EJ304(2)				
Course Title	Virtualization				
Type of Course	Elective				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic understanding of cloud computing				
Course Summary	This course introduces students to the fundamental concepts, technologies, virtualization, various virtualization tools and virtualization in storage, desktop, network and server				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand basics of virtualization	U	C	Instructor-created exams / Quiz
CO2	Understand how hypervisors work and their role in virtualization.	Ap	P	Assignment / Seminar presentations/ Exams
CO3	Understand Differences between various types of virtualization, including server virtualization, desktop virtualization, network virtualization, and storage virtualization	Ap	C	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Explore how virtualization technologies are used in the context of cloud services.	U	P	Instructor-created exams / Home Assignments
CO5	Understand the potential risks and vulnerabilities associated with	U	P	Writing assignments/

	virtualization and learn how to mitigate them.			Exams/ Seminar Presentations
CO6	Compare and analyse various virtualization tools	U	F	Case Study/ Exams

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
I		**Introduction to Virtualisation**	**12**	**18**
	1	Virtualization and computing- need for virtualisation,	2	
	2	Cost, administration,	2	
	3	Fast deployment, reduce infrastructure cost	2	
	4	Limitations	1	
	5	Types of hardware virtualization: full virtualisation, partial virtualization, paravirtualization	3	
	6	Types of hypervisors	2	
II		**Server and Desktop Virtualization**	**14**	**20**
	7	Virtual machine basics	2	
	8	Types of virtual machines	2	
	9	Understanding server virtualisation- types of server virtualization	3	
	10	Business cases for server virtualization	2	
	11	Uses of virtual server consolidation,	2	
	12	Selecting server virtualisation platform	1	
	13	Desktop virtualisation- types of desktop virtualization	2	
III		**Network Virtualisation**	**12**	**18**
	14	Introduction to network virtualisation	2	
	15	Advantages, functions	2	

	16	Tools for network virtualization	3	
	17	VLAN-WAN architecture	2	
	18	WAN Visualization	3	
IV	**Storage Virtualization**		**10**	**16**
	19	Introduction to memory virtualization	2	
	20	Types of storage virtualization	3	
	21	Risk of storage virtualization	2	
	22	SAN-NAS-RAID	3	
V	**Open Ended Module- Virtualization tools (Any 3- 4 hours each)**		**12**	
		• VMWare-Amazon AWS • Microsoft HyperV • Oracle VM Virtual box • IBM PowerVM • Google Virtualization		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	2	--	-	1	1						
CO 2	-	2	-	-	1	1						
CO 3	-	1	-	-	1	1						
CO 4	2	1	-	-	2	1						
CO 5	-	1	-	-	2	1						
CO 6	1	1	-	-	2	2						

Correlation Levels:

Level	Correlation
-	Nil

1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4		✓	✓
CO 5		✓	✓
CO 6	✓	✓	

References

1. Cloud Computing a practical approach- Anthony T Velte, Toby T Velte, Robert Elsenpeter, Tata McGraw Hill
2. Virtualization from Desktop to the Enterprise, Chris Wolf, Eric M Halter

Programme	BSc AI				
Course Code	AIN8EJ401				
Course Title	System Software				
Type of Course	**Major**				
Semester	VIII				
Academic Level	400 - 499.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Introduction to Computer Science 2. Data Structures and Algorithms				
Course Summary	With an emphasis on the creation and use of system software, this course examines the ideas and methods of system programming. Compiler design, system calls, loaders and linkers, and debugging methods are among the topics covered.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define the key concepts in system programming, such as compilers, assemblers, linkers, and loaders. Identify the various stages in the compilation process and understand the purpose of each stage.	U	C	Instructor-created exams / Quiz
CO2	Master different types of system calls and their role in system programming. Master the principles of lexical and syntax analysis in the context of compiler design. Master various linking and loading schemes	Ap	P	Assignment / Seminar presentations/ Exams
CO3	Interpret and understand the process of debugging, including the use of debugging tools and techniques.	Ap	P	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Analyze the impact of different optimization techniques in the compilation process. Evaluate advantages and disadvantages of various linking and loading schemes.	U	C	Instructor-created exams / Home Assignments
CO5	Implement programs using system calls to perform various system-level tasks, such as file operations and	Ap	P	Writing assignments

	process management			
CO6	Apply principles of compiler design to write a simple compiler using a programming language.	Ap	P	Case Study

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks (70)
I	**Introduction to System Programming & Assemblers**		**14**	**15**
	1	Introduction to System Programming- Goals of System Software, System Programs and Systems Programming	3	
	2	Language Processors- Overview, Kinds of Language processors, language processing activities, program execution	4	
	3	System Tables	1	
	4	Assemblers- Elements of Assembly Language Programming	2	
	5	Design of two pass assembler	4	
II	**Macros and Macro Processors**		**10**	**15**
	6	Introduction to macros and macro processors- macro definition and call, macro expression	4	
	7	Nested macro calls	2	
	8	Design of macro processor	4	
III	**Linkers and Loaders, Scanning and Parsing**		**10**	**20**
	9	Relocation and linking concepts	2	
	10	Design of linkers	2	
	11	Self locating program	2	
	12	Loaders- absolute loader, relocating loader	4	
IV		**Compilers, System calls and libraries**	**14**	**20**
	13	Data structures used in compilers	1	
	14	Phases of a compiler – Introduction	1	
	15	Lexical Analysis (Scanning)	2	
	16	Syntax Analysis (Parsing)	2	
	17	Semantic Analysis	1	
	18	Intermediate code generation	1	
	19	Code optimisation- optimisation transformation, local optimisation, global optimisation, Code Generation	2	
	20	Passes of Compiler	1	
	21	System calls and their implementation	1	
	22	Standard C library functions for system calls	2	

V	Open Ended Module: Case Studies		12	
	1	• Case studies of lexical and syntax analyzers: LEX and YAAC. • System programs using system calls		

References

- D.M. Dhamdhere, Systems Programming and Operating Systems
- John J Donovan, Systems programming
- Jim Welsh and R M Mckeag, Structured System Programming, Prentice Hall.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	-	1	-	-						
CO 2	2	3	-	1	-	-						
CO 3	1	-	1	1	1	-						
CO 4	2	2	1	1	-	-						
CO 5	2	3	1	-	-	-						
CO 6	2	3	1	-	-	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4		✓	✓
CO 5		✓	✓
CO 6		✓	

Programme	BSc AI				
Course Code	AIN8EJ402				
Course Title	Digital and Mobile Forensics				
Type of Course	**Elective**				
Semester	VIII				
Academic Level	400 – 499.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites					
Course Summary					

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamental concepts of digital forensics, including the importance of digital evidence and its role in investigations	Ap	P	Instructor-created exams/ Home Assignments
CO2	Demonstrate proficiency in the digital forensic process, from identification and collection to examination, analysis, and presentation of evidence	Ap	P	Instructor-created exams/ Home Assignments
CO3	Gain knowledge of international cooperation mechanisms for collecting digital evidence and the legal frameworks and standards governing digital forensic investigations	U	C	Instructor-created exams / Quiz
CO4	Develop skills in conducting investigations specific to iOS and Android platforms, including knowledge of operating system fundamentals, file systems, security measures, and forensic tools	U	C	Instructor-created exams /Quiz
CO5	Assess and implement enterprise-level digital forensic readiness strategies to prepare organizations for potential cyber incidents and enhance their ability to respond to security breaches effectively	U	C	Instructor-created exams /Quiz
CO6	Analyze real-world cybercrime case studies within the Indian legal context, applying cyber laws and investigative methodologies to solve digital crimes effectively	U	C	Instructor-created exams /Quiz
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)				

Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to digital forensic process**	**10**
	1	Introduction to Digital Forensics – Forensic Science, Digital Forensics, Digital Evidence	2
	2	Digital Forensic process	1
	3	The identification phase	1
	4	The collection phase	2
	5	The examination phase	2
	6	The analysis phase	2
	7	The presentation phases	
II		**Digital Crime and Investigation & Digital Forensic Readiness**	**10**
	8	Digital Crime- Substantive criminal law	3
	9	Investigation methods of Collecting Digital evidence	2
	10	International cooperation in order to collect digital evidence	1
	11	Digital Forensic readiness – the rationale, Frameworks, standards and methodologies, Enterprise digital forensic readiness	4
III		**Mobile Forensics: iOS Forensics**	**16**
	12	Introduction to mobile forensics - What is mobile forensics, its need, Challenges and evidence extraction	3
	13	Practical mobile forensic approaches - overview of mobile operating systems, mobile forensic tool levelling system, data acquisition methods	1
	14	Evidences: Potential evidences stored on mobile phones, examination and analysis and rules of evidence, good forensic practices	2
	15	Overview iOS devices -iPhone, iPad and Apple watch models and hardware, file system, disk layout, iOS architecture and security	3
	16	Data Acquisition form iOS Devices and backups	3
	17	iOS Data analysis and recovery	2
	18	iOS Forensic tools	2
IV		**Android Forensics**	**12**
	19	Understanding android- Android model, Security, file hierarchy, file system	3
	20	Android Forensic setup and Pre-Data Extraction techniques-	3
	21	Android Data Extraction Techniques	3
	22	Android Data Analysis and Recovery	3
V		**Cyber Forensics in the Indian Context**	**12**
		Cyberlaws in India Cybercrime case studies	

References

- "Digital Forensics", edited by Andre Arnes, Published by John Wiley and Sons
- "Practical Mobile Forensics", Rohit Tamma, Oleg Skulkin, Heather Mahalik, Satish Bommisetty
- "An In-Depth Guide to Mobile Device Forensics" Chuck Easttom

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	-	-	-	-						
CO 2	3	3	2	-	-	-						
CO 3	2	3	-	-	-	-						
CO 4	2	3	-	-	-	-						
CO 5	2	3	-	-	-	-						
CO 6	1	3	-	-	-	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓	✓	✓
CO 2	✓	✓	✓
CO 3	✓	✓	✓
CO 4	✓		✓
CO 5	✓		✓
CO 6	✓		✓

Programme	BSc AI				
Course Code	AIN8EJ403				
Course Title	Ethical Hacking				
Type of Course	Elective				
Semester	VIII				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Understanding of the fundamental networking and protocols concepts. 2. Familiarity with various operating systems, file systems and basic system administration tasks.				
Course Summary	This course provides the skills to identify, analyze, and address security vulnerabilities in systems, networks, and web applications. It aims to learn to perform penetration testing, conduct reconnaissance, exploit vulnerabilities, and maintain access ethically and legally.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamentals of Ethical Hacking	U	C	Instructor- created exams / Quiz
CO2	Learn the features of Foot Printing and Reconnaissance	Ap	P	Assignment / Seminar presentations/ Exams
CO3	Apply the System Hacking methods	Ap	P	Seminar Presentation/ Group Tutorial Work/ Viva Voce
CO4	Understand attacks and type of attacks Apply reasoning with ontologies and rules	U	C	Instructor- created exams / Home Assignments
CO5	Apply various Penetration Testing methods	Ap	C	Writing assignments/ Exams/ Seminar Presentations
CO6	Develop theoretical concept on various types of attacks and apply the platforms to explore them.	Ap	P	Case Study/ Group discussions/ Presentations
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)				

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Mark
I	**Fundamentals of Ethical Hacking**		**15**	**15**
	1	Information security overview, Introduction to Hacking, importance of Security – Elements of Security	2	
	2	Hacking Concepts and Hacker Classes - Phases of Hacking Cycle,	3	
	3	Ethical Hacking Tools - Threat and Threat Sources - Malware and Components of Malware -	4	
	4	Types of Malwares, Types of Hackers	3	
	5	Common Hacking Methodologies, Benefits and challenges of Ethical Hacking,	3	
II	**Foot Printing & Reconnaissance**		**12**	**20**
	6	Foot Printing & Reconnaissance: Foot printing concepts, Use of foot printing,	2	
	7	information gathering, Types of foot printing, Website Foot printing	2	
	8	Foot printing through Search Engines, Foot Printing through Social Networking sites	2	
	9	Foot Printing tools, Understanding the information gathering process,	2	
	10	Website Foot printing, WHOIS Foot printing,	2	
	11	Network Scanning, Port scanning,	1	
	12	Tools used for the reconnaissance phase	1	
III	**System Hacking**		**11**	**20**
	13	Password Cracking - Types of Password Attacks	1	
	14	Password Cracking Tools and vulnerabilities	1	
	15	Identity Theft - Social Engineering and tools	2	
	17	Types of attacks and their common prevention mechanisms	2	
	17	Keystroke Logging, Denial of Service (DoS /DDoS),	2	
	18	Waterhole attack, brute force, phishing and fake WAP, Session Hijacking	3	
IV	**Penetration Testing**		**10**	**15**
	19	Introduction to Penetration Testing, Types of Penetration Testing-	2	
	20	Phases of Penetration Testing,	3	
	21	pen testing, type of pen testing.	3	
	22	Tools of Penetration Testing, Test web applications for vulnerabilities	2	
V	**Open Ended Module- Mobile, cloud and IoT Based attacks, Kali Linux**		**12**	
	1	Mobile Platform Attack	3	
	2	Cloud level Attacks and Tools	2	

	3	IoT based attacking Tools	3	
	4	Kali Linux	4	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	-	-	1	1						
CO 2	3	-	-	-	1	1						
CO 3	1	3	1	1	2	3						
CO 4	1	-	1	1	2	3						
CO 5	1	-	-	-	2	3						
CO 6	1	2	1	1	3	3						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓		✓
CO 4	✓	✓	✓
CO 5	✓	✓	✓
CO 6	✓	✓	

Reference:

1. Stuttard, D., & Pinto, M. (2011). The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws (2nd ed.). Wiley. ISBN: 978-1118026472

2. Erickson, J. (2008). Hacking: The Art of Exploitation (2nd ed.). No Starch Press. ISBN: 978-1593271442

3. Baloch, R. (2017). Ethical Hacking and Penetration Testing Guide. CRC Press. ISBN: 978-1138197396

4. Harper, A., Regalado, D., & others. (2015). Gray Hat Hacking: The Ethical Hacker's Handbook (4th ed.). McGraw-Hill Education. ISBN: 978-0071832380

5. Kennedy, D., O'Gorman, J., Kearns, D., & Aharoni, M. (2011). Metasploit: The Penetration Tester's Guide. No Starch Press. ISBN: 978-1593272883

Programme	B. Sc. AI				
Course Code	AIN8EJ404				
Course Title	Big Data Analytics				
Type of Course	Elective				
Semester	VIII				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	4	60
Pre-requisites	Basic knowledge of programming languages (Java, Python) Understanding of Database Management Systems				
Course Summary	This course is structured to provide a comprehensive theoretical understanding of Big Data Analytics, covering fundamental concepts, advanced techniques, and practical applications.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Summarize an understanding of the fundamental concepts of Big Data and its ecosystem.	U	C	Instructor-created exams / Quiz
CO2	Analyze and implement advanced MapReduce programming techniques and optimizations.	An	C	Instructor-created exams
CO3	Utilize SQL and NoSQL databases for efficient data storage, retrieval, and cluster management.	Ap	P	Seminar/assignment / Group Tutorial Work
CO4	Explore and evaluate advanced concepts in Hadoop and its extended ecosystem.	Ap	P	Seminar/assignment / Instructor-created exams
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks (70)
I		**Introduction to Big Data Analytics**	**10**	**15**

	1	Understanding Big Data, Characteristics and Challenges	1	
	2	Introduction to Hadoop Ecosystem	3	
	3	Data Ingestion and Storage	2	
	4	Data Processing and Analysis	2	
	5	Introduction to Data Visualization	2	
II	**Advanced MapReduce Concepts**		**15**	**20**
	6	MapReduce Basic	1	
	7	Advanced Map Reduce API Concepts	2	
	8	Introduction to Apache Pig	2	
	9	Advanced Pig Usage	2	
	10	Introduction to Apache Hive	2	
III	**SQL and Cluster Management**		**10**	**20**
	11	Introduction to SQL for Big Data	1	
	12	SQL on Hadoop: Hive and Impala	2	
	13	The Hadoop Ecosystem	1	
	14	Managing Hadoop Clusters	2	
	15	Resource Management with YARN	2	
	16	Security in Hadoop Ecosystem	2	
IV	**Advanced Concepts in Hadoop**		**10**	**15**
	17	Advanced HDFS	2	
	18	Troubleshooting Hadoop	1	
	19	Integrating Hadoop into the Enterprise	2	
	20	Hadoop in the Cloud	1	
	21	Apache Spark Introduction	2	
	22	Integrating Spark with Hadoop	2	
V	**Open ended module**		**15**	
		Emerging Trends Edge Computing and IoT Integration Quantum Computing in Big Data AI and Machine Learning Integration with Big Data **Research and Innovation** Open Problems and Future Directions in Big Data Big Data and Sustainability **Hands-On Project (Theoretical)** Proposal and Implementation of a Big Data Project (Conceptual) Presentation and Documentation of Findings		

References

1. Jeffrey Aven, Hadoop In 24 Hours Sams Teach Yourself, 2018.
2. Big Data: Principles and Best Practices of Scalable Real-Time Data Systems by Nathan Marz and James Warren
3. Hadoop: The Definitive Guide by Tom White

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	-	-	-	-						
CO 2	1	2	-	-	-	-						
CO 3	1	3	-	1	1	1						
CO 4	-	2	2	2	2	2						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3		✓		✓
CO 4	✓	✓		✓

Programme	BSc AI				
Course Code	AIN8EJ405				
Course Title	Modern Cryptography				
Type of Course	Elective				
Semester	VIII				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Basic understanding of computer networks				
Course Summary	This course covers the essential concepts of computer security, including various security threats and attacks, as well as different cryptographic algorithms aimed at preserving confidentiality, integrity, and ensuring message authentication				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understanding the fundamentals of cryptography	U	C	Instructor-created exams / Quiz
CO2	Acquire a basic knowledge about the security threats and different types of attacks	U	C	Instructor-created exams / Quiz
CO3	Get a basic idea about traditional ciphers	U	C	Instructor-created exams / Home assignments
CO4	Familiarize the standard symmetric key algorithms	A	P	Instructor-created exams / Home assignments
CO5	Familiarize the concepts of public key cryptography	A	P	Instructor-created exams / Home assignments
CO6	Interpret data integrity, authentication, and digital signature	A	P	Instructor-created exams / Home assignments
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Computer and Network Security**		**9**
	1	Computer Security Concepts – CIA triad, challenges of computer security	1

	2	The OSI security architecture – Security attacks, mechanism and services	3
	3	Fundamental security design principles	1
	4	Attack surfaces and attack trees	2
	5	A model for Network security and standards	2
II	**Symmetric Key Cryptography**		**15**
	6	Symmetric Cipher model	3
	7	Substitution and Transposition techniques	4
	8	Traditional block cipher structure	2
	9	Data Encryption standard- Algorithm, example, strength	3
	10	Advanced Encryption standard- structure, Transformation function, example	3
	11	Key channel establishment for symmetric cryptosystems	1
III	**Public Key Cryptography**		**10**
	12	Principles of Public key crypto systems- public key crypto systems, applications, requirements	4
	13	RSA algorithm	2
	14	Security of RSA algorithm	2
	15	Diffie-Hellman key exchange	2
IV	**Cryptographic Data Integrity Algorithms**		**14**
	16	Cryptographic hash functions- applications	2
	17	Message Digest algorithm	2
	18	Secure Hash Algorithm	2
	19	Message Authentication Code -requirements, security	2
	20	MACs based on Hash Functions	2
	21	Digital Signature – properties, attacks and forgeries, requirements	2
	22	RSA-PSS digital signature algorithm	2
V	**Open Ended Module:**		**12**
	1	**Email, IP and web security**	12

References

- "Cryptography and Network Security- Principles and Practice", William Stallings
- "Modern Cryptography: Theory and Practice"- Wenbo Mao Hewlett-Packard Company
- Cryptography and Information Security"- V K Pachghare

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	-	-	-	2	-						
CO 2	3	2	-	-	-	-						
CO 3	3	2	-	-	-	-						

CO 4	3	3	1	2	-	-						
CO 5	3	3	1	2	-	-						
CO 6	3	2	1	1	1	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	End Semester Examinations
CO 1	✓		✓
CO 2	✓		✓
CO 3	✓	✓	✓
CO 4	✓	✓	✓
CO 5	✓	✓	✓
CO 6	✓	✓	✓

Programme	BSc AI				
Course Code	C8EJ406				
Course Title	Mixed Reality				
Type of Course	Elective				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	No pre-requisites required				
Course Summary	This course explores the principles and applications of Mixed Reality-Virtual Reality (VR) and Augmented Reality (AR), covering topics including Tracking, Motion, Interaction and Navigation. Students will delve into the technical foundations, design considerations, and emerging techniques shaping the development and utilization of VR and AR technologies in various fields.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand about virtual reality, creation of immersive VR experiences and human physiology's interaction with the virtual environments.	U	C	Instructor- created exams / Quiz/Assignment/ Seminar
CO2	Able to proficiently define the geometry of the virtual world containing transformations and optics that define the human perception.	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO3	Acquire a comprehensive understanding of different techniques used for visual perception and visual rendering for the creation of virtual world	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO4	Understand how the motion in virtual world happens, the experiments conducted, and how the evaluation of VR systems are carried out	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO5	Familiarize with the concept of Augmented Reality, their characteristics and various the tracking technologies used in the process.	U	C	Instructor-created exams/ Quiz/Assignment/ Seminar
CO6	A comprehensive understanding of the output and input modalities used for navigation, and the software engineering requirements needed for the development of AR technologies.	U	C	Instructor-created exams/ Quiz/Assignment / Seminar

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Contents	Hrs (48+12)	Mark
I		**Virtual Reality**	**16**	**20**
	1	What is Virtual Reality?	1	
	2	Modern VR experiences, History repeats	2	
	3	Hardware, Software	2	
	4	Human physiology and Perception	3	
	5	Geometry of virtual world- Geometric models, Changing position and orientation	3	
	6	Light and optics – Basic behavior light, Lenses	2	
	7	Optical aberrations, Human eye, Cameras, Displays	3	
II		**Implementation of Virtual World**	**16**	**20**
	8	Perception of Depth, Perception of Motion, Perception of Colour	4	
	9	Ray tracing and Shading models, Rasterization	4	
	10	Motion in real and virtual world – Velocities, Acceleration, The Vestibular system (no diagram required)	3	
	11	Physics in the virtual world, Mismatched motion and vection	3	
	12	Evaluating VR systems and experiences – Perceptual training, Experiments on human subjects - scientific method, Human subjects, Ethical standards	2	
III		**Augmented Reality**	**08**	**15**
	13	Introduction - Definition and scope	1	
	14	Tracking - Coordinate systems, Model transformation, View transformation, Projective transformation	1	
	15	Characteristics of tracking technology – Physical phenomena, Measurement principle, Measured geometric property, Sensor arrangement, Signal sources	2	
	16	Stationary tracking systems – Mechanical, Electromagnetic, Ultrasonic	2	
	17	Mobile sensors – GPS, Wireless networks, Magnetometer, Gyroscope	2	
IV		**Interaction, Navigation and Requirements**	**08**	**15**
	18	Output modalities - Augmentation Placement, Agile Displays, Magic Lenses	1	
	19	Input modalities- Tracking and Manipulation of Rigid Objects, Body Tracking, Gestures	1	

	20	Foundations of human navigation	2	
	21	Exploration and discovery, Route visualization	1	
	22	Software engineering requirements - Platform Abstraction, User Interface Abstraction, Reusability and Extensibility, Distributed Computing, Decoupled Simulation	3	
V	**Open Ended Module**		**12**	
		• Comparative analysis of VR applications in different industries such as healthcare, education, entertainment, and training. • Study of the impact of AR on social interaction and communication patterns. • Evaluation of AR games and entertainment experiences, including case studies of popular AR games and immersive storytelling experiences. • Case studies of successful or unsuccessful VR projects, analysing factors contributing to their outcomes. • Exploration of ethical considerations in VR development and usage, considering issues like privacy, safety, and psychological impact.	12	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	-	-	-	-	-						
CO 3	2	2	-	-	-	-						
CO 4	2	2	-	-	2	1						
CO 5	1	-	-	-	2	-						

CO 6	2	2	-	-	-	1						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		✓

References:

1. Steven M. LaValle, “Virtual Reality”, Cambridge university Press, 2020.
2. Dieter Schmalstieg, Tobias Hollerer “ Augmented Reality: Principles and Practice”, Addison-Wesley, 2016.
3. Gregory C. Burdea & Philippe Coiffet “Virtual Reality Technology”, John Wiley & Sons, 2017.

General Foundation Courses

Programme	BSc AI				
Course Code	AIN1FM105				
Course Title	Data Analysis and Visualisation through Spreadsheets				
Type of Course	**MDC**				
Semester	I				
Academic Level	100-199.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	• Basic understanding of computers • Familiarity with basic mathematical operations				
Course Summary	This course provides a comprehensive introduction to Spreadsheets, focusing on understanding formulas, functions, data organization, analysis techniques, and data visualization. Participants will gain skills in spreadsheet management, data cleansing, analysis, and visualization using Excel's various tools and features.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will demonstrate proficiency in managing spreadsheets, including creating, formatting, and manipulating data within Excel workbooks. They will be able to effectively navigate Excel's interface and utilize toolbars.	U	P	Instructor-created exams / Quiz
CO2	Learners will understand the importance of data organization and cleansing in Excel. They will be able to import, export, filter, sort, validate, and remove duplicates from datasets. Students will develop skills to ensure data integrity and consistency, enhancing their ability to work with clean and organized data sets.	U	P	Instructor-created exams/ Home Assignments
CO3	Participants will acquire advanced data analysis skills like pivot tables, what-if analysis, and goal seek. They will be able to apply various Excel functions and tools to perform complex calculations, analyze trends, and make informed decisions based on data analysis.	Ap	P	Instructor-created exams
CO4	Students will gain proficiency in data visualization techniques using Excel.	Ap	P	Instructor-created exams

	They will be able to create a variety of charts, design pivot charts, dashboards for effective data analysis. Additionally, learners will be able to implement form controls for interactive data manipulation in their visualizations.			
CO5	Learners will develop skills in advanced features of Excel like macros, protect data sheets and workbooks, utilize split, freeze, and hide options effectively, incorporate add-ins for extended functionalities, and manage printing options in Excel for professional presentation of data.	Ap	P	Instructor-created exams
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (36+9)	Marks (50)
I	**Introduction to Excel & Understanding Formulas, Functions**		**9**	**15**
	1	Features of Spreadsheet	1	
	2	Parts of Excel Window, Tool bars, Work sheet and Work book, Insertion and Deletion of cells, columns, rows	2	
	3	Formatting in Excel (Merge, Warp, Font Formatting, Number Formatting, Borders and Shading, Colouring)	2	
	4	Range, Autofill, Autosum, Relative, Absolute and Mixed Referencing in Excel, Linking data between worksheets	2	
	5	Formulas and Functions in Excel: Use of Formula Bar, Functions: SUM,ROUND, CEIL, FLOOR,IF, AND, OR,AVERAGE, MIN, MAX ,COUNT, COUNTIF, SUMIF, VLOOKUP,HLOOKUP	2	
II	**Cleansing and Organising Data in Excel**		**9**	**10**
	6	Importance of Data Cleansing and Organisation	1	
	7	Data Import and Export	2	
	8	Filtering and Sorting	2	
	9	Data Validation and remove Duplicates	1	
	10	Group, Ungroup, Subtotal	2	
	11	Conditional Formatting – Highlight Cell Rules, Top/Bottom Rules	1	
III	**Advanced Techniques for Data Analysis**		**8**	**10**

	12	Features of Pivot table	1	
	13	Pivot Table creation	2	
	14	What-if Analysis	2	
	15	Goal Seek	2	
	16	Watch Window	1	
IV	**Data Visualisation Techniques**		**10**	**15**
	17	Creating Charts, Different types of charts	2	
	18	Formatting Chart Objects, Changing the Chart Type, Showing and Hiding the Legend, Showing and Hiding the Data Table	2	
	19	Pivot Chart	2	
	20	Dashboards	1	
	21	Form Controls	3	
V	**Open Ended Module: More about Excel**		**9**	
	1. Recording and Running Macros 2. Protecting Data Sheets and Workbooks 3. Split, Freeze and Hide options 4. Add-ins 5. Printing options in Excel			

References

1. "Excel 2019 Bible" by Michael Alexander and Richard Kusleika
2. "Excel Formulas & Functions For Dummies" by Ken Bluttman and Peter Aitken
3. “Excel with Microsoft Excel: Comprehensive & Easy Guide to Learn Advanced MS Excel” by Naveen Mishra

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Final Exam

Programme	BSc AI				
Course Code	AIN2FM106				
Course Title	Digital Empowerment through Ethical Standards				
Type of Course	**MDC**				
Semester	II				
Academic Level	100 – 199.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	Basic understanding of computers				
Course Summary	This course explores the evolution from pre-digital challenges to the current digital landscape, covering historical milestones, key technologies, and the vision of Digital India. It emphasizes the benefits and importance of digital revolution while addressing ethical and security considerations. Participants engage with digital tools for personal and professional growth and examine case studies on digital infrastructure, missions, and services to understand real-world applications.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will be able to analyze the challenges of the pre-digital age and comprehend the importance and benefits of digital revolution, facilitating a deeper understanding of technological evolution.	An	F	Instructor-created exams / Quiz
CO2	Participants will gain familiarity with key digital technologies like Cloud Computing, IoT, AI, and Blockchain, equipping them with the knowledge to identify their applications and potential benefits in different sectors.	U	C	Instructor-created exams/ Home Assignments
CO3	Students will develop insights into Digital India initiatives and emergence of Kerala as Digital Society	U	C	Instructor-created exams
CO4	Through exploration of digital tools for personal and professional growth, students will enhance their digital literacy and ability in utilizing tools for data sharing, online learning, networking, and content creation,	Ap	P	Instructor-created exams

	empowering them to thrive in the digital age.			
CO5	Learners will become aware of ethical and security considerations in the digital age, including privacy concerns, Intellectual Property Rights, key terminologies related to cyber security, and an introduction to cyber laws in India, fostering responsible digital citizenship.	U	C	Instructor-created exams
CO6	Students will analyze real-world case studies of digital infrastructure projects, digital missions, and digital services to demonstrate a comprehensive understanding of the practical applications and implications of digital technologies in various contexts, fostering critical thinking and strategic decision-making skills in digital transformation initiatives.	An	C	Instructor-created exams
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs 36+9	Marks (50)
I	**Transition to Digital World**		**7**	**8**
	1	Challenges of Pre-Digital Age	1	
	2	Importance and Benefits of Digital Revolution	2	
	3	Key concepts: digitization, digitalization, digital transformation	1	
	4	Introduction to Key Digital Technologies: Cloud Computing, IoT, AI, Block Chain	3	
II	**Perspective of Digital India & Digital Innovations in Kerala**		**11**	**15**
	5	Understanding Digital India: Concept, Objectives, and Evolution	1	
	6	Overview of Digital Infrastructure: Broadband Connectivity, Digital Literacy, and Access to Information	2	
	7	Vision of Digital India: DigiLocker, E-Hospitals, e-Pathshala, BHIM, , e-Health Campaigns	3	
	8	Kerala-Emergence as Digital Society : Internet & Mobile Penetration in Kerala, 4 Pillars of Digital Emergence in Kerala (Akshaya Project, IT@School Project, Digital	2	

		Infrastructure Availability, State Data Centre & allied Applications),		
	9	Role of K-DISC in Digital Empowerment	1	
	10	Kerala State IT Mission: Core IT Infrastructure, e-Governance Applications, Service Delivery Platforms,	2	
III	**Digital Tools for Personal and Professional Growth**		**9**	**12**
	11	Digital Tools for Data Sharing: Google Drive, Google Sheets	2	
	12	Digital Tools for Data Sharing: Google Docs, Google Classroom	3	
	13	Online learning platforms and resources (e.g., Coursera, Khan Academy, MOOCs, Duolingo)	2	
	14	Networking Tools: LinkedIn	1	
	15	Content Creation and Management: Canva	1	
IV	**Ethical and Security Considerations in the Digital Age**		**9**	**15**
	16	Understanding privacy in the digital age	1	
	17	Legal and ethical considerations in data collection and processing: Intellectual Property Rights (IPR)	2	
	18	Key Terminologies: Cyber Security, Cyber Crime, Cyber Attack, Cyber Espionage, Cyber Warfare	2	
	19	Authentication, Authorisation	1	
	20	Cyber Crimes and Classification	2	
	21	Introduction to Cyber Laws in India	1	
V	**Open Ended Module: Case Study (One from each set)**		**9**	
	1	Case Study on Digital Infrastructure Projects: (Bharat Broadband Network (BBNL) , Submarine Cable Project, Google Data Center)	3	
	2	Case Study on Digital Mission: (Digital Literacy Missions in Kerala, SmartDubai Project, China's Digital Silk Road)	3	
	3	Case Study on Digital Services: (MyGov.in , Moodle LMS, Digital Payment Services)	3	

References

1. "Digital India Importance Needs and Values" by S K Kaushal
2. "Cyber Security in India: Government, Law Enforcement and Corporate Sector" by Vipin M. Chaturvedi and Shivani Kapoor
3. "Information Security: Principles and Practices in Indian Context" by R.S. Pressman, G. Sharma, and G. Sridhar
4. "Introduction to Computer Security" by Michael Goodrich and Roberto Tamassia
5. https://kdisc.kerala.gov.in/
6. https://itmission.kerala.gov.in/

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar

- Midterm Exam
- Final Exam

Programme	BSc AI				
Course Code	AIN3FV108				
Course Title	Introduction to Cyber Laws				
Type of Course	VAC				
Semester	III				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	1. Basic Computer Literacy 2. Familiarity with Online Platforms				
Course Summary	Introduction to Cyber laws provides students with a foundational understanding of various concepts Cyber Crimes and Cyber laws against them.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the concept of Cyber Space, Cyber Crimes and cyber laws	U	C	Instructor-Create Exams or Quiz
CO2	To understand details of cybercrimes and criminals	A	P	Discussions and Quizzes
CO3	To examine various provisions in IT Act 2000	U	F	Instructor created exams or home assignments
CO4	To Identify Intellectual Property right and E-commerce related issues.	A, E	P	Discussions, Quizzes
CO5	To get overall idea of cyber laws and its enforcement mechanisms in India	Ap	P	Viva Voce Observation of practical skills
CO6	To get to know about Penalties and legal implications associated with cybercrimes under Indian law	U	M	Instructor Created - Exams, Assignments

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs (36+9)	Marks

I	**Introduction to Cyber Space**		**9**	**12**
	1	Cyber Space- Fundamental definitions	2	
	2	Jurisprudence and-Jurisdiction in Cyber Space	2	
	3	Need for IT act - Enforcement agencies	3	
	4	Introduction to cyber law and its relevance in the Indian context	2	
II	**Cyber Crimes and Criminals**		**9**	**12**
	5	Cyber crimes	2	
	6	Cyber Criminals and their Objectives	2	
	7	Cyber stalking; cyber pornography	2	
	8	Forgery and fraud; crime related to IPRs;	2	
	9	Phishing and Identity Theft	1	
III	**Indian Cyber law**		**9**	**14**
	10	Introduction to Indian Cyber Law	2	
	11	Cyber Crime vs Conventional Crime	2	
	12	Electronic Commerce and related issues	2	
	13	Overview of Intellectual Property rights	2	
	14	Computer Software and related IPR Issues	1	
IV	**Basics of IT law and its regulatory mechanisms**		**9**	**12**
	13	Key provisions of the Information Technology Act, 2000 related to cybercrimes and offenses	2	
	14	Regulatory Mechanisms and Enforcement	2	
	15	Overview of the Cyber Crime Investigation Cell (CCIC)	2	
	16	Understanding the process of reporting cyber crimes	2	
	17	Penalties and legal implications associated with cybercrimes under Indian law (basics only)	1	
V	**Hands-on: Practical Applications, Case Study and Course Project**		**9**	
	1	**S**ocial media based Cyber crimes	2	

	2	Discussion on Emerging issues	2	
	3	Recent trends in digital marketing	3	
	4	Demonstrate how to use google web masters Indexing Using API	2	

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓			✓
CO 4	✓			✓
CO 5		✓		✓
CO6				✓

References:

1. Cyber law –The Indian perspective by Pavan Duggal
2. Justice Yatindra Singh: Cyber Laws, Universal Law Publishing Co., New Delhi
3. Farouq Ahmed, Cyber Law in India, New Era publications, New Delhi

Programme	BSc AI				
Course Code	AIN4FV109				
Course Title	Professional Skill Development for IT Career Excellence				
Type of Course	VAC				
Semester	IV				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	1. Basic Mathematics 2. Basic English reading and Writing Skills				
Course Summary	The course provides a comprehensive overview of essential skills and knowledge relevant to success in information technology. It covers various topics, including personal development, communication, quantitative reasoning, programming, software development, and web technologies.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will demonstrate effective communication skills, including verbal and written communication, and adhere to professional etiquette standards in various contexts, including digital communication.	Ap	C	Assignment / Instructor-created exams / Quiz
CO2	Students will develop job readiness skills, including resume writing, job application preparation, and interview techniques, to enhance their employability and succeed in job interviews.	E	C	Assignment / Instructor-created exams / Quiz
CO3	Students will collaborate effectively in group discussions and presentations, demonstrating teamwork, leadership, and critical thinking skills in diverse group settings.	Ap	C	Assignment / Instructor-created exams / Quiz
CO4	Students will apply quantitative and logical reasoning skills to solve mathematical problems, analyse data, and make informed decisions in various contexts, including financial and analytical reasoning.	Ap	C	Assignment / Instructor-created exams / Quiz
CO5	Students will understand fundamental programming concepts, data structures, and database principles,	Ap	C	Assignment / Instructor-created exams /

	and apply them to solve computational problems and develop software applications.			Quiz
CO6	The student will be able to learn areas and skills essential for success in the IT industry, including communication, problem-solving, programming, and technology integration.	Ap	C	Assignment / Instructor-created exams / Quiz
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs (36+9)	Marks
I	**Introduction to Soft Skills and Academic Skills**		**10**	**15**
	1	Personality Development: Knowing Yourself, Positive Thinking, Communication Skills, Professional Etiquette	2	
	2	Employment Communication: Introduction, Resume, Curriculum Vitae, Developing an Impressive Resume, Job Application or Cover Letter	2	
	3	Job Interviews: Definition of Interview, Types of Interviews, Preparatory Steps for Job Interviews, Interview Skill Tips	2	
	4	Group Discussion: Importance of Group Discussions, Difference between Group Discussion, Panel Discussion and Debate, Preparing the Presentation, Delivering the Presentation	2	
	5	HR round: Self Introduction, Strength and Weakness Analysis, Scenario-Based Tasks, Body Language, Positive Attitude	2	
II	**Basic Aptitude Skills**		**9**	**15**
	6	Number System: HCF and LCM, Decimal Fraction, Problems on Age	2	
	7	Square Root, Cube Root, Problems on Numbers,	1	
	8	Problems on Speed, Time and Distance, Percentage, Problems on Trains	2	
	9	Profit and Loss, Ratio and Proportion, Partnership	2	
	10	Simple Interest, Compound Interest, Chain Rule, Problems on Callender and Clock	2	
	Reasoning Skills Development		**9**	**10**

III	11	Verbal Reasoning: Antonym and Synonym, Verbal Analogies, Spotting Errors, Ordering Words, Sentence correction, Fill in blanks, Replace the word, Idioms and Phrases	3	
	12	Logical Reasoning Aptitude: Series: Missing Numbers, Odd One Out, Assumptions and Conclusions, Alpha-Numeric Sequence Puzzle, Number, Ranking & Time Sequence Test	3	
	13	Non-Verbal Reasoning: Choosing the Missing Figure in a Series, Choosing the Set of Similarly Related Figures, Dot Situation, Basic Analytical Reasoning	3	
IV	**Technical Skills and Programming Skills**		**8**	**10**
	14	Concept of Procedure-Oriented Programming and Object-Oriented Programming, Basic structure of C Programming	2	
	15	Data Structures: Array, Linked list, Stack, Queue, Tree and Graphs (Concept Only)	2	
	16	Database Concept: ER Model, Normalisation, ACID Property, DML and DDL	2	
	17	Basic Concept of SDLC, Agile Model(Concept Only), Blackbox and Whitebox Testing(Concept)	2	
V	**Open Ended Module- Application Level**		**9**	
		Assign the tasks from the following • Writing an impressive resume • Active listening and feedback mechanisms • Conduct Ice breaking Session • Assign students to participate in a group discussion on a given topic and write a reflective analysis of their experience, including observations on communication dynamics, collaboration, and leadership. • Pair students and assign roles (interviewer and interviewee) to conduct mock interviews based on various scenarios, such as behavioural questions, technical challenges, or situational inquiries. • Task students with designing and delivering a professional presentation on a topic related to their field of study or interest, incorporating effective visual aids, storytelling techniques, and audience engagement strategies. • Conduct low-level Aptitude tests, including Verbal and Non-Verbal Reasoning. • Conduct high-level Aptitude tests, including Verbal and Non-Verbal Reasoning. • Writing Simple programming in any language. • Assign students to research and analyse a real-world software development project, applying		

		concepts of the Software Development Life Cycle (SDLC)			

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	3	2	1	-	-						
CO 2	1	1	2	1	-	-						
CO 3	-	3	1	1	-	-						
CO 4	-	3	3	2	-	-						
CO 5	-	1	3	3	1	-						
CO 6	-	1	3	3	1	-						

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓

CO 6	✓	✓		✓

Reference:

1. Chauhan, G. S., & Sharma, S. (2016). Soft Skills: An Integrated Approach to Maximise Personality. Wiley India.
2. Sonmez, J. (2015). Soft Skills: The Software Developer's Life Manual. Manning Publications.
3. Mitra, B. K. (2011). Personality Development and Soft Skills. Oxford University Press.
4. Aggarwal, R. S. (2017). Quantitative Aptitude for Competitive Examinations. S. Chand Publishing.
5. Verma, R. (2018). Fast Track Objective Arithmetic. Arihant Publications.
6. Aggarwal, R. S. (2018). A Modern Approach to Verbal and Non-Verbal Reasoning. S. Chand Publishing.
7. Rizvi, M. A. (2005). Effective Technical Communication. Tata McGraw-Hill Publishing.

Programme	BSc AI				
Course Code	AIN5FS112				
Course Title	Introduction to Digital Marketing				
Type of Course	SEC				
Semester	V				
Academic Level	100 - 199.				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	3	45
Pre-requisites	1. Basic Computer Literacy 2. Familiarity with Online Platforms 3. Willingness to Learn				
Course Summary	Introduction to Digital Marketing" provides students with a foundational understanding of key concepts and techniques in the rapidly evolving field of digital marketing. Through engaging lectures. Students will explore various digital marketing channels, including search engine optimization (SEO), social media marketing, email marketing, and content marketing				

Sl. NO:	Course Outcome	Cognitive level *	Knowledge category #	Evaluation Tools used
CO1	To understand the concept of digital marketing and its integration with traditional marketing	U	C	Instructor-Create Exams or Quiz
CO2	To understand customer value journey in digital context and behaviour of online consumers	A	P	Discussions and Quizzes
CO3	To examine various tactics for enhancing a website’s position and ranking with search engines	U	F	Instructor created exams or Home assignments

CO4	To Identify and differentiate between various digital marketing channels, including SEO, social media, email, and content marketing.	A ,E	P	Discussions, Quizzes
CO5	To get overall idea in implementing basic digital marketing strategies to enhance online visibility and engagement.	Ap	P	Viva Voce Observation of practical skills
CO6	To get to know about ethical considerations and best practices in digital marketing, including privacy, data protection, and consumer trust	U	M	Instructor Created -Exams, Assignments
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus

Module	Unit	Content	Hrs	Marks
I		Digital Marketing Basics	**9**	**12**
	1	Overview of digital marketing	2	
	2	Importance of digital marketing for businesses	2	
	3	Introduction to key digital marketing channels (SEO, social media, email marketing)	3	
	4	Basics of creating a digital marketing strategy	2	
II		**Content Marketing & Social Media**	**9**	**12**
	5	Content Marketing Fundamentals	2	
	6	Content Strategy Development	2	
	7	Content Creation for Different Platforms	2	
	8	Introduction to Social Media Marketing & keyword Optimization	2	
	9	Social Media Strategy & Community Management	1	
III		**Search Engine Optimization (SEO) & Paid Advertising**	**9**	**14**

	10	Introduction to Search Engine Optimization	2	
	11	On-page and Off-page SEO Techniques	2	
	12	Search Engine Marketing (SEM) Fundamentals	2	
	13	Pay-Per-Click (PPC) Advertising with Google Ads	2	
	14	Social Media Advertising Platforms	1	
IV	**Web Analytics & Emerging Trends**		**9**	**12**
	13	Introduction to Web Analytics & Key Metrics	2	
	14	Using Analytics Tools for Data-Driven Decision Making	2	
	15	Conversion Tracking & Optimization	2	
	16	Emerging Trends in Digital Marketing	2	
	17	The Future of Marketing	1	
V	**Hands-on :** **Practical Applications, Case Study and Course Project**		**9**	
	1	**S**ocial Media Marketing-Social media Channels	2	
	2	Leveraging social media for brand conversions and buzz	2	
	3	Recent trends in digital marketing	3	
	4	Demonstrate how to use google web masters Indexing Using API	2	

References:

1. Digital Marketing for Dummies by Ryan DeWald
2. MARKETING 4.0 Moving from Traditional to Digital PHILIP KOTLER HERMAWAN KARTAJAYA IWAN SETIAWAN
3. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited
4. Taxmanns - Digital Marketing - Satinder Kumar, Supereet Kaur
5. Social Media Marketing 2024 - Mastering New Trends & Strategies for Online Success - Robert Hill

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Practical Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓			✓
CO 4	✓			✓
CO 5		✓		✓
CO6				✓

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	-	--	-	3	2						
CO 2	-	-	-	-	-	-						
CO 3	-	-	-	-	2	3						
CO 4	-	-	-	-	2	2						
CO 5	-	-	-	-	1	1						
CO 6	-	-	-	-	3	3						