

ST. THOMAS COLLEGE (AUTONOMOUS) THRISSUR

Affiliated to UNIVERSITY OF CALICUT

SYLLABUS FOR DEGREE OF B.C.A HONOURS (MAJOR, MINOR AND GENERAL FOUNDATION COURSES)

SYLLABUS & MODEL QUESTION PAPERS w.e.f. 2024 admission onwards

St. Thomas College Four Year Under Graduate Programme [STCFYUGP]

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- 13. Dr. Bindiya M Varghese, Rajagiri College of Social Sciences (Autonomous), Kochi
- 14. Mr.Ranjith Nambiar, Programme Director, FIS University Nominee

PROGRAMME OUTCOMES (PO):

At the end of the graduate programme at St. Thomas College, a student would:

PO1	Knowledge Acquisition: Demonstrate a profound understanding of knowledge trends and their impact on the chosen discipline of study.
PO2	Communication, Collaboration, Inclusiveness, and Leadership: Become a team player who drives positive change through effective communication, collaborative acumen, transformative leadership, and a dedication to inclusivity.
PO3	Professional Skills: Demonstrate professional skills to navigate diverse career paths with confidence and adaptability.
PO4	Digital Intelligence: Demonstrate proficiency in varied digital and technological tools to understand and interact with the digital world, thus effectively processing complex information.
PO5	Scientific Awareness and Critical Thinking: Emerge as an innovative problem-solver and impactful mediator, applying scientific understanding and critical thinking to address challenges and advance sustainable solutions.
PO6	Human Values, Professional Ethics, and Societal and Environmental Responsibility: 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.
PO7	Research, Innovation, and Entrepreneurship: 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 BCA Honours programme at St. Thomas College, a student would:

PSO1	Identify the relevance and applications of computers in other disciplines
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 software field.

BCA (HONOURS) PROGRAMME

Single Major

COURSE STRUCTURE

				H V	ou Vee	rs/ ek		Ma	arks	
Seme ster	Course Code	Course Title	Total Hour s	Т	Р	Т	Credit	Internal	External	Total
	BCA1CJ101	Core Course 1 in Major Fundamentals of Computers and ComputationalThinking	60	4	0	4	4	30	70	100
	BCA1CJ 102/ BCA1MN 101	A1CJ 102/ A1MN 101 Core Course 2 in Major Mathematical Foundation for Computer Applications				4	4	30	70	100
	BCA1CJ 103/ BCA1MN 102	Core Course 3 in Major Discrete Structures for Computer Applications	60	4	0	4	4	30	70	100
1	BCA1FM 105	MDC/MDE – 1 Digital Marketing	45	3	0	3	3	25	50	75
	BCA1FS111	Skill Enhancement Course 1 Introduction to Computers and OfficeAutomation	45	3	0	3	3	25	50	75
	ENG1FA101(2)	Ability Enhancement Course 1English	60	2	2	4	3	25	50	75
		Ability Enhancement Course 2Additional Language	45	3	0	3	0	-	-	-
		Total			25		21			525
	BCA2CJ101	Core Course 4 in Major Fundamentals of Programming (C Language)	75	3	2	5	4	30	70	100
2	BCA2CJ102/ BCA2MN 101	Core Course 5 in Major Statistical Foundation for ComputerApplications	60	4	0	4	4	30	70	100
2	BCA2CJ103/ BCA2MN102	Core Course 6 in Major Numerical Analysis and OptimizationTechniques	60	4	0	4	4	30	70	100
	BCA2FS112	Skill Enhancement Course 2 Data Analysis using Spread Sheet	60	2	2	4	3	25	50	75

	ENG2FA103 (2)	Ability Enhancement Course 3English	60	2	2	4	3	25	50	75
		Ability Enhancement Course 4Additional Language	45	3	0	3	-	-	-	-
		Total			24	ŀ	18			450
	BCA3CJ201	Core Course 7 in MajorData Structures using C	75	3	2	5	4	30	70	100
3	BCA3CJ202	Core Course 8 in MajorComputer Networks	75	3	2	5	4	30	70	100
	BCA3CJ203/ BCA3MN20 1	Core Course 9 in Major Introduction to Data Science	60	4	0	4	4	30	70	100
	BCA3CJ204/ BCA3MN20 2	Core Course 10 in Major Foundations of Artificial Intelligence	60	4	0	4	4	30	70	100
-	BCA3FS113	Skill Enhancement Course 3 Website Designing using Content ManagementSystem		2	2	4	3	25	50	75
		MDC/MDE 2 – (E/AL) Kerala Knowledge System	45	3	0	3	3	25	50	75
		Total			25	;	22			550
	BCA4CJ205	Core Course 11 in Major Database Management System	75	3	2	5	4	30	70	100
	BCA4CJ206	Core Course 12 in MajorPython Programming	75	3	2	5	4	30	70	100
4	BCA4CJ207	Core Course 13 in MajorSoftware Engineering	60	4	0	4	4	30	70	100
	BCA4CJ208	Core Course 14 in Major Automation and Robotics	60	4	0	4	4	30	70	100
	BCA4FV108	Value-Added Course 1 Introduction to Cyber Laws	45	3	0	3	3	25	50	75
	ENG4FV109 (2)	Value-Added Course 2English	45	3	0	3	3	25	50	75
		Total			24		22			550
	BCA5CJ301	Core Course 15 in Major Object Oriented Programming (Java)	75	3	2	5	4	30	70	100
5	BCA5CJ302	Core Course 16 in Major Progressive Web Application using PHP	75	3	2	5	4	30	70	100

	BCA5CJ303	Core Course 17 in Major Digital Fundamentals and Computer Organization	60	4	0	4		4	30	70	100	
	BCA5EJ301(X)	Elective Course 1 in Major	60		4	0	4	4	30	70	10	0
	BCA5EJ302(X)	Elective Course 2 in Major	60		4	0	4	4	30	70	10	0
	BCA5FS114	Skill Enhancement Course 4 Professional Skill Development for IT Career Excellence	45		3	0	3	3	25	50	75	5
	BCA5FS115	Skill Enhancement Course Internship 1	-			-		4	100	-	10	0
		Audit Course 1			-		-	-	-	-		
		Total				25		27			67	5
	BCA6CJ304/ BCA8MN304	Core Course 18 in Major Introduction to AI and ML	75		3	2	5	4	30	70	10	0
	BCA6CJ305/ BCA8MN305	Core Course 19 in Major Principles of Operating System	75		3	2	5	4	30	70	10	0
	BCA6EJ303(X)	Elective Course 3 in Major	60		4	0	4	4	30	70	10	0
ſ	BCA6EJ304(X)	Elective Course 4 in Major	60		4	0	4	4	30	70	10	0
6	BCA6FV110	Value-Added Course 2 Business Intelligence and Innovation	45		3	0	3	3	25	50	75	5
	BCA6FS 116	Skill Enhancement Course Project 1	60		4	0	4	4	30	70	10	0
		Audit Course 2	-			-		-	-	-	-	
		Total				25	.5 23				57	'5
		Total Credits for Three Years						133			332	25
	BCA7CJ401	Core Course 20 in Major Advanced Data Structures and Algorithms	75		3	2	5	4	30	70	10	0
	BCA7CJ402	Core Course 21 in Major Data Science Programming using R	75		3	2	5	4	30	70	10	0
	BCA7EJ401(X)	Elective Course 5 in Major	60		4	0	4	4	30	70	10	0
7	BCA7EJ402(X)	Elective Course 6 in Major	60		4	0	4	4	30	70	10	0
·	BCA7EJ403(X)	Elective Course 7 in Major (in Honours with Research Programme)	60		4	0	4	4	30	70	10	0
	BCA7OE401(X)	Open Elective in Major (in Honours programme)	60		4	0	4	4	30	70	10	0
	BCA7FS117	Skill Enhancement Course Internship 2			-			4	100	-	10	0
		Total				22		24			60	0

	BCA8EJ404(X)	Elective Course 8 in Major (in Honours Programme)	60	4	0	4	4	30	70	100	
8	BCA8EJ405(X)	A8EJ405(X)Elective Course 9 in Major (in Honours Programme)60404						30	70	100	
	BCA8EJ406(X)	Elective Course 10 in Major (in Honours Programme)	60	4	0	4	4	30	70	100	
	BCA8FS118	Skill Enhancement Course Project 2 (in Honours Programme)	8	0	8	8	60	140	200		
	OR (instead of Elective Course 8– 10 in Major										
	BCA8FS119	Skill Enhancement Course Research Project (in Honours with Research Programme)	300	20	0	20	20	150	350	500	
	Total				20		20			500	
	Total Credits for Four Years						177			4425	

Note

- 1. Core Courses 2, 5, & 9 can be offered to students of other Major disciplines as Minor courses of Group 1, and Core courses 3, 6 &10 can be offered to them as Minor courses of Group II. 1. Core Courses 18 & 19 can be offered to eighth semester students of other Major disciplines as Minor courses.
- 2. There will be no pathway for BCA students.
- 3. Students from other disciplines can choose Minor Groups in BCA.
- If a student from other department chooses Minor Group I in BCA, then the title of the Minor will be Data Science.
- If a student from other department chooses Minor Group II in BCA, then the title of the Minor will be Artificial Intelligence.
- 6. If a student from other department chooses two Minor groups in BCA (Major with Minor Pathway), then the title of the Minor will be **Data Science and Artificial Intelligence**.

Audit Courses

There are four mandatory Audit Courses or zero-credit courses that the students must attend in different semesters. Two of them are Ability Enhancement Courses offered by Additional Languages in the first and second semesters. The other two are Discipline Specific Elective courses in the fifth and sixth semesters. Students need to complete 75% attendance in Ability Enhancement Courses offered by Additional Languages in the first and second semesters, but need not appear for the internal and external evaluation of these courses. Discipline Specific Elective courses in the fifth and sixth semesters are not meant for class room study. The students can choose any course in Computer Science/Application/IT discipline and attend these courses online in platforms like SWAYAM, MOOC etc.

Semester	Major Core Courses	Major DSE		General Foundation Courses									
			AEC	MDC/ MDE	VAC	SEC	Interns hip/ Project						
1	4+4+4		3	3		3	-	21					
2	4+4+4		3			3	-	18					
3	4+4+4+4			3		3	-	22					
4	4 + 4 + 4 + 4				3 + 3		-	22					
5	4 + 4 + 4	4 + 4				3	4	27					
6	4 + 4	4 + 4			3		4	23					
Total for													
Three	76	16	6	6	9	12	8	133					
Years													
7	4 + 4	4 + 4 + 4		4*			4	24					
8		4 + 4 + 4					8 / 20**	20					
* Instead of M	Major DSE Course; **I	nstead of Three	Major D	SE & 8 Cre	dit Projec	t							
Total for													
Four	76 + 8 = 84	16+24=40	6	6	9	12	20	177					
Years													

CREDIT DISTRIBUTION

DISTRIBUTION OF MAJOR COURSES IN BCA

Semes ter	Course Code	Course Title	Hours/ Week	Credits
	BCA1CJ101	Core Course 1 in Major – Fundamentals of Computers and Computational thinking	4	4
1	BCA1CJ 102/ BCA1MN101	4	4	
	BCA1CJ 103/ BCA1MN102	Core Course 3 in Major -Discrete Structures for Computer Applications	4	4
2	BCA2CJ101 Core Course 4 in Major –Fundamentals of Programming (C Language)		5	4
	BCA2CJ102/ BCA2MN101	Core Course 5 in Major -Statistical Foundation for Computer Applications	4	4

	BCA2CJ103/ BCA2MN102	Core Course 6 in Major - Numerical Analysis and Optimization Techniques	4	4
	BCA3CJ201	Core Course 7 in Major – Data Structures using C	5	4
	BCA3CJ202	Core Course 8 in Major –Computer Networks	5	4
3	BCA3CJ203/ BCA3MN201	Core Course 9 in Major - Introduction to Data Science	4	4
	BCA3CJ204/ BCA3MN202	Core Course 10 in Major - Foundations of Artificial Intelligence	4	4
	BCA4CJ205	Core Course 11 in Major – Database Management System	5	4
4	BCA4CJ206	Core Course 12 in Major – Python Programming	5	4
	BCA4CJ207	4	4	
	BCA4CJ208	4	4	
	BCA5CJ301	Core Course 15 in Major – Object Oriented Programming in Java	5	4
	BCA5CJ302	Core Course 16 in Major – Progressive Web Application using PHP	5	4
5	BCA5CJ303	Core Course 17 in Major – Digital Fundamentals and Computer Organization	4	4
	BCA5EJ301(X)	Elective Course 1 in Major	4	4
	BCA5EJ302(X)	Elective Course 2 in Major	4	4
	BCA6CJ304	Core Course 18 in Major – Introduction to AI and ML	5	4
	BCA6CJ305	Core Course 19 in Major – Principles of Operating System	5	4
6	BCA6EJ303(X)	Elective Course 3 in Major	4	4
	BCA6EJ304(X)	Elective Course 4 in Major	4	4

		Total for the Three Years		92
	BCA7CJ401	Core Course 20 in Major – Advanced Data Structures and Algorithms	5	4
	BCA7CJ402	Core Course 21 in Major – Data Science Programming using R	5	4
7	BCA7EJ401(X)	Elective Course 5 in Major	4	4
	BCA7EJ402(X)	Elective Course 6 in Major	4	4
	BCA7EJ403(X)	Elective Course 7 (in Honours with Research Programme)	4	4
	BCA7OE401(X)	Open Elective in Major (in Honours Programme)	4	4
	BCA8EJ404(X)	Elective Course 8 (in Honours Programme)	4	4
8	BCA8EJ405(X)	Elective Course 9 (in Honours Programme)	4	4
	BCA8EJ406(X)	Elective Course 10 (in Honours Programme)	4	4
		Total for the Four Years		124

ELECTIVE COURSES IN BCA WITH SPECIALISATION

Group	Sl.								Marks	5			
No.	No.	Course Code	Title	Semes	Total	Hrs/	Cred	Inter	Exte	Total			
				ter	Hrs	Week	its	nal	rnal				
		Image Processing											
1	1	BCA5EJ301(1)	Fundamentals of Digital	5	60	4	4	30	70	100			
	1		Image Processing										
	2	BCA5EJ302(1)	Pattern Recognition	5	60	4	4	30	70	100			
			Advanced Digital Image	6	60	4	4	30	70	100			
	3	BCA6EJ303(1)	Processing and Computer										
			Vision										
	4	BCA6EJ304(1)	Applied Digital Image	6	60	4	4	30	70	100			
	4		Processing										
			Co	mputer	· Netwo	rks							
	1	BCA5EJ301(2)	Wireless Communication	5	60	4	4	30	70	100			
2	2	DCA5E1202(2)	Cryptography and	5	60	4	4	30	70	100			
2	2	BCA5EJ502(2)	Network Security										
	3	BCA6EJ303(2)	Storage Area Network	6	60	4	4	30	70	100			
	4	BCA6EJ304(2)	Internet of Things	6	60	4	4	30	70	100			

			Cl	oud Co	mputin	g							
	1	BCA5EJ301(3)	Cloud Computing	5	60	4	4	30	70	100			
3	2	BCA5EJ302(3)	Security and Privacy in Cloud	5	60	4	4	30	70	100			
	3	BCA6EJ303(3)	Storage Technologies	6	60	4	4	30	70	100			
	4	BCA6EJ304(3)	Virtualization	6	60	4	4	30	70	100			
		· · · ·	Dat	a Scien	ce and	AI	1		1	1			
	1	BCA5EJ301(4)	Data Analytics and Visualization	5	60	4	4	30	70	100			
1	2	BCA5EJ302(4)	Knowledge Engineering	5	60	4	4	30	70	100			
-	3	BCA6EJ303(4)	Advanced Python for Data Science	6	60	4	4	30	70	100			
	4	BCA6EJ304(4)	Neural Networks and Deep Learning	6	60	4	4	30	70	100			
	Computer Vision												
	1	BCA5EJ301(5)	Fundamentals of Computational Vision	5	60	4	4	30	70	100			
5	2	BCA5EJ302(5)	Deep Learning for Computer Vision	5	60	4	4	30	70	100			
	3	BCA6EJ303(5)	Computer Vision for Embedded Systems	6	60	4	4	30	70	100			
	4	BCA6EJ304(5)	Modern Computer Vision	6	60	4	4	30	70	100			
			Cybe	r Secu	rity								
	1	BCA5EJ301(6)	Introduction to Cyber Security	5	60	4	4	30	70	100			
6	2	BCA5EJ302(6)	Advanced Python Scripting for Cyber Security	5	60	4	4	30	70	100			
	3	BCA6EJ303(6)	Cyber Security Operational Fundamentals	6	60	4	4	30	70	100			
	4	BCA6EJ304(6)	Artificial Intelligence in Cyber Security	6	60	4	4	30	70	100			

ELECTIVE COURSES IN BCA WITH NO SPECIALISATION

Semes	Elective	Course Code	Title	Total	Hrs/	Cre		Marks	
ter	No.			Hrs	Week	dits	Internal	External	Total
		BCA7EJ401(1)	Theory of Computation	60	4	4	30	70	100
		BCA7EJ401(2)	Expert Systems and Fuzzy	60	4	4	30	70	100
	EL-5		Logic						
		BCA7EJ401(3)	Modern Cryptography	60	4	4	30	70	100
7		BCA7EJ401(4)	Computer Graphics	60	4	4	30	70	100
		BCA7EJ402(1)	Client Server Architecture	60	4	4	30	70	100
		BCA7EJ402(2)	Blockchain Technology	60	4	4	30	70	100
	EL-6	BCA7EJ402(3)	Data Mining	60	4	4	30	70	100
		BCA7EJ402(4)	Natural Language Processing	60	4	4	30	70	100
		BCA7EJ403(1)	Research Methodology in	60	4	4	30	70	100
	EL-7		Computer Science						
		BCA7OE401(1)	Ethical Hacking	60	4	4	30	70	100
	OE-1	BCA7OE401(2)	Cyber Forensics	60	4	4	30	70	100
		BCA8EJ404(1)	Compiler Design	60	4	4	30	70	100
	EI 8	BCA8EJ404(2)	Mixed Reality	60	4	4	30	70	100
8	LL-0	BCA8EJ404(3)	Principles Of Information Security	60	4	4	30	70	100
	EL-9	BCA8EJ405(1)	Mastering Java Web	60	4	4	30	70	100
			Development						
		BCA8EJ405(2)	Social Network Analysis	60	4	4	30	70	100
	EL-10	BCA8EJ406(1)	System Security	60	4	4	30	70	100
		BCA8EJ406(2)	Parallel Computing	60	4	4	30	70	100
		BCA8EJ406(3)	Android Programming	60	4	4	30	70	100

DISTRIBUTION OF GENERAL FOUNDATION COURSES IN BCA

C1			Total	Hound			Marks			
51. No.	Course Code	Course Title	Hours	Week	Credits	Internal	External	Total		
1	BCA1FM 105	MDC/MDE – 1 Digital Marketing	45	3	3	25	50	75		
2	BCA4FV108	Value-Added Course 1 Introduction to Cyber Laws	45	3	3	25	50	75		
3	BCA6FV110	Value-Added Course 2 Business Intelligence and Innovation	45	3	3	25	50	75		
4	BCA1FS111	Skill Enhancement Course 1 Introduction to Computers and Office Automation	45	3	3	25	50	75		
5	BCA2FS112	Skill Enhancement Course 2 Data Analysis using Spread Sheet	60	4	3	25	50	75		
6	BCA3FS113	Skill Enhancement Course 3 Website Designing using Content Management System	60	4	3	25	50	75		
7	BCA5FS114	Skill Enhancement Course 4 Professional Skill Development for IT Career Excellence	45	3	3	25	50	75		
8	BCA5FS115	Internship	60	-	4	100		100		
9	BCA6FS116	Project Implementation	60	4	4	30	70	100		
10	BCA7FS117	Internship	60	-	4	100		100		
11	BCA8FS118/ BCA8FS119	Project (in Honours Programme)/ Research Project (in Honours with Research	200/ 500	8/20	8/20	60/ 150	140/ 350	200/ 500		

GROUPING OF MINOR COURSES IN BCA

For Other Departments

(Title of the Minor: Data Science and Artificial Intelligence)

Group	Sl.	Course Code	Title	Semes	Total	Hrs/	Cred		Marks	5
No.	No.			ter	Hrs	Week	its	Inter	Exte	Total
								nal	rnal	
			I	Data Sci	ience					
	1	BCA1MN 101	Mathematical Foundation	1	60	4	4	30	70	100
			for Computer							
1			Applications							
	2	BCA2MN 101	Statistical Foundation for	2	60	4	4	30	70	100
			Computer Applications							
	3		Introduction to Data	3	60	4	4	30	70	100
		BCA5MIN201	Science							
			Artif	icial Int	elligen	ce				
	1	DCA 1MNI 102	Discrete Structures for	1	60	4	4	30	70	100
		DCATIVIN 102	Computer Applications							
	2	DCAMNI 102	Numerical Analysis and	2	60	4	4	30	70	100
2		DCA2IVIIN 102	Optimization Techniques							
	3	DCA2MNI202	Foundations of Artificial	3	60	4	4	30	70	100
		DCA5MIN202	Intelligence							

Group	SI.	Course Code	Title	Semes	Total	Hrs/	Cred		Marks	5
No.	No.			ter	Hrs	Week	its	Inter	Exte	Total
								nal	rnal	
			4 th Year Minor Courses							
1	1	BCA8MN304	Introduction to AI and ML	8	75	5	4	30	70	100
	2	BCA 9MNI205	Principles of Operating	8	75	5	4	30	70	100
		BCA8MIN305	System							

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.** 3-credit courses (General Foundational Courses) in BCA are of two types: (i) courses with only theory and (ii) courses with 2-credit theory and 1-credit practical.
 - In 3-credit course with only theory 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. theory
 - In 3-credit courses with 2-credit 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 practicals. The practical component is internally evaluated for 15 marks. The internal evaluation of the 4 theory modules is for 10 marks.

Sl. No.	Nature of the Course		Internal Evaluatio 30% of t	n in Marks (about the total)	External Exam on 4 modules (Marks)	Total Marks
			Open-ended module / Practical	On the other 4 modules	(indiks)	
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

4	3-credit	Theory	15	10	50	75
	course	(4 modules) +				
		Practical				

1. MAJOR AND GENERAL FOUNDATION COURSES

1.1. INTERNAL EVALUATION OF THEORY COMPONENT

Sl. No.	Components of Internal Evaluation of Theory Part	0	Internal Marks f f a Major / Minor	For the Theory Par r Course of 4-crea	rt lits	
	of a Major / Minor Course	Theory	Only	Theory + Practical		
		4 Theory Modules	Open-ended Module	4 Theory Modules	Practical	
1	Test paper/	10	4	5	-	
	Mid-semester Exam					
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	Marks for	Weightage
	of Credit-1 in a Major / Minor Course	Practical	
1	Continuous evaluation of practical/ exercise performed in	10	50%
	practical classes by the students		
2	End-semester examination and viva-voce to be conducted	7	35%
	by teacher-in-charge along with an additional examiner		
	arranged internally by the Department Council		
3	Evaluation of the Practical records submitted for the end	3	15%
	semester viva-voce examination by the teacher-in-charge		
	and additional examiner		
	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).

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

PATTERN OF QUESTION PAPER FOR MAJOR COURSES

PATTERN OF QUESTION PAPER FOR GENERAL FOUNDATION COURSES

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

2. INTERNSHIP

- All students should undergo **TWO** Internship of 4-credits during the FIFTH and SEVENTH 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 Computer application or allied disciplines.
- 2. There should be minimum 120 hrs. of engagement from the student in the Internship.
- 3. Summer vacations and other holidays can be used for completing the Internship.
- 4. In BCA 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 5 & semester 7.
- 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 Eval	Marks for Internship 4Credits	Weightage	
1	Continuous evaluation of internship through interim	Acquisition of skill set	20	40%
2	presentations and reports by the committee internally	Interim Presentation and Viva-voce	10	
3	constituted by the Department Council	Punctuality and Log Book	10	
4	Report of Institute Visit/ Study	10	10%	
5	End-semester viva-voce examination to be conducted	Quality of the work	12	35%
6	by the committee internally constituted by the Department	Presentation of the work	10	
7	Council	Viva-voce	12	
8	Evaluation of the day-to-day re supervisor, and final report su viva–voce examination before constituted by the Department (16	15%	
		10		

3. PROJECT

3.1 MINI PROJECT WORK (Skill Enhancement Course BCA6FS116)

A mandatory mini-project is scheduled in the VI Semester of the BCA 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.

Project Selection and Approval:

- Student groups (at most four members) can propose projects in Information Technology 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.

Evaluation Criteria and Rubrics:

1. Internal Evaluation (30%) - Conducted by the project supervisor throughout the semester. This could involve:

- Project Proposal and Planning (10%):
 - 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 (10%):**
 - > 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 (10%):

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

2. External Evaluation (70%) - Conducted by an internal examiner appointed by the Department Council and the project supervisor. This will take place at the end of the VI th semester:

- Project Report (25%):
 - > 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 (25%):
 - Demonstration: Ability to showcase the functionality of the project or present the research findings effectively.
- Viva-voce (20%):
 - Viva-voce: Understanding of project concepts, ability to answer questions confidently, and critical thinking skills

3.2. PROJECT IN HONOURS PROGRAMME

- In Honours programme, the student has the option to do a Project of 8-credits along with three 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.

3.3. 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 20-credits in semester 8.
- 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.

3.4. GUIDELINES FOR THE PROJECT IN HONOURS PROGRAMME

AND HONOURS WITH RESEARCH PROGRAMME

- 1. Project can be in Computer application or 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.
- 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 theUG (Honours) programme.

3.5. 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 will be evaluated for 200 marks. Out of this, 60 marks is from internal evaluation and 140 marks, from external evaluation.
- The Project in Honours with Research programme will be evaluated for 500 marks. Out of this,150 marks is from internal evaluation and 350 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 College.
- The scheme of continuous evaluation and the end-semester viva-voce of the Project shall be as given below:

	Marks for the	Marks for the	Weightage
	Research Project	Optional	
	(Honours with	Project	
Components of Evaluation of Project	Research)		
		(Honours)	
	20 Credits	8 Credits	
Continuous evaluation of project work through interim	150	60	30%
presentations and reports by the committee internally			
constituted by the Department Council			
End-semester viva-voce examination to be conducted	250	100	50%
by the external examiner appointed by the university			
Evaluation of the day-to-day records and project report	100	40	20%
submitted for the end-semester viva-voce examination			
conducted by the external examiner			
Total Marks	500	200	

INTERNAL EVALUATION OF PROJECT

Sl. No	Components of Evaluation of Project	Marks for the Research Project (Honours with Research programme) 20 credits	Marks for the Optional Project (Honours programme) 8 credits
1	Skill in doing project work	50	20
2	Interim Presentation and Viva-Voce	35	15
3	Punctuality and Log book	35	15
4 Scheme/ Organization of Project Report		30	10
	Total Marks	150	60

		Marks for the Research	Marks for the
Sl. No	Components of Evaluation of Project	Project	Optional Project
		(Honours with Research	(Honours
		programme)	programme)
		20 credits	8 credits
1	Content and relevance of the Project,		
	Methodology, Quality of analysis, and	100	40
	Innovations of Research		
2	Presentation of the Project	75	30
3	Project Report (typed copy), Log Book	100	40
	and References	100	40
4	Viva-Voce	75	30
	Total Marks	350	140

EXTERNAL EVALUATION OF PROJECT

5. 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.

Sl.	Percentage of Marks	Description	Letter	Grade	Range of	Class
No.	(Internal & External		Grade	Point	Grade Points	
	Put Together)					
1	95% and above	Outstanding	0	10	9.50 - 10	First Class with
2	Above 85% and below 95%	Excellent	A+	9	8.50 - 9.49	Distinction
3	75% to below 85%	Very Good	А	8	7.50 - 8.49	
4	65% to below 75%	Good	B+	7	6.50 - 7.49	
5	55% to below 65%	Above	В	6	5.50 - 6.49	First Class
		Average				
6	45% to below 55%	Average	С	5	4.50 - 5.49	Second Class
7	35% to below 45% aggregate	Pass	Р	4	3.50 - 4.49	Third Class
	(internal and external put					
	together) with a minimum of 30%					
	in external valuation					
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

LETTER GRADES AND GRADE POINTS

• 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.

5.1. 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,

i.e. SGPA (Si) = Σi (Ci x Gi) / Σi (Ci)

where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith 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.

Semester	Course	Credit	Letter	Grade	Credit Point
			Grade	point	(Credit x Grade)
Ι	Course 1	3	А	8	3 x 8 = 24
Ι	Course 2	4	B+	7	4 x 7 = 28
Ι	Course 3	3	В	6	3 x 6 = 18
Ι	Course 4	3	0	10	$3 \ge 10 = 30$
Ι	Course 5	3	С	5	3 x 5 = 15
Ι	Course 6	4	В	6	4 x 6 = 24
	Total	20			139
		SGF	139/20 = 6.950		

ILLUSTRATION – COMPUTATION OF SGPA

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

- 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

Semester I

BCA1CJ101 - Fundamentals of Computers and Computational Thinking

Programme	BCA				
Course Code	BCA1CJ101				
Course Title	Fundamentals of Con	nputers and C	Computationa	ıl Thinking	
Type of Course	Major				
Semester	Ι				
Academic	100 - 199				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	4	-	-	60
Pre-requisites	1. Fundamentals of el	lectronic con	ponents		
	2. Basic mathematica	l operations			
Course	This course provides	a comprehen	nsive overvie	w of computi	ng, covering
Summary	historical milestones	s, hardware	components	, software s	ystems, and
	computational thinking	ng principles	. Students wi	ll explore the	evolution of
	computing systems,	from early	pioneers to	modern pro	cessors and
	quantum units. The c	urriculum de	lves into hard	lware intricac	ies, software
	distinctions, and esse	ential concep	ots in compu	iter science,	emphasizing
	problem-solving skill	s and algorith	nmic thinking	g. Practical asp	pects include
	hands-on experiences	s with hardv	vare assembl	ing, operating	g system
	installation, algorithn	n and flowch	art visualizati	ion.	

Course Outcomes (CO):

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Explain foundational concepts and historical developments in computing, including the evolution of computers, the contributions of computing pioneers, and basic number systems	U	F	Instructor- created exams / Quiz
CO2	Identify key hardware components and their functions, including active and passive electronic components, motherboard components, and various types of storage devices	U	C	Practical Assignment / Observation of Practical Skills
CO3	Classify and differentiate between types of software, operating systems, and file systems, understanding their installation, compatibility, and system requirements.	Ap	Р	Practical Assignment / Observation of Practical Skills
CO4	Apply Computational Thinking Skills such as decomposition, pattern recognition, and abstraction, to solve	Ар	Р	Practical Assignment /

	problems using logical and algorithmic thinking			
CO5	Design and evaluate basic algorithms and flowcharts to represent solutions to computational problems, incorporating qualities of effective algorithms	An	С	Instructor- created exams / Quiz
* - Re # - Fa Know	emember (R), Understand (U), Apply (Ap), A ctual Knowledge(F) Conceptual Knowledge (ledge (M)	nalyse (An), Eva C) Procedural K	luate (E), Create (nowledge (P) Me	(C) tacognitive

Detailed Syllabus

Module	Unit	Content	Hrs	Marks
			(48+12)	
		History and Evolution of Computing System	10	
	1	Evolution of Computers – History, Generations	2	
	2	Overview of Computer System- Von Neumann Model, Number	2	
		Systems (Binary, Hexa, Octal, Decimal)		
	3	Number Conversion and Digital Codes - Conversion from one	2	
		number system to another, Digital Codes (Gray, Excess-3, BCD)		
_	4	Pioneers and Contributors of Computing Systems - First	2	
I		Mechanical computer - Charles Babbage, Stored-Program		15
		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).		
	5	Computing Systems: Past to Present - Single Core, Dual-Core	2	
		and Multi-Core Processors, Graphics Processing Unit (GPU),		
		Accelerated Processing Unit, Quantum Processing Units (QPU)		
		(Concept only).		
		Hardware	11	
	6	Electronic Components – Active Components - Diode, Transistor,	1	
		Integrated Circuits (Definition, Symbol and Function).		
	7	Electronic Components - Passive Components - Resistors,	1	
		Capacitors, Inductors (Definition, Symbol and Function).		
	8	Motherboard Components – CPU and Cooling Fan, RAM,	2	
		Expansion Slots (PCIe), Input/Output Ports, Chipset (Concept		20
		only).		
	9	Motherboard Components – BIOS/UEFI Chip, SATA/NVMe	3	
		Slots, Network Interface, Ports- Ethernet, VGA, HDMI, USB		
		(Concept only).		
	10	Computer Components – SMPS, Motherboard, Storage Devises	2	
		(HDD, SSD, NVMe (Concept only).		
	11	Computer Components – RAM (DRAM, SRAM, DDR SDRAM), ROM,		
		Cache (Concept only).		

III		Software	12	
	12	Software - Application Software, System Software, Examples	2	
	13	Operating System – Need of OS, Types – Proprietary and Open	4	
		Source, Hardware Software Compatibility, POST, Booting.		
	14	OS Installation – Bootable Media, UEFI/Legacy BIOS, Disk	4	15
		Partitioning, Dual Booting, Boot Manager – BOOTMGR, Grub,		
	1.5	File Systems- FAT, NTFS, ext4.	2	
	15	Device Drivers – Need of Device Drivers, Driver Interactions	2	
117		(Basic concept only).	15	
1 V	16	Computer Science and Computer Science in the Modern Era	15	
	10	Problem Solving - Defining the Problem Systematic Approach	2	20
	17	Computational Thinking Problem Decomposition Pattern	2	20
	10	Identification Abstraction Generalization	2	
	19	Logical Thinking – Inductive and Deductive Reasoning Logical	2	
	17	Expressions.	2	
	20	Algorithmic Thinking – Intuition vs Precision, Defining	2	
	_	algorithms.		
	21	Algorithm – Need of Algorithm, Qualities of a Good Algorithm,	3	
		Examples.		
	22	Flowchart - Flowchart Symbols, Examples. Raptor.	3	
V		Identification of motherboard components and	12	
		implementation of Algorithm using Raptor		
		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		
		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 <i>Rufus</i> .		
		6. Check the hardware compatibility and Install operating system		
		(single booting) on given computer. 0 Check the hardware compatibility and Install operating systems		
		(dual booting – Windows and Linux) on given computer		
		(and sooting thindows and Emax) on given comparent		
		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	PO7
CO 1	1	3	-	-	-	1	2	-	1	-	2	-	-
CO 2	1	3	-	-	1	-	3	2	-	-	1	-	-
CO 3	1	3	-	-	2	2	-	-	-	-	1	1	-
CO 4	1	3	-	-	2	2	-	-	1	-	3	-	-
CO 5	2	1	3	1	1	-	-	-	2	-	1	-	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%)

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

Mapping of COs to Assessment Rubrics:

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.

BCA1CJ102/BCA1MN 101 - Mathematical Foundation for

Programme	BCA						
Course Code	BCA1CJ102/BCA1M	IN 101					
Course Title	Mathematical Founda	ation for Con	nputer Applic	cations			
Type of Course	Major/Minor (A1)						
Semester	Ι						
Academic	100-199						
Level							
Course Details	Credit	Lecture	Tutorial	Practical	Total		
		per week	per week	per week	Hours		
	4	4	-	-	60		
Pre-requisites	Basic Mathematics is	required (Al	lgebra, Arithi	metic)			
Course	This course provides a	a fundamenta	al exploration	of mathemati	cal concepts		
Summary	essential for comput	er science. S	Students will	l explore into	key topics		
	including Linear Algo	ebra, Differen	ntial and Inte	gral Calculus	. The course		
	aims to equip students with the mathematical tools and reasoning skills						
	necessary for creating and analyzing algorithms, understanding and						
	solving computationa	l problems in	n various area	is of computer	science like		
	Data science, Artifici	al Intelligenc	e.				

Computer Applications

Course Outcomes (CO):

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

CO5	Apply differential and integral calculus to various functions encountered in computer applications such as polynomials, exponentials and logarithmic functions.	U	С	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)	Marks
		Matrices and Determinants	14	18
I	1	Matrices: Definition, Order of a matrix, Types of matrices	2	
	2	Operations on matrices: Addition, Subtraction, Multiplication	3	
1	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	
		Linear Algebra and Vector Calculus	12	18
	7	Linear Independence: Characteristic equations,	1	
	8	Eigen values, Eigen Vector	2	
п	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	
		Differentiation	11	17
	13	Limits; Definition (concept only), Derivative of a Point, Derivative at Function	2	
п	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	

		Integration	11	17
	18	Integration: Integral as Anti-derivative, Indefinite integral & constant of integration	2	
	19	Fundamental theorems, Elementary Standard results	2	
IV	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	
		Application of Matrices and Determinants	12	
		Discuss topics from the following:		
		• Differential Equation.		
		• Concept of First Order ODE's.		
	1	• Concept of Second Order ODE's.		
		• Application of Logarithm.		
V		Combinatorics.	10	
	1	Trigonometric concept.	10	
		• 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.		
	2	Case Study	2	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	1	1	-	-	1	1	-	-	2	-	-
CO 2	2	-	2	2	-	-	3	2	-	-	1	-	-
CO 3	2	-	2	2	-	-	-	-	-	-	1	1	-
CO 4	2	-	2	2	-	-	1	-	1	-	3	-	-
CO 5	2	-	2	2	-	-	-	-	2	-	1	3	-

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	Assignme nt	Practical Evaluation	End Semester Examinations
CO 1	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		√
CO 5				
	\checkmark	\checkmark		\checkmark

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
- 7. Gilbert Strang, "Introduction to Linear Algebra", Wellesley-Cambridge Press, 2023.
- 8. Kenneth Hoffman, Ray Kunze, "Linear Algebra", Prentice Hall India Learning, 2015.
- 9. Gilbert Strang, "Calculus", Wellesley-Cambridge Press, 2023.
- 10. Joseph Edwards, "Differential Calculus for Beginners", Arihant Publications, 2016.
- 11. Joseph Edwards, "Integral Calculus for Beginners", Arihant Publications, 2016.

BCA1CJ103/BCA1MN 102 - Discrete Structures for

Programme	BCA					
Course Code	BCA1CJ103/BCA1M	IN 102				
Course Title	Discrete Structures for	or Computer	Applications			
Type of Course	Major/Minor (B1)					
Semester	Ι					
Academic	100-199					
Level						
Course Details	Credit	Lecture	Tutorial	Practical	Total	
		per week	per week	per week	Hours	
	4	4	-	-	60	
Pre-requisites	No pre-requisites requ	uired				
Course	This course provides	a foundation	nal understan	ding of essent	tial concepts	
Summary	that are fundamenta	l to compu	ter science a	and various	branches of	
	mathematics. The co	urse explore	s topic relate	d to Proposit	ional Logic,	
	Sets and Relations, Graphs and Trees. This helps the students to equip					
	with the analytical an	d problem-se	olving skills	necessary for	applications	
	in computer science a	nd algorithm	n design.			

Computer Applications

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	С	Instructor- created exams / Quiz/Assignment/ Seminar
CO2	Define and manipulate sets, analyse relations and functions and their representation by Venn diagrams	U	С	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	С	Instructor- created exams/ Quiz/Assignment/ Seminar
CO4	Demonstrate a deep understanding of advanced graph theory concepts, focusing on Euler's graph, Hamiltonian graphs, Isomorphism and Homeomorphism.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar
CO5	Apply the tree data structures, spanning trees and associated algorithms for solving problems such as Prim's and Kruskal.	U	С	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)

Module	Unit	Contents	Hrs (48+12)	Mark	
		Mathematical Logic	09		
I	Propositional Logic: Definition, Logical Operators (Negation, Disjunction, Conjunction, Implication, Biconditional), Truth Table			17	
	2	Law of Logic: Tautology, Contradiction, Contingency, Logical equivalence	2	17	
	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		
		Set Theory and Relations	12		
	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		
п	8	Relation: Definition and Examples, Type of Relations with example,	2	17	
	9	Equivalence relation, Equivalence Class and Di-Graph and problems	3		
	10	Functions: Introduction, type of function, Composition function	2		
	11	One-to-one function, Onto function, One-to-one correspondence	2		
		Introduction to Graphs	16		
	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		
III	14	Connected Graph, Complete Graph, Euler Graph, Hamiltonian graph, Travelling Sales Man Problem, Operations on Graph, Homeomorphism	3	20	
	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	4		

Detailed Syllabus
IV		Trees and Applications	11	
	18	Trees: Definition, Properties, Pendant vertex, Distance, Eccentricity and Center of Trees	2	
	19	Rooted Trees, Binary Trees and Its Properties	2	
	20	Basic Theorems on Trees	3	16
	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	
		Applications of Discrete Structure	12	
V	1	 Discuss topics from the following: First Order Logic. Application of Logic in Intelligence System. Set theory in Computer Applications. POSET and Hasse Diagram. Di-Graph of the relation. Application of Graphs like Konigsberg Bridge Problem, Utilities Problem, Electrical Network Problems, Seating Problem. Different type of Binary Tree and their applications. BFS and DFS Algorithm. Directed Graphs and Directed Trees. Application of Graphs in Computer fields. Basic Concept of Group and Ring. 	10	
	2	Case Study	2	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	1	1	-	-	2	-	1	-	3	-	-
CO 2	2	-	2	2	-	-	1	2	-	-	-	-	1
CO 3	2	-	2	2	-	-	_	-	-	_	1	1	-
CO 4	2	-	2	2	_	-	-	1	1	-	3	-	-
CO 5	2	-	2	2	-	-	-	-	2	-	1	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

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

Semester II

BCA2CJ101 - Fundamentals of Programming (C Language)

Programme	BCA							
Course Code	BCA2CJ101							
Course Title	Fundamentals of Progr	amming (C L	anguage)					
Type of Course	Major							
Semester	II							
Academic Level	100 - 199							
Course Details	Credit	Lecture	Tutorial	Practical	Total Hours			
		per week	per week	per week				
	4	3	-	2	75			
Pre-requisites	1. Fundamentals of Algorithms and Flowcharts							
	2. BCA1CJ104 – Fund	lamentals of C	Computers and	l Computation	al Thinking			
Course Summary	The objectives of this c	course are to r	nake the stude	ent understand	programming			
	language, programmin	g, concepts o	of Loops, read	ling a set of I	Data, stepwise			
	refinement, Functions	, Control str	ucture, Array	s, Structures,	Unions, and			
	Pointers. After comple	tion of this co	urse the stude	nt is expected	to analyze the			
	real-life problem and	write a progra	um in 'C' lang	guage to solve	the problem.			
	The main emphasis of	of the course	will be on p	problem solvin	ng aspect i.e.			
	developing proper algo	orithms.						

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe the fundamental concepts of C programming, including its history, significance, and basic program structures, with an understanding of character sets, tokens, constants, variables, and data types	U	C	Instructor- created exams / Quiz
CO2	Identify and Apply C operators, including arithmetic, relational, logical, bitwise, and special operators, to create and evaluate expressions that follow precedence and type conversions in C programs	Ар	Р	Practical Assignment / Observation of Practical Skills
CO3	Demonstrate Control Structures in C, such as decision-making (if-else, switch, conditional) and looping constructs (for, while, do-while), and use them to write efficient branching and looping statements for various scenarios.	Ap	Р	Practical Assignment / Observation of Practical Skills
CO4	Implement and Manipulate arrays (one- dimensional, two-dimensional, multi- dimensional) and strings, utilizing C's string-handling functions, and design user-defined functions, including	Ap	С	Practical Assignment / Observation of Practical Skills

	recursive functions, to solve structured problems						
CO5	Apply advanced concepts in C, such as pointers, dynamic memory allocation, storage classes, structures, and unions, to optimize data management, access memory efficiently, and manage variable lifetimes within programs	Ap	Р	Practical Assignment / Observation of Practical Skills			
* - Reme	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)						
# - Factu	al Knowledge(F) Conceptual Knowledge	(C) Procedur	al Knowledge (I	P) Metacognitive			
Knowled	lge (M)						

Module	U nit	Content	Hrs	Marks					
mouule	omt	(45+30)							
Ι		Introduction to C Language	10						
	1	History of C, Importance of C, and sample programs	2						
	2	Character set, Tokens, Constants, Variables, and Data types	2						
	3	Operators - Arithmetic, Relational, logical, assignment,	3						
		increment, decrement, conditional, bitwise and special							
		operators. Arithmetic expressions, operator precedence, type							
		conversions, mathematical functions							
	4	Managing Input and Output Operators: Reading and writing a	3						
		character, formatted input, formatted output.							
II		Decision Making Branching and Looping	10						
	5	Decision making with If - simple If, If else, nested If else, else	3						
		If ladder							
	6	Switch statement, conditional operator, Goto statement	2						
	7	Loops: while, do while, for statements and nested loops	3						
	8	Jumps in loops – break, continue	2						
III		Arrays and Functions	15						
	9	One dimensional array – declaration, initialization and	2						
		accessing							
	10	Two-dimensional array – declaration, initialization and	2						
		accessing							
	11	Multi dimensional array, dynamic array	1						
	12	Strings – Reading, Writing. Arithmetic operations on characters,	2						
		Comparisons and string handling functions							
	13	Functions – Need, Elements of user defined functions and	2						
		definition							
	14	Return values and their types, function call and declaration, call	2						
		by value and call by reference	-						
	15	Categories of functions, Nesting of functions	1						
	16	Recursion and command line arguments	1						
	17	Passing arrays to functions and passing strings to functions	2						
IV	10	Storage Classes, Structure and Union, Pointers	10						
	18	Storage classes – The scope, visibility and lifetime of variables.	2						
		Auto, Extern, Static and Register storage classes. Storage							
		classes in a single source file and multiple source files							

Detailed Syllabus

	19	Structure and Union - Defining, giving values to members, initialization and comparison of structure variables, arrays of structure, arrays within structures, structures within structures,	2	
	20	structures and functions, unions Pointers definition, declaring and initializing pointers, accessing a variable through address and through pointer, pointer expressions, pointer increments and scale factor	2	
	21	Pointers and arrays, pointers and functions, pointers and structure	2	
	22	Dynamic memory allocation and memory management functions	2	
V		Hands-on Problem-Solving Using C	30	
	1	Practical Applications, Case Study and Course Project	20	
	1	Implement the following:	30	
		1. variables, Data types, Constants and Operators: 1. Evolution of expression are $((y + y)) \Delta 2 * (y + z))/y$		
		2. Temperature conversion problem (Eabrenheit to Celsius)		
		3 Program to convert days to months and days (Ex: 364 days =		
		12 months and 4 days)		
		4. Salesman salary (Given: Basic Salary, Bonus for every item		
		sold, commission on the total monthly sales)		
		2. Decision making (Branch / Loop) Statements:		
		5.Solution of quadratic equation		
		6. Maximum of three numbers		
		7. Calculate Square root of five numbers (using goto statement)		
		8.Pay-Bill Calculation for different levels of employee (Switch		
		9 Fibonacci series		
		10 Armstrong numbers		
		11 Pascal 's Triangle		
		3. Arrays. Functions and Strings:		
		12. Prime numbers in an array		
		13. Sorting data (Ascending and Descending)		
		14.Matrix Addition and Subtraction		
		15.Matrix Multiplication		
		16. Transpose of a matrix		
		1 /Function with no arguments and no return value		
		16. Functions with argument and multiple return values		
		20 Function that convert lower case letters to upper case		
		21. Factorial using recursion.		
		22. Perform String Operations using Switch Case		
		23. Largest among a set of numbers using command line		
		argument		
		4. Structures and Union:		
		24. Structure that describes a hotel (name, address, grade, avg $(1 + 1)$		
		room rent, number of rooms) Perform some operations (list of hotels of a given grade etc.)		

	 25. Using Pointers in Structures. 26. Cricket team details using Union. 5. Pointers: 27. Evaluation of Pointer expressions 28. Function to exchange two pointer values 29. Reverse a string using pointers 30. Insertion, deletion, and searching in an array 	
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	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	-	1	1	-	-	2	-	1	-	1	-	-
CO 2	_	1	2	2	-	-	3	2	-	-	1	-	-
CO 3	-	1	3	3	_	-	2	-	-	-	1	1	-
CO 4	-	1	2	2	_	-	-	-	1	-	3	-	-
CO 5	-	2	2	2	-	-	1	-	2	-	1	-	1

Correlation Levels:

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

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	~	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- Kernighan, B. W., & Ritchie, D. M. (1988). The C Programming Language (2nd ed.). Prentice Hall. ISBN: 978-0131103627
- King, K. N. (2008). C Programming: A Modern Approach (2nd ed.). W. W. Norton & Company. ISBN: 978-0393979503
- 3. Schildt, H. (2000). C: The Complete Reference (4th ed.). McGraw-Hill. ISBN: 978-0072121247
- 4. Kochan, S. G. (2004). Programming in C (3rd ed.). Sams Publishing. ISBN: 978-0672326660
- 5. Griffiths, D., & Griffiths, D. (2012). Head First C. O'Reilly Media. ISBN: 978-1449399917
- 6. Kanetkar, Y. (2008). Let Us C (8th ed.). BPB Publications. ISBN: 978-1934015256
- 7. Prata, S. (2004). C Primer Plus (5th ed.). Sams Publishing. ISBN: 978-0672326967

BCA2CJ102/BCA2MN101 - Statistical Foundation for Computer Applications

Programme	BCA								
Course Code	BCA2CJ102/BCA2MN101								
Course Title	Statistical Foundation	for Compute	er Application	ns					
Type of Course	Major/Minor (A2)								
Semester	II								
Academic	100 - 199								
Level									
Course Details	Credit	Lecture	Tutorial	Practical	Total				
		per week	per week	per week	Hours				
	4	4	-	-	60				
Pre-requisites	1. A strong foun	dation in alg	ebra						
	2. Fundamentals	of Set theor	y and logic						
Course	The course on pro	bability and	statistics co	overs fundam	ental topics				
Summary	including descriptiv	ve statistics	(measures	of central te	ndency and				
	dispersion), probabi	lity theory (e	events, sampl	e spaces, prol	babilitylaws,				
	random variables, a	and distribut	ions), inferen	ntial statistics	(regression				
	analysis), and applic	ations in vari	ous fields su	ch as science,	engineering,				
	economics, and so	cial sciences	, emphasizii	ng critical th	inking, data				
	analysis, and problem	m-solving							
	skills.								

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Apply fundamental statistics concepts	Ap	С	Quizzes, Homework,
	1			Exams
	Analyze data using descriptive			Projects, Midterm,
CO2	statistics	An	Р	Exams
CO3	Perform regression analysis	An	Р	Projects, Exams

	Apply probability and statistics								
CO4	in real-world situations	Ap	С	Projects, Exams					
	Develop critical thinking and			Homework,					
CO5	problem-solving skills	E	М	Projects					
* - Re	emember (R), Understand (U), Ap	ply (Ap), Analys	se (An), Evaluate (H	E), Create (C)					
# - Fa	# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)								
Metao	cognitive Knowledge (M)								

Hrs Module Unit Content Mark (48+12)**DESCRIPTIVE STATISTICS** 10 Ι 15 Concept of primary and secondary data, Methods of 2 1 collection Measures of central tendencies (Mean, Median, Mode, HM, 2 4 GM) Measures of dispersion, Relative Measures and Absolute 3 2 Measures Range, Quartile deviation, Mean deviation, standard 4 2 deviation. Variance STATISTICAL INFERENCE AND REGRESSION ANALYSIS 10 3 5 Principles of Least Squares and Fitting of Stright Line Point estimation: maximum likelihood estimation (MLE), method of moments. Confidence intervals for population 2 6 Π 15 parameters. 7 Pearson's Coefficient of Correlation and Rank Correlation 2 Simple linear regression and multiple linear regression. 8 3 Logistic regression for classification problems. **PROBABILITY THEORY** 12 9 Random experiment, Sample point, Sample Space 1 Events. Operation of events (Union, Intersection, 10 2 Complement of Events) Exclusive and exhaustive events, equally likely events with 11 1 examples Ш 20 Classical approach to probability, Axiomatic definitions of 12 2 probability, Simple problems Theorems of probability - Addition Theorem, Multiplication 2 13 Theorem 2 Conditional probability 14 1 15 Inverse probability Baye's Theorem 16 1 ADVANCED PROBABILITY DISTRIBUTION 16 Discrete and continuous random variables and probability 3 17 distribution Binomial distribution: Definition, Expectation, Variance,

Detailed Syllabus

18

Moment Generating Function and Problems

2

TT 7	19	Poisson distribution: Definition, Expectation, Variance, Moment Generating Function and Problems	2	
IV	20	Normal distribution: Definition, Expectation, Variance, Moment Generating Function, Standard normal curve and Problems	3	20
	21	Testing of Hypothesis: General principles of testing, Two types of errors	3	
	22	Type of Testing: T-Test, ANOVA-Test, Chi-square test (Concept Only)	3	
		Application of probability theorems and statistical methods	12	
	1	 Discuss topics from the following: Reliability and Validity of Different Data Sources. Highlighting the use of Measures Mean, Median and Mode in Real-World Scenarios. 	10	
V		 Significance of Measures of Dispersion in Data Analysis. Interpretation of EDA plots. Importance of Correlation and Regression in numerous Computer fields. Problem sets involving real-world applications of probability theorems. Central Limit Theorem. Real-world scenario of Binomial, Poisson and Normal Distribution. Difference between of Binomial, Poisson and Normal Distribution. Advanced Concept of T-Test, ANOVA-Test, Chi- square test, Z-Test. Markov-Chain-Montee-Carlo Method and it's use. 		
	2	Case Study	2	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	3	-	1	1	1	2	-	1	-	2	-	-
CO 2	1	3	-	-	1	-	-	2	2	-	1	-	-
CO 3	1	3	-	_	2	2	-	-	-	-	1	1	-
CO 4	1	3	-	_	2	2	3	-	1	-	3	-	1
CO 5	2	1	-	1	1	-	-	-	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	\checkmark	\checkmark	\checkmark	\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- 1. Introduction to Mathematical Statistics, Hogg R V Craig A T, Macmillan
- 2. Mathematical Statistics, Freund J E, Waple R E, Prentice Hall of India.
- 3. Probability and Statistics for Engineers, Miller I Freund J E, Prentice Hall of India.
- 4. Statistics for Management, Levin R I, Prentice Hall of India
- 5. Introduction to Mathematical Statistics, Hogg R V Craig A T, Macmillan
- 6. Mathematical Statistics, Freund J E, Waple R E, Prentice Hall of India.
- 7. Probability and Statistics for Engineers, Miller I Freund J E, Prentice Hall of India.
- 8. Gupta, S.P. Statistical Methods. Sultan Chand and Sons: New Delhi.
- 9. Mood, A.M., Graybill, F.A and Boes, D.C. Introduction to Theory of Statistics. 3rd Edition
- $Paperback-International\ Edition.$
- 10. Mukhopadhyay, P. Mathematical Statistics. New central Book Agency (P) Ltd: Calcutta
- 11. Probability and Statistics for Computer Scientists by Michael Baron

BCA2CJ103/BCA2MN102 - Numerical Analysis and Optimization Techniques

Programme	BCA	BCA								
Course Code	BCA2CJ103/BCA2MN102									
Course Title	Numerical Analysis a	nd Optimizati	ionTechniques							
Type of Course	Major/Minor (B2)									
Semester	II									
Academic	100 - 199									
Level										
Course Details	Credit	Lecture	Tutorial	Practical	Total					
		per week	Hours							
	4	4	-	-	60					
Pre-requisites	1. Understanding of a	algebraic con	cepts, includ	ing solving ed	quations and					
	inequalities.									
	2. Familiarity with the	e concept of	derivatives a	nd integrals.						
Course	This course covers	foundational	concepts in	numerical n	nethods and					
Summary	operations research, e	emphasizing	error analysi	s and solution	n techniques					
	for algebraic and tran	scendental ec	juations. Stud	lents will deve	elop skills in					
	polynomial interpolat	tion, numeric	al integration	, and explore	fundamental					
	principles of operatio	ns research, i	including line	ear programm	ing.					

CO	CO Statement	Cognitive	Knowledge	Evaluation
		Level*	Category#	Tools used
CO1	Develop a solid foundation in numerical	Ар	Р	Practical
	methods, acquiring the skills to analyze			Assignment /
	and solve algebraic and transcendental			Instructor-
	equations, and gaining a practical			created exams /
	understanding of the sources and			Quiz
	management of errors in numerical			
	computations.			
CO2	Cultivate both a comprehensive grasp	Ар	Р	Practical
	and practical proficiency in polynomial			Assignment /
	interpolation techniques, alongside			Instructor-
	acquiring expertise in numerical			created exams /
	methods for the solution of definite			Quiz
	integrals.			
CO3	Establish a robust groundwork in	Ар	Р	Practical
	Operations Research, nurturing a			Assignment /
	discerning capability to critically			Instructor-
	evaluate its applications across diverse			created exams /
	problem-solving scenarios.			Quiz
CO4	Develop expertise in Linear	Ар	Р	Practical
	Programming, mastering the art of			Assignment /
	employing sophisticated optimization			Instructor-
	techniques for the effective resolution of			created exams /
	Linear Programming problems.			Quiz
CO5	Impart a comprehensive understanding	Ар	Р	Practical
	of transportation problems and cultivate			Assignment /
	an appreciation for the methods used in			Instructor-
	finding basic feasible solutions.			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)

Module	Unit	Content	Hrs	Marks
			(48+12)	
Ι		Numerical Analysis I	10	15
	1	Errors in numerical calculations - Sources of errors	1	
	2	Solution of Algebraic and Transcendental Equations - Bisection	3	
		method		
	3	Method of false position	3	
	4	Newton Raphson method	3	
II		Numerical Analysis II	12	15
	5	Polynomial Interpolation - Lagrange interpolation	3	
	6	Newton's forward and backward difference interpolation	3	
	7	Numerical Solution of Definite Integral - Simpson's 1/3rd rule	2	
	8	Simpson's 3/8 Rule	2	
	9	Trapezoidal method	2	
III		Operations Research I	13	20
	10	Introduction to Operations Research – Definition, Advantages and	1	
		Limitations of Operations Research		
	11	Linear Programming Problem – Definition, Formulation of LPP,	2	
		Feasible solution and Optimal solution		
	12	Dual of LPP	2	
	13	Graphical solution of LPP	2	
	14	Simplex Method	3	
	15	Big-M method	3	
IV		Operations Research II	13	20
	16	Transportation Problem – Definition, Balanced and unbalanced	1	
		Transportation problems		
	17	Finding basic feasible solutions – Northwest corner method	2	
	18	Least cost method	1	
	19	Vogel's approximation method	2	l
	20	Optimized (MODI) method	3	l
	21	Assignment model - Definition, Balanced and unbalanced	1	
		Assignment problems		l
	22	Hungarian method for optimal solution	3	
V		Advanced Numerical Methods	12	
	1	• Any other two methods to solve Algebraic and Transcendental	12	
		Equations		
		• Any other two methods for Polynomial Interpolation		
		• Any other two methods to solve Solution of Definite Integral		
		• Any other method to solve LPP		1

Detailed Syllabus

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	-	1	-	3	-	1	-	2	-	2	-	-
CO 2	1	-	1	-	3	-	3	2	-	-	-	-	-
CO 3	3	-	1	-	3	_	-	-	-	-	1	1	-
CO 4	3	-	1	-	3	-	-	2	1	-	3	-	-
CO 5	3	-	1	-	3	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- 1. Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall India.
- 2. E. Carl Froberg and Erik Carl Frhoberg, Introduction to Numerical Analysis, Addition Wesley.
- 3. Hamdy A. Taha, Operations Research an Introduction, Pearson Education Limited.
- 4. P. Sankara Iyer, Operations Research, Tata McGraw-Hill, 2008.

5. A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Operations Research, Pearson Education, 2005.

Semester III

Programme	BCA						
Course Code	BCA3CJ201						
Course Title	Data Structures using	С					
Type of Course	Major						
Semester	III						
Academic	200 - 299						
Level							
Course Details	Credit	Lecture	Tutorial	Practical	Total		
		per week	per week	per week	Hours		
	4	3	-	2	75		
Pre-requisites	1. Fundamental Math	ematics Con	cepts: Set, Fu	inctions, Logi	c		
	2. BCA2CJ101 – Fun	damentals of	f Programmir	ng			
Course	This course explores	implementat	ions of linked	l list and array	y-based data		
Summary	structures, delving in	to the inner	workings of l	basic data stru	ictures		
	including lists, stacks	, queues, tree	es, and graph	s.			

BCA3CJ201 - Data Structures using C

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	Implement fundamental operations (insertion, deletion, traversal) on linear data structures, including arrays, singly linked lists, stacks, and queues, using algorithms to perform these operations efficiently.	Ар	Р	Practical Assignment / Observation of Practical Skills
CO3	Implement non-linear data structures such as binary trees and graphs, understanding their properties, types, and practical applications, and demonstrate traversal techniques	Ар	Р	Seminar Presentation / Group Tutorial Work
CO4	Compare different sorting (selection, bubble, quick, merge) and searching algorithms (linear, binary), analyzing their classifications, performance, and usage in various computational scenarios	U	С	Practical Assignment / Seminar
CO5	Apply hashing techniques, including hash functions and collision resolution methods, to organize and retrieve data efficiently within hash tables, enhancing search and storage mechanisms	Ap	Р	Viva Voce/ 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				
Ι		Introduction to Data Structures and Basic Algorithms	9	15				
	1	1						
	2	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.	1					

	21	Introduction to Searching: Linear search and Binary search (Algorithm needed) with example.	2				
	22	Hashing: Hash Tables, Hash Functions, Different Hash Functions -	2				
		Division method, Multiplication method, Mid square method, Folding					
		Method, Collision and Collision resolution Techniques: Open hashing-					
		Chaining, Closed hashing- Probing					
V	H	ands-on Programming in Data Structures: Practical	30				
		Applications, Case Study and Course Project					
	1 Implement the following:						
		1. Basic Operations in a single linked list (Menu driven)					
		2. Sort the elements in given singly linked list					
	3. Stack using array.						
	4. Stack using Linked list						
		5. Queue using Array					
		6. Queue using Linked list					
		7. Sorting algorithms- Selection, Bubble Sort					
		8. Searching Algorithms- Linear and Binary search					
	2	Project/ Case study	5				

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	1	1	-	-	-	1	-	1	-	2	-	-
CO 2	2	1	2	3	-	-	-	2	-	-	1	-	-
CO 3	2	1	2	3	-	-	-	-	3	-	-	1	-
CO 4	2	-	2	3	-	-	3	-	1	-	-	-	-
CO 5	1	1	2	3	1	_	-	-	2	-	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%)

Bachelor of Computer Application

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

Mapping of COs to Assessment Rubrics:

References:

- 1. Seymour Lipschutz, "Data Structures with C", McGraw Hill Education (Schaum's Outline Series).
- 2. Reema Thareja, "Data Structures Using C", Oxford University Press.

BCA3CJ202 - Computer Networks

Programme	BCA				
Course Code	BCA3CJ202				
Course Title	Computer Networks				
Type of Course	Major				
Semester	III				
Academic	300 - 399				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	3	-	2	75
Pre-requisites	1.Knowledge in Com	puter Organi	zation and A	rchitecture.	
	2.Knowledge in Oper	ating System	1.		
Course	This course covers the	he concepts	of data com	munication a	nd computer
Summary	networks. It comprise	es of the study	y of the stand	ard models fo	r the layered
	protocol architecture	to communio	cate between	autonomous d	computers in
	a network and also	the main fe	eatures and	issues of cor	nmunication
	protocols for differen	t layers. Top	ics covered c	omprise of in	troduction to
	OSI and TCP/IP mod	els also.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Explain various types of computer networks, topologies, and layered network architectures (OSI and TCP/IP), understanding their classifications, structures, and roles in communication	U	C	Instructor- Create Exams or Quiz
CO2	Describe the workings of the physical and data link layers, including signal conversion, transmission media, multiplexing, error detection and correction techniques, and data link protocols to achieve reliable data communication	A	Р	Discussions and Quizzes
CO3	Apply addressing schemes, such as MAC, IPv4, IPv6, and NAT, as well as essential networking devices (routers, firewalls, gateways) to support effective data flow and device communication in networked systems.	U	F	Instructor created exams or Home assignments
CO4	Implement core routing and forwarding algorithms (Distance Vector, Link State), analyzing their impact on network efficiency and reliability while demonstrating understanding of logical addressing and address mapping	A, E	Р	Discussions, Quizzes
CO5	Evaluate transport and application layer protocols, such as TCP, UDP, DNS, and HTTP, and basic concepts in network management (SNMP), demonstrating how they provide end-to-end communication, error control, and application- specific services	Ap	Р	Viva Voce Observation of practical skills
* - Re # - Fac	member (R), Understand (U), Apply (Ap), Analyse (An), E ctual Knowledge(F) Conceptual Knowledge (C) Procedural	valuate (E), C Knowledge (Create (C) P) Metacognitiv	ve Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs	Marks
			(45+30)	
Ι		Introduction to Computer networks and Network models	12	17
	1	Types of computer networks, Internet, Intranet, Network	2	
		topologies, Network classifications.		
	2	Network Architecture Models: Layered architecture approach,	2	
		OSI Reference Model, TCP/IP		
	3	Physical Layer: Analog signal, digital signal, Analog to Digital,	4	
		Digital to Analog, maximum data rate of a channel transmission		
	4	Transmission media (guided transmission media, wireless	2	
		transmission, satellite communication).		
	5	multiplexing (frequency division multiplexing, time division	2	
		multiplexing, wavelength division multiplexing		
II		Data Link Layer	11	18
	6	Data link layer services, error-detection Types of errors, Single bit	2	
		error and Burst error, Vertical redundancy check (VRC),		
		longitudinal redundancy Check (LRC), Cyclic Redundancy Check		
		(CRC), Check sum Error correction - Single bit error correction,		
		Hamming code		

	7	Error correction techniques,	3	
		error recovery protocols (stop and wait, go back n, selective		
	8	Multiple access protocols (TDMA/FDP)	2	_
	0			
		CDMA/FDD/CSMA/CD, CSMA/CA),		_
	9	Datalink and MAC addressing, Ethernet, Polling	1	_
	10	IEEE Standards- Wireless LANS, Ethernet, Bluetooth	3	
III		Network layer		18
	11	Networking and Internetworking devices - Repeaters, Bridges, Routers, Gateways, Firewall	2	
	12	Logical addressing - IPv4 & IPv6 addresses, Network Address Translation (NAT), Internet protocols, internetworking, Datagram,	2	
	13	Transition from IPv4 to IPv6	1	
	14	Address Mapping-Error reporting and multicasting - Delivery,	2	
	15	Forwarding and Routing algorithms, Distance Vector Routing,	2	_
	16	Link State Routing. Dijkstra	2	
IV		Transport Layer and Application layer	11	17
	17	Transport layer, Process-to-process Delivery: UDP, TCP	2	
	18	Congestion control and Quality of Service,	2	_
	19	Domain Name Systems-Remote Login, Email	2	_
	20	FTP, WWW, HTTP	2	
	21	Introductory concepts on Network management& Mail transfer: SNMP	2	
	22	SMTP	1	
V		Hands-on Computer Networks:	30	
	1	Practical Applications,	20	_
	1	LABI: identifying Networking Hardware components (Jacks,	20	
		Lab 2: ID address configuring		
		Lab 2. If address - configuring.		
		Lab 4: Configuring network host - setting hostname - assigning IP		
		address		
		Lab 5: configuring the Network Interface card –		
		Lab 6: Setup a Wired LAN with more than two systems		
		Lab 7: Setup a Wireless LAN with more than two systems		
		Lab 8: Setting up Internet services File Transfer Protocol (FTP),		
		Lab 9: Simple Mail Transfer Protocol (SMTP) and Post Office		
		Protocol (POP) Lab 10: Sotting up Intropot Someticos Naturals Eile Southers (NES)		
	2	Lao 10: Setting up intranet Services - Network File System (NFS),	2	-
	2	Case suuy Constana ((Course) Project: Duild a practical application using	3 7	-
	3	Wired Network		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	-	-	-	-	3	-	1	-	2	-	-
CO 2	2	2	1	-	-	-	-	2	-	-	1	-	-
CO 3	_	2	1	-	_	_	-	-	2	-	-	1	-
CO 4	-	2	1	1	1	-	3	-	-	-	-	-	-
CO 5	1	1	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	\checkmark		\checkmark	\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark			\checkmark
CO 4	\checkmark			\checkmark
CO 5		\checkmark	\checkmark	\checkmark

References:

- 1. Behurouz A Forozan, Introduction to Data Communications & Networking, TMH
- 2. Andrew S. Tanenbaum, Computer Networks, PHI
- 3. William Stallings, Data and Computer Communications, VIIth Edition, Pearson Education

Programme	BCA								
Course Code	BCA3CJ203/BCA3N	BCA3CJ203/BCA3MN201							
Course Title	Introduction to Data	Science							
Type of Course	Major/Minor (A3)								
Semester	III								
Academic	200-299								
Level									
Course Details	Credit	Lecture	Tutorial	Practical	Total				
		per week	per week	per week	Hours				
	4	4	-	-	60				
Pre-requisites	1. Basic understandin	ig of compute	er science con	ncepts.					
	2. Familiarity with da	ata handling.							
	3. simple mathematical analysis.								
Course	Data science is the domain of study that deals with vast volumes of data								
Summary	using modern tools	using modern tools and techniques to find unseen patterns, derive							
	meaningful informati	on, and make	e business de	cisions.					

BCA3CJ203/BCA3MN201 - Introduction to Data Science

СО	CO Statement	Cognitive	Knowledge	Evaluation				
		Level*	Category#	Tools used				
CO1	Define key concepts and terminology in data science, including its evolution, roles, and applications across various industries.	R	С	Assignment / Instructor- created exams / Quiz				
CO2	Demonstrate the ability to collect and preprocess data using appropriate strategies, including data cleaning, integration, and transformation techniques.	U	С	Assignment / Instructor- created exams / Quiz				
CO3	Analyze datasets using descriptive statistics and visualizations, interpreting results to identify patterns, correlations, and insights.	U	С	Assignment / Instructor- created exams / Quiz				
CO4	Evaluate various data models, including simple and multiple regression, using visualization techniques and model assessment metrics.	Ар	Р	Assignment / Instructor- created exams / Quiz				
CO5	Create predictive models using supervised and unsupervised learning techniques, applying concepts of overfitting, underfitting, and cross-validation to enhance model performance.	Ар	Р	Assignment / Instructor- created exams / Quiz				
* - Rer # - Fac Metaco	 * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) 							

Module	Unit	Content	Hrs (48+12)	Mark
Ι		Introduction to Data Science	10	15
	1	Introduction to Data Science-Definition	2	
	2	Evolution of Data Science	2	
	3	Data Science Roles	3	
	4	Application of data sciences.	3	
II		Data Collection and Data Pre-Processing	12	15
	5	Data Collection Strategies	2	
	6	Data Pre-Processing Overview	2	
	7	Data Cleaning	2	
	8	Data Integration and Transformation	3	
	9	Data Reduction and Descretization	3	
III		Data Analytics	12	20
	10	Descriptive Statistics	2	
	11	Mean, Standard Deviation	2	
	12	Skewness and Kurtosis	2	
	13	Box Plots	2	
	14	Pivot Table	2	
	15	Correlation Statistics	2	
IV		Data Model Development and Evaluation	14	20
	16	Simple and Multiple Regression	2	
	17	Model Evaluation using Visualization	2	
	18	Residual plot and distributional plot	2	
	19	Prediction and Decision Making	2	
	20	Model Evaluation techniques-	3	
	21	Supervised learning techniques	2	
	22	unsupervised learning techniques	1	
V		Model Evaluation and Prediction		
	•	Out of samples evaluation metrics	12	
	•	Cross validation in Model evaluation		
	•	Over fitting and under fitting concepts		
	•	Appropriate model selection.		
	•	Prediction and decision-making concepts.		
	•	Prediction by ridge regression.		

Detailed Syllabus

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	-	1	-	2	-	1	-	1	-	2	-	-
CO 2	3	-	1	-	1	-	-	2	-	-	1	-	-
CO 3	3	-	2	-	1	-	-	-	3	-	-	1	-
CO 4	2	-	2	-	2	-	3	-	1	-	-	-	-
CO 5	1	-	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	am Assignment Practical Evaluation		End Semester Examinations
CO 1	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3		\checkmark	\checkmark	\checkmark
CO 4		\checkmark	\checkmark	\checkmark
CO 5		\checkmark	\checkmark	\checkmark

References:

- 1. Jojo Moolayil, "Smarter Decisions: The Intersection of IoT and Data Science", PACKT, 2016.
- 2. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015.
- 3. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013
- 4. Introduction to Data Science a Python approach to concepts, Techniques and Applications, Igual, L;Seghi', S. Springer, ISBN:978-3-319-50016-4 2.
- 5. Data Analysis with Python A Modern Approach, David Taieb, Packt Publishing, ISBN-9781789950069

Programme	BCA							
Course Code	BCA3CJ204/BCA3N	BCA3CJ204/BCA3MN202						
Course Title	Foundations of Artifi	cial Intelliger	nce					
Type of Course	Major/Minor (B3)							
Semester	III							
Academic	200-299							
Level								
Course Details	Credit	Lecture	Tutorial	Practical	Total			
		per week	per week	per week	Hours			
	4	4	-	-	60			
Pre-requisites	A course on Discrete	Mathematics	is recommen	nded				
Course	This course provides	an introducti	on to the fiel	d of Artificial	Intelligence			
Summary	covering fundamenta	l concepts, p	roblem solvi	ng methods su	ich as search			
	algorithms and heuristics approaches and different knowledge							
	representation techniques. The course addresses the ethical dimensions of							
	AI and their societal	impacts.						

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts in artificial intelligence, including its applications, foundational principles, and the history of AI development.	U	С	Instructor- created exams / Quiz/Assignment/ Seminar
CO2	Demonstrate the ability to identify and implement basic AI concepts, such as intelligent agents, problem-solving strategies, and search algorithms.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar
CO3	Analyze various problem-solving strategies, distinguishing between uninformed and informed search strategies, and apply these concepts to real-world scenarios.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar
CO4	Evaluate the effectiveness and ethical implications of AI technologies, considering philosophical questions related to weak and strong AI.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar
CO5	Design and implement an AI application that incorporates knowledge representation techniques and agent architectures, demonstrating an understanding of the task environment.	U	С	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)

Module	Unit	Contents	Hrs (48+12)	Marks
		Introduction to AI	11	
	1	Artificial Intelligence: Definition and Applications	2	
	2	Foundations of Artificial Intelligence	1	
	3	History of Artificial Intelligence, State of the Art	2	
	4	Intelligent Agents: Agents and Environments	1	
Ι	5	The Concept of Rationality, Nature of Environments: Specifying the Task Environment, Properties of Task Environment	3	18
	6	Structure of Agents: Agent Programs, Simple Reflex Agent, Model Based Reflex Agent, Goal Based Agent, Utility Based Agent, Learning Agent (Concept Only, No Algorithm required)	2	
		AI Problem Solving	15	
п	7	Problem Solving Agents (Concept Only), Examples Problems: Toy problems, Real world problems	3	20
	8	Solutions for searching: Tree Search and Graph Search and Measuring Problem Solving Performance (Concept Only)	2	20
	9	Uninformed Search Strategies: Breadth First Search, Uniform Cost Search, Depth First Search,	4	
	10	Informed search strategies: Greedy Best First search, A* Search, Heuristic Search (Concept Only)	2	
	11	Constrain Satisfaction Problems: Definition, Examples: Map colouring, Job-Shop scheduling	2	L
	12	Constraint Propagation: Node Consistency, Arc Consistency, Path Consistency and K-Consistency	2	
		Knowledge Representation	13	
	13	Logical agents: Knowledge based agents, The Wumpus world	2	l
	14	Logic: Definition, Propositional logic, Syntax and Semantics, Simple Knowledge Base	3	
III	15	First Order Logic: Definition, Syntax and Semantic (Models, Symbols and Interpretations, Terms, Atomic Sentences, Complex Sentences, Quantifiers, Equality)	3	20

Detailed Syllabus

	16	Ontological Engineering: Definition	1	
	17	Categories and Objects: Physical Composition, Measurements, Objects: Things and Stuff, Process, Time Intervals, Fluent and Objects Quantifying Uncertainty (Concept Only)	4	
		AI: Philosophical Foundations and Future	9	
	18	Weak AI: Can machines act intelligently?	1	
	19	Strong AI: Can machines really think?	2	
IV	20	Ethics and risks of developing Artificial Intelligence	2	12
	21	Agent components and architectures	2	
	22	Are we going in the right direction? What if AI succeed?	2	
		Domain specific Applications of AI	12	
V		 Discuss topics from the following: Discuss on evolution of AI Analyzing different agent types and environments Building a simple Reflex Agent Identifying Problem-Solving agents in everyday applications Implementation of Tree Search Algorithmic implementation of A* Search and Heuristic Search 	10	
		 Discussion on the effectiveness of heuristic methods Real-world applications of CSP Building a knowledge-based agent for the Wumpus World Discussion on uncertainty in AI Case Study: Provide students with case studies or examples of AI applications in different domains (e.g., healthcare finance marketing) 	2	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	-	-	3	-	2	-	2	-	-
CO 2	2	-	2	2	2	2	-	2	-	-	1	-	-
CO 3	2	_	2	2	2	2	-	-	3	-	-	1	-
CO 4	2	-	2	2	2	2	3	-	1	-	-	-	-
CO 5	2	-	2	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- 1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2010.
- 2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education, 2017.
- 3. Elaine Rich, Kevin Knight, & Shivashankar B Nair, "Artificial Intelligence", McGraw Hill, 3rd Edition, 2009.

Semester IV

Programme	BCA								
Course Code	BCA4CJ205								
Course Title	Database Managemer	nt System							
Type of Course	Major								
Semester	IV								
Academic	200 - 299								
Level									
Course Details	Credit	Lecture	Tutorial	Practical	Total				
		per week	per week	per week	Hours				
	4	3	-	2	75				
Pre-requisites	Discrete Mathematics	s, Data struct	ures and Prog	gramming Bas	sics				
Course	This course provides	an introduct	tion to databa	ase managem	ent systems.				
Summary	The topics covered in	clude the con	cept of Datab	oase Managen	nent System,				
	ER Model, Relation	nal model, S	SQL, Databa	ise design, T	Transactions,				
	concepts of other data	a model-NoS	QL and prac	tical session to	o implement				
	Database Concepts.								

BCA4CJ205 - Database Management System

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used						
CO1	Define key concepts and characteristics of database systems, including differences between file systems and database management systems (DBMS), and describe various data models.	U	C	Instructor- created exams / Quiz						
CO2	Apply the Entity-Relationship (ER) model to design a database, identifying entities, attributes, and relationships, and converting the ER model into a relational model.	U	С	Instructor- created exams / Quiz						
CO3	Analyze relational database designs for normalization and integrity, assessing redundancy and anomalies in data to normalize up to the Third Normal Form (3NF).	Ар	Р	Practical Assignment / Observation of Practical Skills						
CO4	Evaluate SQL queries and transaction processing techniques, assessing their effectiveness in managing data integrity, concurrency, and recovery.	Ар	р	Practical Assignment / Observation of Practical Skills						
CO5	Design and implement a database system using both SQL and NoSQL technologies, demonstrating the ability to create, manipulate, and query data in a multi-database environment.	Ар	Р	Practical Assignment / Observation of Practical Skills						
* - Re # - Fa Know	 * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) 									

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Detalleu	Synabus

Module	Unit	Hrs (45 + 30)	Mark	
т		Database System- Concept	(45+30)	15
1	1	Introduction. Characteristics of the Database Approach	2	15
	2	Actors on the Scene. Workers behind the Scene. Advantages of	2	
	_	Using the DBMS Approach, File system vs Database	-	
	3	Data Models, Schemas, and Instances, Three-Schema	3	
		Architecture and Data Independence		
	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,	2	
		weak entities	2	
	8	Relational Model Concepts-Domains, Attributes, Tuples, and	2	
	0	Relations, Values and NULLS in the Tuple	2	
	9	Relational Model Constraints and Relational Database Schemas	2	
	10	INF 2NF 3NF BCNF	4	
	11	4NF.5NF	2	
III		Query Languages	11	20
	12		1	
		SQL-, introduction to Structured Query Language (SQL)		
	13	Data Definition Language (DDL), Table definitions and	2	
		operations	4	
	14	SQL DML (Data Manipulation Language) - SQL queries on	4	
		single and multiple tables		
	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),	2	
		Document DB (examples from: MongoDB)	10	
IV	10	Transaction Processing, Concurrency Control	10	15
	18	Transaction Processing: Introduction, Transaction and System	3	
	19	Desirable Properties of Transactions	1	
	20	Characterizing Schedules Based on Recoverability &	2	
	20	Serializability	-	
	21	Transaction Support in SQL.	1	
	22	Introduction to Concurrency Control: Two-Phase Locking	3	
		Techniques		
V		DBMS LAB	30	
	1	Students should decide on a case study and formulate the problem	3	
		statement.		
	2	Based on Identified problem Statement, Design ER Diagram	3	
		(Identifying entities, attributes, keys and relationships between		
		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

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	-	-	-	-	1	-	1	-	2	-	-
CO 2	2	2	1	-	_	_	-	2	-	1	1	-	-
CO 3	-	-	2	3	_	-	-	-	3	-	-	1	-
CO 4	-	-	_	3	3	-	3	-	1	-	3	-	1
CO 5	_	-	-	3	3	-	-	-	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	Project Evaluation	End Semester Examinations
CO 1	\checkmark			\checkmark
CO 2	\checkmark			\checkmark
CO 3		\checkmark	\checkmark	\checkmark
CO 4		\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark		\checkmark

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 ISBN: 978-0072465631/ 0-07-246563-8.

Programme	BCA						
Course Code	BCA4CJ206						
Course Title	Python Programming						
Type of Course	Major						
Semester	IV						
Academic Level	200 - 299						
Course Details	Credit	Lecture	Tutorial	Practical	Total		
		per week	per week	per week	Hours		
	4	3	-	2	75		
Pre-requisites	Knowledge in Fundar	nentals of Pro	ogramming				
Course	This course explores the versatility of Python language in programming						
Summary	and teaches the application of various data structures using Python. The						
	course also introd	uces fundai	nental conc	epts of ob	ject-oriented		
	programming and ins	ights into lev	veraging Pyth	on packages.			

BCA4CJ206 - Python Programming

CO	CO Statement	Cognitive	Knowledge	Evaluation Tools
		Level*	Category#	used
CO1	Define and describe the	U	С	Instructor-created
	fundamental concepts of			exams / Quiz
	Python, including tokens,			
	operators, data types, and			
	control flow statements (if,			
	loops)			

CO2	Apply Python programming concepts to create functions, manipulate data structures (lists, dictionaries, tuples), and implement control flow in practical scenarios.	Ар	Р	Coding Assignments/ Code reading and review				
CO3	Analyze and compare the performance and utility of different data structures (lists, dictionaries, NumPy arrays) in solving computational problems.	Ар	Р	Coding Assignments/ Code reading and review				
CO4	Evaluate scientific computing libraries (NumPy, Pandas, Matplotlib) in Python for data analysis and visualization, assessing their advantages and use cases.	An	С	Instructor-created exams / Case studies				
CO5	Design and develop a comprehensive application using Python that integrates multiple modules and data visualization tools, demonstrating proficiency in scientific computing and data manipulation.	Ap	Р	Coding Assignments/ Case studies				
* - Re # - Fa Metae	 * - 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
			(45+30)	
Ι		Introduction to Python and Control Flow	10	15
		Statements		
	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	
Ι		Introduction to Functions & Modules	12	20
Ι	6	Introduction to functions	2	
	7	1		
	8	Types of arguments	3	

	9	Types of functions – recursive, anonymous, returning more	3	
		than one value		
	10	Introduction to Modules	1	
	11	User-defined modules and packages	2	
			12	20
	12	Introduction to Strings and traversal	2	
III	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	
		Introduction to Scientific Computing in Python	11	15
	18	Basics of NumPy Arrays	2	
IV	19	Computation on NumPy Arrays	2	
	20	Basics of Pandas objects	3	
	21	Basics of Matplotlib	1	-
	22	Plotting in Matplotlib	3	-
	Hand	ls-on Data Structures: Practical Applications, Case	30	
	Study	and Course Project		
	1	Introduction to Python	20	-
		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		
V		floating point numbers using Python operators like		
		+, -, *, /, //, %, and **		
		• Call functions residing in the math module		
	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	
0	• 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	
	Leoping 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
10		7
13	Capstone (/Course) Project: Build a practical application using any openackage and implement the visualization tools	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	-	-	-	-	-	1	-	1	-	2	-	-
CO2	1	-	2	-	1	-	-	2	-	3	1	-	-
CO3	1	-	2	1	-	-	-	-	3	-	-	1	-
CO4	1	-	1	-	-	-	3	-	1	-	-	-	-
CO5	3	2	2	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	Project Evaluation	End Semester Examinations
CO 1	\checkmark			\checkmark
CO 2	\checkmark			\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4		\checkmark		\checkmark
CO 5		\checkmark		\checkmark

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 | Bachelor of Compute | r Application | ns (BCA) | | |
|----------------|-----------------------------------------------------------------------|-----------------|-----------------|------------------|----------------|
| Course Code | BCA4CJ207 | | | | |
| Course Title | Software Engineering | 5 | | | |
| Type of Course | Major | | | | |
| Semester | IV | | | | |
| Academic | 200-299 | | | | |
| Level | • | | | | |
| Course Details | Credit | Lecture | Tutorial | Practical | Total |
| | | per week | per week | per week | Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | 1. Understanding fund | lamental com | puter science c | oncepts, data st | tructures, and |
| | algorithms. | | | | |
| | 2. Basic knowledge of | f project planr | ing and sched | uling | |
| Course | After completing th | e course stu | udents may | be engaged | in practical |
| Summary | exercises, projects, an | nd teamwork | to apply the | eoretical conc | epts to real- |
| | world scenarios. The goal is to equip students with the knowledge and | | | | |
| | skills needed to deve | lop high-qua | ality software | e solutions an | d contribute |
| | effectively to the soft | ware develop | oment lifecyc | le. | |

BCA4CJ207 - Software Engineering

СО	CO Statement	Cognitiv eLevel*	Knowled ge Category #	Evaluation Tools used
CO1	Apply various software development methodologies to real-world projects by selecting and justifying the most suitable process model based on project requirements and constraints.	Ар	С	Practical Assignment / Instructor-created exams / Quiz
CO2	Analyze and differentiate between functional and non-functional requirements in a software project, utilizing various elicitation techniques to gather and specify these requirements effectively.	Ар	Р	Practical Assignment / Instructor-created exams / Quiz
CO3	Evaluate and compare different architectural models and patterns, assessing their suitability for specific software applications based on functional and non-functional requirements.	Ар	С	Practical Assignment / Instructor-created exams / Quiz
CO4	Apply various software testing strategies and techniques to develop a comprehensive testing plan for both conventional and object-oriented software projects	Ар	Р	Practical Assignment / Instructor-created exams / Quiz

CO5	Design and implement a comprehensive software project that integrates knowledge	Ар	р	Practical Assignment / Instructor-created				
	from multiple software engineering			exams / Quiz				
	for a stortur							
	for a startup.							
* - Re	emember (R), Understand (U), Apply (Ap), A	Analyse (An),	Evaluate (E), C	Create (C)				
# - Fa	# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive							
Know	$r_{\rm red}$	(-)		(-)				
12110 W								

Module	Unit	Content	Hrs	Marks
			(48+12)	
Ι		THE SOFTWARE PROCESS	10	15
	1	Software Engineering: Nature of Software, Software	1	
		Engineering, Software Process, Software Development		
		Life Cycle		
	2	Prescriptive Process Models – Waterfall, Incremental,	3	
		Evolutionary		
	3	Agile Process: What is Agility, What is agile Process?	2	
	4	Extreme Programming: XP Values, XP Process, Industrial	1	
		XP, XP Debate		
	5	Other Agile Process Models: Adaptive Software	3	
		Development, , Scrum, Dynamic Systems Development		
		Method, Crystal		
II		REQUIREMENT ENGINEERING	10	15
	6	Introduction to Requirement Engineering: Functional and	2	
		non-functional requirement (Types)		
	7	Requirement engineering process	2	
	8	Requirement Elicitation: Concept of Requirement	2	
		Elicitation, Elicitation Technique, Stories and Scenarios,		
	9	Requirement Specification: Concept, Natural Language	2	
		Specification, Structured Specification, Use Cases, Software		
		Requirement Document,		
	10	Requirement Validation: Concept, Requirement Change,	2	
III	SY	STEM MODELLING, ARCHITECTURAL DESIGN	14	20
	11	Context models: Detailed Concept	2	
	12	Interaction models: Concept, Use case modelling,	2	
		Sequence Diagram,		
	13	Structural Models: Concept, Class Diagram,	2	
		Generalization, Aggregation,		

	12	Behavioural Models: Concept, Data driven modelling,	2	
		Event driven modelling, Model driven engineering,		
	13	Architectural design decisions: Detailed concept	2	
	14	Architectural views: Detailed concept, Layered	2	
		Architecture, Repository Architecture, Client-Server		
		architecture, Pipe and Filter Architecture.		
	14	Architectural patterns: Transaction Processing	2	
		Systems, Information Systems, Language Processing		
		System,		
IV	TE	STING, MAINTANENCE AND RE ENGINEERING	14	20
	16	Strategic Approach to Software Testing: Verification	2	
		and Validation, Organizing for Software Testing,		
		Software Testing Strategy		
	17	Strategies for Conventional Software: Unit and	2	
		IntegrationTesting		
	18	Strategies for Object Oriented Software: Unit Testing	2	
		andIntegration Testing in OO Context.		
	19	Validation Testing, System Testing, White Box	2	
		Testingand Black Box Testing		
	20	Software Maintenance - Software	2	
		Supportability,		
		Reengineering		
	21	Business Process Reengineering: Business Process, BPR	2	
	- 22	Model	2	
X 7	22	Software Reengineering and Reverse Engineering	<u> </u>	
V		1 Cose Study	12	
		1. Case Sludy.		
		2. Engage in a substantial project that integrates		
		sinowieuge from various areas of software		
		Engineering.		
		5. Explore the process of creating a software startup.		
		4. Apply critical thinking skills to software design and		
		implementation.		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	1	-	-	2	-	1	-	1	-	2	-	-
CO 2	1	1	-	-	2	-	-	2	-	3	-	-	1
CO 3	1	1	2	-	3	-	-	-	-	-	-	1	-
CO 4	1	1	2	_	3	-	3	-	1	-	-	-	
CO 5	1	1	2	-	3	3	-	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- 1. Sommerville, I. (2016). Software Engineering (10th ed.). Pearson Education.
- 2. Pressman, R. S. (2010). Software Engineering: A Practitioner's Approach (7th ed.).
- 3. Van Vliet, H. (2008). Software Engineering: Principles and Practices.

4. Fairley, R. E. (2008). Software Engineering Concepts.

5. Khurana, R. (n.d.). Software Engineering: Principles and Practices (2nd ed.). Vikas Publishing House Pvt Ltd.

6. Jalote, P. (n.d.). An Integrated Approach to Software Engineering (3rd ed.). Narosa Publishing House.

	1							
Programme	BCA	BCA						
Course Code	BCA4C	BCA4CJ208						
Course Title	Automa	tion and Rob	ootics					
Type of	Major							
Course								
Semester	IV							
Academic	200-299)						
Level								
Course Details	Cre	Lecture	Tutorial	Practical	Total Hours			
	dit	per week	per week	per week				
	4	4	-	-	60			
Pre-requisites	No pre	-requisites re	equired					
Course	This co	urse provide	s a comprehe	ensive overvi	ew of automation which			
Summary	includes	their produ	ction systems	s, elements, a	utomation functions and			
	usage o	of discrete a	nd continuo	us control s	ystem. The course also			
	explores the fundamentals of robotics, including anatomy, process							
	control a	and howthese	e functions co	ould be impro	ved by the integration of			
	Artificia	al Intelligence	e.					

BCA4CJ208 - Automation and Robotics

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Explain the key concepts and components of production systems and automation, including the roles of manual labour and automated processes in manufacturing.	U	С	Instructor- created exams / Quiz/Assignment/ Seminar
CO2	Analyse the differences between process industries and discrete manufacturing, comparing their control systems and the capabilities of various computer control technologies.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar
CO3	Apply robotic programming techniques to design and implement control systems for various robotic configurations, utilizing sensors and end effectors effectively.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar

CO4 Evaluate the impact of artificial intelligence on automation and robotics, comparing flexible automation with traditional robotic technologies and assessing their implications for future manufacturing practices.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar
CO5 Explain the key concepts related to automation and its impact on modern manufacturing, including the role of manual labour, benefits and challenges of automation, and the significance of computer process control.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar
* - Remember (R), Understand (U), Apply (Ap) # - Factual Knowledge(F) Conceptual Knowledg Metacognitive Knowledge (M)	, Analyse (An ge (C) Proced), Evaluate (E), ural Knowledge	, Create (C) e (P)

Module	Unit	Contents	Hrs (48+12)	Mark
		Introduction to Automation	11	
	1	Production systems - Facilities, Manufacturing support systems	2	
	2	Automation in production systems – Automated manufacturing system, Computerized manufacturing support systems, Reasons for automating	3	
Ι	3	Manual labour in production systems	1	15
	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	
		Control Systems	14	
	7 Process industries versus Discrete manufacturing industries, Continuous versus Discrete control		2	
	8	Continuous control system	3	
	9	Discrete control system	1	
	10 Computer process control, Control requirements, Capabilities of computer control		2	
II		Forms of computer process control - Computer process monitoring, Direct digital control,		15

	11	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	
	Au	tomation and Robotics: Present and Future	8	
	19	Machine Intelligence, Computer and Robotics	2	
IV	20	Flexible automation vs Robotics technology	2	15
1	21	Artificial Intelligence and Automated Manufacturing, AI and Robotics	2	15
	22	Robotics in India, Future of Robotics	2	
		Benefits and challenges of Automation	12	
		 Discuss topics from the following: Role of manual labour in modern manufacturing. 		

	2	Host a discussion session on the intersection of Artificial Intelligence (AI) and Robotics in automated manufacturing	2	
		automated manufacturing.		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	-	-	-	-	1	-	2	-	1
CO 2	2	2	-	-	2	-	1	2	-	3	1	-	-
CO 3	2	2	-	-	2	-	3	-	3	-	-	1	-
CO 4	2	2	-	-	2	-	3	-	1	-	-	-	-
CO 5	1	-	-	-	-	1	-	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

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

Semester V

BCA5CJ301 - Object Oriented Programming (Java)

Programme	BCA				
Course Code	BCA5CJ301				
Course Title	Object Oriented Prog	ramming (Ja	va)		
Type of Course	Major				
Semester	V				
Academic	300-399				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	3	-	2	75
Pre-requisites	1. Knowledge in basi	c programmi	ng		
	2. Knowledge in OOI	P Concepts			
Course	The aim of this course is to provide students with an understanding of the				
Summary	basic concepts in Java	a programmir	ng. This cours	se will help stu	idents create
	GUI applications in J	ava and estab	olish database	e connectivity	

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Apply object-oriented programming principles in Java to design and implement a functional program that utilizes classes, objects, inheritance, method overriding, and interfaces.	U	C	Practical Assignment / Exams /Quiz
CO2	Manage exceptions and perform input/output file operations in Java, implementing error handling techniques and file manipulation in their programs.	Ар	Р	Practical Assignment / Exams /Quiz
CO3	Design and implement a multithreaded Java application that connects to a database, performs data manipulation, and executes queries using JDBC.	Ар	Р	Practical Assignment / Exams /Quiz
CO4	Explain the key concepts of GUI application development in Java, including the use of AWT and Swing, layout management, and event handling.	Ар	Р	Practical Assignment / Exams /Quiz

CO5 Develop and implement various Swing applications that demonstrate event handling, data validation, and database connectivity	Ap	Р	Practical Assignment / Exams /Quiz
* - Remember (R), Understand (U), Appl Factual Knowledge(F) Conceptual Know Knowledge (M)	y (Ap), Analyse ledge (C) Proced	(An), Evaluate (E), lural Knowledge (P	Create (C)# -) Metacognitive

Module	Unit	Content	Hrs	Marks
T		Devices of OODs and Introduction to Java	(45+30)	20
1	1	Review of OOPs and Introduction to Java	1/	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	Excep	tion and I/O Operations	8	15
	11	Exception: Baic Concept of exception and Exception Hierarchy	2	
	12	Managing Exception: Use of trycatch 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	Multit	hreading 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 P	rogramming	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	s-on Programming in Java(Using IDE NetBeans,	30	30
	Eclips	e, VSCode):		
	1	Lumplement the following:		
	1	1. String and Amoust	20	
		I. String and Arrays.	20	
		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 trycath, finally block		
		(Hint: Arithmetic and ArrayOutOfBoundException)		
		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)	
I	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

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	3	3	-	-	1	-	1	-	2	-	-
CO 2	1	-	3	3	-	-	-	2	-	3	1	-	-
CO 3	-	-	3	3	2	3	-	-	-	-	-	1	_
CO 4	-	-	2	3	-	-	3	-	1	-	-	-	-
CO 5	-	-	3	3	2	3	-	-	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%)

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

Mapping of COs to Assessment Rubrics:

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	BCA								
Course Code	BCA5CJ302								
Course Title	Progressive Web App	olication usin	g PHP						
Type of Course	Major								
Semester	V								
Academic	300-399								
Level									
Course Details	Credit	Lecture	Tutorial	Practical	Total				
		per week	per week	per week	Hours				
	4	3	-	2	75				
Pre-requisites	1. Knowledge in basi	c programmi	ng						
	2. Basic Knowledge	in HTML							
Course	main objective of th	nis course is	to develop	dynamic wel	o pages. To				
Summary	implement server-sid	de scripting	and client-s	side scripting	, data base				
	connectivity to develo	op dynamic v	veb page.						

BCA5CJ302 - Progressive Web Application using PHP

Course Outcomes (CO):

СО	CO Statement	Cognitive	Knowledge	Evaluation Tools
001		Level*	Category#	used
COI	Explain the fundamental concepts of web programming, including client and server-side scripting, and the structure and features of HTML5 and CSS.	U	Р	Assignment / Instructor-created exams / Quiz
CO2	Apply JavaScript and jQuery to create interactive web applications, utilizing programming fundamentals, event handling, and object manipulation.	Ap	Р	Practical Assignment / Instructor-created exams / Quiz
CO3	Design and develop a dynamic web application using PHP that interacts with users, processes form data, and manages sessions and cookies.	Ap	Р	Practical Assignment / Instructor-created exams / Quiz
CO4	Apply MySQL and PHP to create a dynamic web application that performs database operations, utilizes AJAX for partial page updates, and implements the MVC architecture using Laravel.	Ap	Р	Practical Assignment / Instructor-created exams / Quiz
CO5	Design and develop a comprehensive web application that incorporates form controls, JavaScript functionalities, and PHP for dynamic data handling and user authentication.	Ap	Р	Practical Assignment / Instructor-created exams / Quiz
* - Re	emember (R), Understand (U), Ar	oply (Ap), Analys	e (An), Evaluate (E), Create (C)
# - Fa	ctual Knowledge(F) Conceptual	Knowledge (C) P	rocedural Knowled	ge (P) Metacognitive
Know	vledge (M)			

Module	Unit	Content	Hrs	Marks
			(45+30)	
Ι		Introduction to Web Document	16	22
	1	Introduction to the Web Programming	1	
	2	Client and Server-Side Scripting	1	
	3	Introduction to HTML 5: Essential of HTML 5, Exploring	2	
		New Features, Structuring an HTML document		
	5	Fundamentals of HTML: Elements and Attributes, Data	2	
		Types, HTML form elements, Organizing the text in		
		HTML		
	6	Advance features of HTML: Working with links and	2	
		URLs, Creating the table, Creating with images, colors and		
		Canvas		

	7	HTML5 Web Workers: HTML5 Web Storage, HTML5 Cache Manifes, Basics Web Worker	2	
	8	Fundamentals of CSS: Evolution of CSS, Syntax of CSS, Exploring CSS Selectors, Inserting CSS in HTML	2	
	9	CSS Effects: Background and Color Gradient in CSS,Fonts and Text styles in CSS, Creating Boxes and Columnsusing CSS	2	
	10	Working with CSS: Working with Class, CSS ID, List and Tables, CSS3 basic transformation	2	
II		Exploring Scripting Language	8	13
	11	Introduction to JavaScript: Overview of JavaScript, Programming Fundamentals of JavaScript (Variable, operators, Control Flow, Conditional Statement)	2	
	12	Functions of JavaScript: Working with Functions(Invoking function, Return statement, Function withparameter, Built in Function), JavasCript Objects (String, RegExp, Boolean, Number, Array, Math, Date)	2	
	13	Events Familiarization: onLoad, onClick, onBlur, onSubmit, onChange, Document Object, Model (Concept). Objects: String, Array, Date	2	
	14	Introduction to JQuery: Fundamentals of JQuery, JQuery Selectors, Basic JQuery methods, Jquery events, Jquery Effects	2	
III		Introduction to PHP	10	20
	15	Fundamentals of PHP: History of PHP, General structure of PHP, Displaying Output, Escaping Special Characters, Comments,	3	
	16	Variables – (Declaring, Assigning, Destroying), Datatypes, Setting and Testing Datatypes – Constants -Operators (Arithmetic, Comparison, Logical, Assignment, Concatenation) – Super global variables	2	
	17	Basics of PHP: Control structures – Looping structures - 1- D Array & its manipulation (Storing Data, Assigning, Accessing Array Elements, Displaying) - User-Defined Functions, Function Scope	2	
	18	Advanced PHP and Form Interaction: Working with PHP: Passing information between pages, HTTP GET and POST method, Cookie, Session. String functions: strlen, strops, strstr, strcmp, substr, str_replace, string case, Array constructs: array(), list() and foreach(). Header().	3	
IV		Database programming and PHP	11	15
	19	Overview of MySQL: Features of MySQL, data types, basic queries (CREATE, INSERT, SELECT, UPDATE, DELETE)	2	
	20	PHP functions for MySQL operations: mysqLconnect, mysql_select_db, mysqLquery, mysql_fetch_row, mysql_fetch_array, mysql_fetch_object, mysqLresult, Insertion and Deletion of data using PHP, Displaying data from MySQL database in webpage.	4	

	21	Introduction to AJAX - Implementation of AJAX in PHP - Simple example for partial page update.	2	
	22	Introduction to Laravel's: Fundamental concept, Features,	3	
		MVC Architecture, Installing Laravel, Building		
		Application with Laravel		
V	Ha	ands-on Programming in PHP (Using IDE NetBeans, Notepad++, VSCode):	30	
	Pr	actical Applications, Case Study and Course Project		
	1	Implement the following:		
		1. HTML and CSS	20	
		Design a webpage that illustrates the use of the following		
		form controls:		
		(i) Input controls: single-line text, password, radio-button,		
		multi-line text. (ii) Buttons: submit and reset		
		Design a webpage that illustrates the use of the following		
		form controls:		
		(i) Input controls: data list, multi-select box, grouped select		
		box		
		(11) Buttons: submit and reset		
		Legends		
		Design a web page to demonstrate Text alignment and		
		Border colours using internal CSS		
		Using HTML, CSS create a custom hover and focus effect		
		for navigation items, using CSS transformations		
		Design a web page to demonstrate inline CSS.		
		2. JavaScript and JQuery		
		Write a JavaScript program to calculate multiplication and		
		division of two numbers (input from the user).		
		a human-readable string		
		Write a JavaScript program that implements a "form"		
		validation that displays an error message if a required field		
		is left empty when submitting the form.		
		Write a JavaScript program to compare two objects to		
		determine if the first contains equivalent property values to		
		3. Database Programming		
		Create a php program to display the bio data of a person by		
		reading the personal details using an HTML page.		
		Create a login page using database.		
		Create a MySQL table student with fields roll no, name,		
		mark, grade. Write a PHP program to insert and display the		
		mark list of a student by accepting the register no of the		
		Design a PHP page to implement a login screen using		
		sessions. Login details are to be verified from the server		
		side with values stored in a database.		

	Design a PHP page to illustrate the use of file upload – uploading files of a type with a specified size to the webserver		
	Design sample application using Leravel		
2	Case Study	2	
3	Project: Build a web application for shop management system (Eg: Admin Login, Product registration, stock management, product selling, employee salary)	8	

	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	
CO 1	1	-	3	3	_	-	1	-	1	-	2	-	
CO 2	1	-	3	3	-	-	-	2	-	3	1	-	
CO 3	-	-	3	3	2	3	1	-	3	-	-	1	
CO 4	-	-	2	3	-	-	3	-	1	-	-	-	
CO 5	-	-	3	3	2	3	-	-	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%

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	\checkmark			\checkmark
CO 2	\checkmark			\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4		\checkmark		√
CO 5		\checkmark		\checkmark

Mapping of COs to Assessment Rubrics:

References:

- 1. Dreamtech Press. (2016). HTML 5 Blackbook. ISBN 9879351199076.
- 2. Gilmore, W. (n.d.). Beginning PHP and PostgreSQL 8: From Novice to Professional. Goels Computer Hut. ISBN: 9788181286000.
- 3. Duckett, J. (n.d.). Beginning Web Programming with HTML, XHTML, CSS. Wrox.
- 4. Converse, J., & Park, J. (n.d.). PHP & MySQL Bible. Wiley.
- 5. PostgreSQL. (n.d.). Official Documentation Online.

Programme	BCA					
Course Code	BCA5CJ303					
Course Title	Digital Fundam	entals and Co	mputer Organi	ization		
Type of Course	Major					
Semester	V					
Academic	200-299					
Level						
Course Details	Credit	Lecture per	Tutorial	Practical	Total Hours	
		week	per week	per week		
	4	4	-	-	60	
Pre-requisites	Basic understar	nding of mathe	ematical conce	pts, especially	areas like	
	algebra					
Course	This course pro	ovides a comp	rehensive intro	oduction to the	e fundamentals	
Summary	of digital syste	ems, covering	topics related	d to binary ar	ithmetic, basic	
	computer logic	, combination	al and sequen	tial logic circu	its, as well as	
	basic computer organization and design. Throughout the course, students					
	will gain a solic	will gain a solid understanding of digital systems, from the basic building				
	blocks of logic	circuits to the	e design and or	rganization of	processors and	
	memory					

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Convert various number systems (binary, decimal, hexadecimal) and apply Boolean algebra to simplify expressions, utilizing DEMorgan's theorem and Karnaugh maps for up to four variables.	U	С	Instructor- created exams / Quiz
CO2	Demonstrate the ability to design and analyze combinational circuits (e.g., adders, encoders, decoders, multiplexers) and sequential circuits (e.g., latches, flip-flops, counters), understanding their functionality through truth tables and circuit diagrams	Ap	Р	Instructor- created exams/ Home
CO3	Explain the basic components of computer organization, including instruction codes, registers, common bus systems, and the differences between hardwired and microprogrammed control, and how these components interact during the instruction cycle.	U	C	Instructor- created exams
CO4	Compare and contrast RISC and CISC architectures, evaluate memory hierarchies, and describe the function of cache memory, associative memory, and various I/O organization techniques, including programmed I/O and DMA.	U	С	Instructor- created exams
CO5	Apply knowledge of computer arithmetic algorithms for addition, subtraction, multiplication, and division, and will categorize and implement different types of instructions (data transfer, manipulation, and control) in a programming context, demonstrating their understanding through practical examples.	U	С	Instructor- created exams
* - Re # - Fa	emember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), (ural Knowledge	Create (C)
Metac	cognitive Knowledge (M)			(1)

Unit	Content	Hrs (48+12)	Marks
	Number systems and Boolean Algebra	10	15
1	Binary arithmetic: Addition, Subtraction, Concepts of 1's and 2's	2	
	complement, 1's and 2's complement addition		
2	Logic Gates: AND, OR, NOT, NOR, NAND, XOR, XNOR,	3	
	Universal Property of NAND and NOR gates		
3	Boolean algebra: Boolean operations, laws and rules, Demorgan's theorem	2	
4	Boolean Expression Simplification using K Map up to 4 variables	3	
•	Combinational and Sequential Logic Circuits	12	20
5	Combinational Circuits: Half Adder, Full Adder, Ripple Carry Adder	1	20
6	Combinational Circuits: Encoder and Decoder (Basic Circuit Only)	1	
7	Combinational Circuits: Multiplexer and Demultiplexer (Basic	1	
,	Circuit Only)	1	
8	Concepts of Latches and Flipflops, Types of Flipflops (SR, D, JK,	3	
	T): Truth Table and Circuit	-	
9	Sequential Circuits: Synchronous and Asynchronous Counters	4	
10	Johnsons and Ring counter, Shift Registers	2	
B	asic Computer Organization and Micro Programmed Control	10	15
11	Instruction codes, Registers and Common Bus system	2	
12	Computer Instructions	1	
13	Timing and Control: Concepts of hardwired and microprogrammed	1	
	control		
14	Instruction Cycle	1	
15	Microprogrammed Control: Control memory & Address Sequencing	3	
16	Micro Instruction Format and Symbolic Micro Instruction	2	
	Processor, Memory and I/O Organization	16	20
17	Processor Organisation: General Register organization and stack	4	15
18	Processor Organisation: RISC vs CISC Parallel Processing	2	
19	Pipelining: General Considerations Arithmetic Pipeline Instruction	3	
17	Pipeline	5	
20	Memory Organisation: Memory Hierarchy, Main Memory	1	
21	Associative Memory, Cache Memory Mapping	4	
22	IO Organisation: Modes of transfer: programmed IO, Interrupt	2	
	initiated IO, DMA (Concepts Only)		
	Computer Arithmetic & Types of Instruction	12	
1	Computer Arithmetic: Addition and Subtraction, Multiplication	7	
2	Examples for Memory Reference Register Reference Input Output	5	
2	Instructions Data Transfer Instructions Data Manipulation	5	
	Instructions, Data Hanster Instructions, Data Manipulation		
	Instructions, Antimice instructions, Logical and Dit Manipulation		
	Conditional Branch Instructions		
	Subroutine Call and Return		
	Unit 1 2 3 4 5 6 7 8 9 10 8 9 10 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 1 22 1 22 1 22	Unit Content Number systems and Boolean Algebra 1 Binary arithmetic: Addition, Subtraction, Concepts of 1's and 2's complement, 1's and 2's complement addition 2 Logic Gates: AND, OR, NOT, NOR, NAND, XOR, XNOR, Universal Property of NAND and NOR gates 3 Boolean algebra: Boolean operations, laws and rules, Demorgan's theorem 4 Boolean Expression Simplification using K Map up to 4 variables Combinational Circuits: Half Adder, Full Adder, Ripple Carry Adder 6 Combinational Circuits: Encoder and Decoder (Basic Circuit Only) 7 Combinational Circuits: Multiplexer and Demultiplexer (Basic Circuit Only) 8 Concepts of Latches and Flipflops, Types of Flipflops (SR, D, JK, T): Truth Table and Circuit 9 Sequential Circuits: Synchronous and Asynchronous Counters 10 Johnsons and Ring counter, Shift Registers Basic Computer Organization and Micro Programmed Control 11 Instruction codes, Registers and Common Bus system 12 Computer Instructions 13 Timing and Control: Control memory & Address Sequencing 14 Instruction Format and Symbolic Micro Instruction 17 Processor Organisation: General Register organization and stack organization, Instruction formats	Unit Content Hrs (48+12) Number systems and Boolean Algebra 10 1 Binary arithmetic: Addition, Subtraction, Concepts of I's and 2's complement, 1's and 2's complement addition 2 2 Logic Gates: AND, OR, NOT, NOR, NAND, XOR, XNOR, Universal Property of NAND and NOR gates 3 3 Boolean algebra: Boolean operations, laws and rules, Demorgan's 2 4 Boolean Expression Simplification using K Map up to 4 variables 3 5 Combinational Circuits: Half Adder, Full Adder, Ripple Carry Adder 1 6 Combinational Circuits: Half Adder, Full Adder, Ripple Carry Adder 1 7 Combinational Circuits: Multiplexer and Demultiplexer (Basic Circuit Only) 1 8 Concepts of Latches and Flipflops, Types of Flipflops (SR, D, JK, 3 3 9 Sequential Circuits: Synchronous and Asynchronous Counters 4 10 Johnsons and Ring counter, Shift Registers 2 2 Basic Computer Organization and Micro Programmed Control 10 11 Instruction Codes, Registers and Common Bus system 2 12 Computer Instructions 1 13 Timing and C

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	-	-	-	-	-	3	-	1	-	2	-	1
CO 2	-	3	-	-	-	-	-	2	-	3	1	-	2
CO 3	-	3	-	-	-	-	-	-	3	-	-	1	-
CO 4	-	2	-	-	-	-	3	-	-	-	-	-	-
CO 5	-	3	-	-	-	-	-	-	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	Project Evaluation	End Semester Examinations
CO 1	\checkmark			\checkmark
CO 2	\checkmark			\checkmark
CO 3	\checkmark			\checkmark
CO 4	\checkmark	\checkmark		\checkmark

CO 5	\checkmark	\checkmark	\checkmark

References:

- 1. "Digital Fundamentals", Thomas L. Floyd
- 2. "Computer System Architecture", M. Morris Mano
- 3. "Computer Organization", Carl Hamacher, Zvonko Vranesic

Semester VI

Programme	BCA				
Course Code	BCA6CJ304/BCA8M	IN304			
Course Title	Introduction to AI and	d ML			
Type of Course	Major				
Semester	VI				
Academic	300 - 399				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	3	-	2	75
Pre-requisites	1. Fundamental Math	ematics Con	cepts: Sets		
	2. Fundamentals of F	ython Progra	amming		
Course	This course provide	s an introdu	uction to the	e ideas, tech	niques, and
Summary	applications of artific	applications of artificial intelligence (AI) is given in this course. The			
	fundamentals of kn	fundamentals of knowledge representation, machine learning, and			
	problem solving will	be taught to	the students.		

BCA6CJ304/BCA8MN304 - Introduction to AI and ML

CO	CO Statement	Cognitive	Knowledge	Evaluation			
		Level*	Category#	Tools used			
CO1	Describe the fundamental concepts of	U	С	Instructor-			
	artificial intelligence, including key AI			created exams /			
	problems, techniques, and various AI			Quiz			
CO2	Explain the principles of problem-	U	Р	Practical			
	solving techniques, including search			Assignment /			
	algorithms and knowledge			Observation of			
	representation methods.			Practical Skills			
CO^2	Implement basic seerch algorithms (DES	An	D	Sominor			
COS	and DES) and demonstrate their	Ар	P	Presentation /			
	application in solving AI-related			Group Tutorial			
	problems using Python.			Work/ Viva			
	r			Voce			
CO4	Analyze the architecture and learning	U	С	Instructor-			
	mechanisms of single-layer and multi-			created exams /			
	layer perceptrons, identifying their			Home			
	advantages and limitations.			Assignments			
CO5	Evaluate and compare different machine	Ар	Р	One Minute			
	learning models, including supervised			Reflection			
	and unsupervised learning algorithms,			Writing			
	using appropriate metrics and feature			assignments			
	selection techniques.						
* - Re	emember (R), Understand (U), Apply (Ap)	, Analyse (An), Evaluate (E), (Create (C)			
# - Fa	ctual Knowledge(F) Conceptual Knowledge	ge (C) Proced	ural Knowledge	(P)			
Meta	cognitive Knowledge (M)						

Detailed	Syllaburg
Detalleu	Synabus

Module	Unit	Content	Hrs	Marks
			(45+30)	
Ι	I	ntroduction to Artificial Intelligence & Problem Solving and	15	15
		Searching		
	1	Introduction to AI – AI problems, AI Techniques	2	
	2	Various AI Domains (Introduction only)	1	
	3	Problem Solving Techniques - Search Algorithms, Knowledge	3	
		representation and reasoning, constraint satisfaction problems,		
		Game playing, Machine learning, Simulated Annealing (Concepts		
		only)		
	4	Uninformed search algorithms (breadth-first, depth-first)	3	
	5	Informed search algorithms (A*, heuristic search- Generate and	6	
		Test, Hill Climbing, Best First Search)		
II		Knowledge Representation & Reasoning	10	20
	6	Knowledge representation using Propositional & Predicate Logic	3	
	7	Semantic Networks & Frames	3	
	8	Rule based system & Introduction to Expert System (Concepts	2	
		only)		
	9	Reasoning- Forward Vs Backward reasoning & logics for non-	2	
		monotonic Reasoning		
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	2	
		Perceptron Model		
	13	Multi-Layer Perceptron Model & Learning in Multi-layer	2	
		Perceptron Model		
	14	Introduction to python packages- keras & sklearn	2	
IV		Machine Learning Fundamentals	12	20
	15	Introduction to Machine learning- Applications of Machine	1	
		Learning		
	16	Supervised Machine learning- Classification & regression	2	
		algorithms (Introduction: Linear Regression, Decision tree)	-	
	17	Unsupervised Machine Learning-Clustering & Dimensionality	2	
	10	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 confusion matrix	1	
	21	Practical implementation to set up a machine learning model	1	
V	Hand	s-on Artificial Intelligence & Machina I aarning using Dython	30	
v	114110	Practical Applications, Case Study and Course Project	50	

1	Implement the following:	20
	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	
2	Case study – AI tools / Use of AI in any movie	3
3	Implementation of Comparison of any two machine learning	7
	algorithms on a dataset	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	1	1	1	2	1	-	-	3	-	2	-	-
CO 2	1	3	2	3	2	2	-	2	-	-	1	-	1
CO 3	2	3	2	3	2	3	-	-	3	-	-	1	-
CO 4	2	-	1	2	-	_	3	-	-	-	-	-	2
CO 5	2	_	2	3	3	3	-	-	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%)

Bachelor of Computer Application

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

Mapping of COs to Assessment Rubrics:

References:

1. Elaine Rich, Kevin Knight, Shivsankar B Nair, "Artificial Intelligence", Third Edition, Tata McGraw Hill Publisher

- 2. Tom M. Mitchell, Machine Learning, McGraw-Hill, 1st Ed.
- 3. Ethem Alpaydin, Introduction to Machine Learning- 3rd Edition, PHI.

BCA6CJ305/BCA8MN305 - Principles of Operating System

Programme	BCA							
Course Code	BCA6CJ305/BCA8MN305							
Course Title	Principles of Operatin	ng System						
Type of Course	Major							
Semester	VI							
Academic	300-399							
Level								
Course Details	Credit	Lecture	Tutorial	Practical	Total			
		per week	per week	per week	Hours			
	4	3	-	2	75			
Pre-requisites	Knowledge in Basic S	System Arch	itecture					
Course	This course provides	students with	n a comprehe	nsive understa	unding of the			
Summary	fundamental principles, design concepts, and practical implementation							
	aspects of operating systems. The course covers key topics such as							
	Process Management	, CPU Sched	uling, Memo	ry Manageme	nt and Linux			
	Shell Programming c	oncepts.						

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe the fundamental concepts of operating systems, including their history, types, objectives, and functions.	U	С	Instructor-created exams / Quiz

CO2	Explain the process states and the role of the Process Control Block (PCB) in process management.	U	С	Instructor-created exams				
CO3	Demonstrate the ability to implement basic CPU scheduling algorithms, such as First Come First Serve (FCFS) and Round Robin, through shell scripting.	Е	Р	Seminar Presentation / Group Tutorial Work				
CO4	Analyze different inter-process communication mechanisms and their applicability in real-world scenarios, distinguishing between message passing and shared memory	Ар	Р	Viva Voce				
CO5	Evaluate the effectiveness of various deadlock handling strategies (prevention, avoidance, detection, and recovery) in operating systems, providing examples of their implementation.	An	С	Instructor-created exams/Assignments				
* - Re	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)							
# - Fa	# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)							
Metao	cognitive Knowledge (M)							

Module	Unit	Content	Hrs	Marks		
			(45+30)			
Ι		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	Cooperating 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	8 Process Synchronisation: Critical Section 2				
	9	9 Semaphores 2				
	10	0 Classical Problems of Synchronisation: Reader Writer, Dining 2				
		Philosopher				
	11	11 Introduction to Deadlock: Necessary Conditions, Resource 2				
		Allocation Graph				
	12	Handling Deadlocks: Prevention, Avoidance, Detection &	4			
TTT		Kecovery Momony Management Techniques	10	20		
111	12	Desis Concenter Divised VS Logical Address Continuous	10	20		
	13	13 Basic Concepts: Physical VS Logical Address, Continuous				
	14	1				
	14	Non contiguous Momenty Allocation: Desing	2			
	15	Non contiguous Memory Allocation: Paging	2			
	16	Non contiguous Memory Allocation: Segmentation, Segmentation	2			
		with Paging				

	17	Virtual Memory Concepts: Demand Paging and Page Replacement	3	
		Algorithms, Thrashing		
IV		Linux Shell Programming	10	15
	18	Introduction: Types of Linux Shells, File	2	
		Directory & File Management Commands: ls, cd, pwd, mkdir, rm,		
		cp, mv, chmod, touch		
		Input/Output Commands: read, echo,		
		Text Processing Commands: grep, cat		
	19	Piping and Redirection operators: , >, <, >>, << Arithmetic Logical and Relational Operator	2	
	20	Iterative and Conditional Commands: if while for break continue	2	
	20	case	2	
	21	Arrays and functions	2	
	22	Command line arguments Network commands: inconfig ping date	2	
		and time commands. Informative commands: random w ps free	2	
		uptime		
V		Practical Applications using Linux Shell Programming	30	
	Imple	ment 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		
	2.	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		
	5.	input file		
	1	Write a shell script to find the average of the number entered as		
	т.	command line arguments		
	5	Write a shell script to copy the contents of file to another. Input file		
	5.	while a shell senter to copy the contents of the to another. Input the		
		second file exists		
	E	Write a shall series to shack notwork connectivity		
	0.	Write a shell excite that englance a lag file extracting and		
	/.	write a shell script that analyzes a log file, extracting and		
		warning massages, info and dobug massages using grap command		
	0	Write a shall seriet to display surrent data and time list all year		
	0.	while a shell script to display current date and time, list an user		
		account names, count of logged in user accounts, list allogged in		
		user accounts with login time.		
	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 Schedulingalgorithm. Find the		
		average waiting time and turnaround time.		
	12	2. Write a shell script program to implement Inter Process		
		Communication.		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	1	-	-	-	-	-	-	1	-	2	-	1
CO 2	-	2	-	-	-	-	-	2	-	3	1	-	-
CO 3	-	3	-	1	-	-	-	-	3	-	-	1	1
CO 4	-	2	2	-	-	-	3	-	1	-	-	-	-
CO 5	-	3	-	-	-	_	-	-	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	\checkmark			\checkmark
CO 2	\checkmark			\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4		\checkmark		\checkmark
CO 5	\checkmark			\checkmark

References:

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

Semester VII

Programme	BCA						
Course Code	BCA7CJ401						
Course Title	Advanced Data Struc	tures and alg	orithms				
Type of Course	Major						
Semester	VII						
Academic	400-499						
Level							
Course Details	Credit	Lecture	Tutorial	Practical	Total		
		per week	per week	per week	Hours		
	4	3	-	2	75		
Pre-requisites	1. Fundamental	Mathematics	Concepts: S	ets, matrices			
	2. Awareness of	Data struct	ures and ope	erations like a	array, stack,		
	queue						
	3. Fundamental	s of Java, C I	Programming	5			
Course	This course provide	s an introdu	uction to th	e ideas, tech	niques, and		
Summary	applications of advar	applications of advanced data structures) is given in this course. The					
	advanced data struct	tures and its	variants lik	ke tree, graph	n, heaps are		
	covered in this syllab	us.		_			

BCA7CJ401 - Advanced Data Structures and Algorithms

CO	CO Statement	Cognitive Level*	Knowledge Categorv#	Evaluation Tools used
CO1	Define key concepts and terminology related to data structures and algorithms, including types, characteristics, and the principles of abstract data types (ADTs).	U	C	Instructor- created exams / Quiz
CO2	Explain the quality of an algorithm, discussing time complexity and space complexity, as well as interpret asymptotic notations for analyzing algorithm efficiency.	U	С	Practical Assignment / Observation of Practical Skills
CO3	Implement basic data structures such as linked lists and binary search trees, applying appropriate algorithms in Java or C to perform operations on these structures.	U	F	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Compare and contrast different algorithm design techniques by analyzing their efficiency and suitability for solving specific problems.	AP	Р	Instructor- created exams / Home Assignments
CO5	Assess the effectiveness of various data structures and algorithms by evaluating their performance in practical implementations, including algorithmic complexity and resource utilization in real-world scenarios.	Ар	Р	Writing assignments/ Instructor- created exams/ practicals

* - 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		
Modul e	Unit	Content	Hrs (45+30)	Marks
Ι	Intr	oduction to Data Structures and Analysis of Quality of an	9	12
		Algorithm		
	1	Data structure - definition - types & operations, characteristics	2	1
		of data structures		
	2	Abstract Data Type (ADT) – algorithms - concepts - definition	1	1
		- objectives of algorithms -		
	3	Quality of an algorithm - space complexity and time	2]
		complexity of an algorithm.		
	4	Growth of Functions: Asymptotic notations, Cost estimation	3	
		based on key operations- Big Oh, Big Omega, Little Oh, Little		
		Omega and Theta notations		
	5	Algorithm Design: Introduction, Steps in developing	1	
		algorithm, Methods of specifying an algorithm		
II		Basic Technique for Design of Efficient Algorithm	11	15
	6	Brute Force approach (String pattern matching)	1	_
	7	Divide-and-Conquer approach (Merge sort)	1	_
	8	Branch-and-Bound technique (Knapsack problem)	2	_
	9	Greedy approach (Kruskal's algorithm and Prim's Algorithm)	3	_
	10	Dynamic Programming (Longest Common Subsequence)	2	_
	11	Backtracking (Sum of subsets problem)	2	
III		Linked lists - operations and implementations	12	15
	12	Introduction to Singly Linked list and its operations	2	_
	13	Circular Linked list and its operations	3	
	14	Doubly Linked list and its operations	2	
	15	Circular Doubly Linked list and its operations	2	
	16	Recursive lists, heterogeneous lists, deterministic skip lists-	3	
		Creation & Searching		
IV		Non-linear Data Structures	13	20
	17	Binary search trees - traversals and operations on BST	3	_
	18	AVL tree, Red Black Tree (concept only)	2	_
	19	Balanced trees - M-way trees - B Tree (Concepts only)	1	_
	20	Graphs - representation of graphs	1	_
	21	Graphs- operations - traversals and their implementation.	2	_
	22	Heap structures- Min-Max heaps - Deaps - leftist heaps -	3	
		binomial heaps (concepts only) - Applications		
V	Pract	ical Implementations of Data Structures and its Operations	30	20
		in Java or C Programming Language		_
	1	• Implementation of linear linked list	25	
		Implementation of circular linked list		
		Implementation of doubly linked list		
		Implementation of BST operations		
		• Implementation of Depth First Search using graph		
		Implementation of Breadth First Search using graph		1

	Implementation of max heap and delete a node from it.Sort a set of data using Heap tree		
2	Case Study/ Project	5	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	1	3	3	2	1	1	-	1	-	2	-	-
CO 2	1	1	3	3	2	1	-	2	-	3	1	-	1
CO 3	1	1	3	3	2	1	-	-	3	-	-	1	2
CO 4	1	1	3	3	_	-	3	-	1	-	-	-	-
CO 5	1	1	3	3	3	1	-	-	2	-	1	-	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	\checkmark	\checkmark	\checkmark	\checkmark
CO 2	\checkmark	\checkmark	\checkmark	\checkmark
CO 3	\checkmark	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark	\checkmark

References:

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley, ISBN: 978-0201000238.

2. Horowitz E and Sahni S, Fundamentals of Data Structures, Computer Science Press, ISBN: 9780716780427.

3. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, ISBN: 0929306406.

4. Thomas H Cormen, Charles E Leiserson, and Ronald L Rivest, Introduction to Algorithms, 3rd Edition, Prentice Hall of India Private Limited, New Delhi, ISBN: 9780262033848

5. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, 1st Edition. Addison Wesley, ISBN: 0534915728

Programme	BCA						
Course Code	BCA7CJ402						
Course Title	Data Science Prog	ramming usi	ng 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	 Basic knowledge about Data Science Basic knowledge about Programming languages 						
Course Summary	The R programmi language, encomp essential for data a	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					

BCA7CJ402 - Data Science Programming using R

со	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Identify and describe the basic components of R, including installation,	U	С	Instructor-created exams / Quiz
	operators, and data types.			
CO2	explain how to manipulate data structures in R, such as vectors, matrices, and lists.	U	С	Practical Assignment / Group Tutorial Work

CO3	Implement control statements and functions in R, utilizing loops and conditional statements to solve problems and perform data analysis.	U	С	Practical Assignment / Group Tutorial Work				
CO4	Analyze data sets using the dplyr package, selecting, filtering, and transforming data while comparing results through various visualization techniques (e.g., bar plots, histograms, scatter plots).	U	С	Instructor-created exams / Home Assignments				
CO5	Evaluate data visualizations and manipulation techniques in R by conducting a case study on a data set (e.g., MNIST or IRIS), justifying their approach to data analysis and visualization based on best practices.	Ар	Р	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)

Module	Unit	Content	Hrs (45+30)	Marks	
Ι		Fundamentals Of R	10	10	
	1	Installation of R & R Studio			
	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		
П		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, ifelse 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 M	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		
	Implem	ent the following:	30		
	•	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)

	PSO1	PSO 2	PSO3	PSO 4	PSO5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	1	-	-	-	-	1	-	1	-	2	-	1
CO 2	1	2	1	-	-	-	1	2	-	3	1	-	-
CO 3	2	2	2	2	-	1	-	-	3	-	-	1	1
CO 4	2	2	2	2	1	2	3	1	1	-	3	-	-
CO 5	3	3	2	2	2	2	-	-	2	-	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%)

Bachelor of Computer Application

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

Mapping of COs to Assessment Rubrics:

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)

Basket of Electives (for V, VI Semesters)

1. Image Processing

BCA5EJ301(1) - Fundamentals of Digital Image Processing

Programme	BCA							
Course Code	BCA5EJ301(1)							
Course Title	Fundamentals of Dig	ital Image Pr	ocessing					
Type of Course	Elective							
Semester	V							
Academic	300-399							
Level								
Course Details	Credit	Lecture	Tutorial	Practical	Total			
		per week	per week	per week	Hours			
	4	4	-	-	60			
Pre-requisites	1. Basic understandin	g of mathem	atics concepts	s involved in c	ligital image			
	processing algorithms	s and transfor	rmations.					
	2. Familiarity with pr	ogramming l	anguages suc	ch as MATLA	B or Python			
Course	This course provides	s a comprehe	ensive under	standing of d	igital image			
Summary	processing fundamen	tals, coverin	g topics such	as pixel stru	cture, image			
	formation, and types	of images.	Students will	ll learn a ran	ge of image			
	processing techniqu	es includin	g intensity	transformation	ons, spatial			
	filtering, and frequen	cy domain fi	ltering, along	g with their ap	plications in			
	various industries suc	ch as medical	imaging and	l multimedia s	systems.			

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe the basic concepts of digital images, including pixels, resolution, and types of images (gray scale, binary, and color), and explain the fundamental steps involved in digital image processing.	U	C	Assignment / Instructor- created exams / Quiz
CO2	Demonstrate Image Acquisition Techniques: Students will demonstrate knowledge of various image acquisition methods, including single sensing elements, sensor strips, and sensor arrays, and apply a simple image formation model to represent digital images effectively.	Ар	С	Practical Assignment / Instructor- created exams / Quiz
CO3	Apply Intensity Transformation and Spatial Filtering: Students will apply intensity transformation functions (e.g., image negatives, logarithmic transformations, contrast stretching) and spatial filtering techniques (e.g., smoothing and sharpening filters) to manipulate and enhance digital images.	An	С	Practical Assignment / Instructor- created exams / Quiz

CO4 Analyze and implement filtering techniques in the frequency domain, including the Discrete Fourier Transformation (DFT) and various low- pass and high-pass filters, and will understand their applications in image restoration.	Ар	Р	Practical Assignment / Instructor- created exams / Quiz		
CO5 Evaluate the relationships between pixels, perform intensity transformations, and apply both spatial and frequency domain filtering techniques to solve real-world image processing problems, demonstrating their understanding through practical projects or assignments.	An	Р	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	Hrs	Marks	
			(48+12)	
Ι		Digital Image and Digital Image Processing	10	15
	1	Digital image and Digital image processing system, Pixels,	1	
		Resolution of an image, Types of Images – Gray Scale, Binary and		
		Color Images		
	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	3	
		acquisition using sensor strips, Image acquisition using sensor		
		arrays		
	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,	2	
		adjacency, connectivity, regions, and boundaries		
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,	1	
		Log transformations		
	12	Piecewise linear transformation functions - Contrast stretching,	2	
		Intensity-level slicing		
	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		13	20				
	18	Filtering in Frequency Domain - The Discrete Fourier	1				
		Transformation (DFT)					
	19	Steps for filtering in the frequency domain, Ideal and Butterworth	2				
		Low pass and High pass filters					
	20	Image Restoration - degradation model, Properties	1				
	21	21Noise models, Mean Filters – Order Statistics2					
	22	Inverse Filtering – Wiener filtering	3				
V		Application of Image Processing	12				
	1	Relationships between pixels	12				
		• Intensity transforms					
		Spatial and Frequency Domain Filtering					

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	1	-	2	2	1	-	1	-	2	-	-
CO 2	1	-	1	-	2	2	-	2	-	3	1	-	1
CO 3	1	1	1	-	2	2	-	-	3	-	-	1	2
CO 4	3	3	2	1	2	1	3	-	1	-	-	-	-
CO 5	1	-	1	-	2	2	-	-	2	-	1	-	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%)

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

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.

PCA				
DCA				
BCA5EJ302(1)				
Pattern Recognition				
Elective				
V				
300-399				
Credit	Lecture	Tutorial	Practical	Total
	per week	per week	per week	Hours
4	4	-	-	60
1. Basic understandin	g of probabil	lity theory an	d statistics.	
2. Prior knowledge of	f data structu	res and algor	ithms.	
This course provides	a comprehe	nsive overvie	ew of pattern	recognition,
covering fundamenta	l concepts su	ch as statisti	cal decision-n	naking, 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 application	ns.		C	2
	BCA BCA5EJ302(1) Pattern Recognition Elective V 300-399 Credit 1. Basic understandin 2. Prior knowledge of This course provides covering fundamenta parametric technique develop practical ski systems through hand real-world application	BCA BCA5EJ302(1) Pattern Recognition Elective V 300-399 Credit Lecture per week 4 4 1. Basic understanding of probabil 2. Prior knowledge of data structu This course provides a comprehe covering fundamental concepts su parametric techniques, clustering develop practical skills in design systems through hands-on implem real-world applications.	BCA BCA5EJ302(1) Pattern Recognition Elective V 300-399 Credit Lecture Tutorial per week 4 4 4 2. Prior knowledge of data structures and algor This course provides a comprehensive overvide covering fundamental concepts such as statistic parametric techniques, clustering, and feature develop practical skills in designing and evalue systems through hands-on implementation of a real-world applications.	BCA BCA5EJ302(1) Pattern Recognition Elective V 300-399 Credit Lecture per week per week per week 4 4 5 1. Basic understanding of probability theory and statistics. 2. Prior knowledge of data structures and algorithms. This course provides a comprehensive overview of pattern covering fundamental concepts such as statistical decision-n parametric techniques, clustering, and feature selection. S develop practical skills in designing and evaluating pattern systems through hands-on implementation of algorithms and real-world applications.

BCA5EJ302(1) - Pattern Recognition

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Explain the basic concepts of pattern recognition, including its applications and the fundamental problems encountered in system design, providing a solid foundation for further study.	U	C	Assignment / Instructor- created exams / Quiz
CO2	Demonstrate proficiency in statistical decision-making methods, including Bayes' theorem and decision boundaries, and will analyse the impact of unequal costs of error on classification performance.	Ар	Р	Practical Assignment / Instructor- created exams / Quiz
CO3	Implement and evaluate various pattern recognition models, employing statistical measures for performance assessment.	E	Р	Practical Assignment / Instructor- created exams / Quiz
CO4	clustering using various algorithms (e.g., agglomerative, K-means) and apply feature selection methods, such as entropy minimization and orthogonal expansion, to enhance model performance and interpretability.	U	Р	Practical Assignment / Instructor- created exams / Quiz

CO5	Design, implement, and evaluate a simple pattern recognition model using a programming language (e.g., Python, MATLAB) and will write a research paper to document their methodology and findings, demonstrating their understanding of the entire pattern recognition process.			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	Marks
			(48+12)	
I	1		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		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		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	3	
		algorithm		
	20	K-Means's algorithm	3	
	21	Clustering in feature selection through entropy minimization	2	
	22	Features selection through orthogonal expansion.	2	
V		Implementation of pattern	12	
		recognition		
	1	• Implement a simple pattern recognition model using a	12	
		programming language/tool (e.g., Python, MATLAB		
		etc.) and write a research paper.		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	2	2	1	1	-	1	-	2	-	-
CO 2	1	2	1	2	2	1	1	2	-	3	1	-	1
CO 3	2	2	2	3	1	1	-	-	3	-	3	1	2
CO 4	1	2	2	2	2	1	3	-	1	-	-	-	-
CO 5	2	2	2	2	2	1	-	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

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.

BCA6EJ303(1) - Advanced Digital Image Processing and Computer Vision

Programme	BCA						
Course Code	BCA6EJ303(1)	BCA6EJ303(1)					
Course Title	Advanced Digital Ima	age Processin	ng and Comp	uter Vision			
Type of Course	Elective						
Semester	VI						
Academic	300-399						
Level							
Course Details	Credit	Lecture	Tutorial	Practical	Total		
		per week	per week	per week	Hours		
	4	4	-	-	60		
Pre-requisites	1. Basic understandin	g of mathem	atics concept	s involved in c	ligital image		
	processing algorithms	s and transfor	rmations.				
	2. Familiarity with pr	ogramming l	languages suc	ch as MATLA	B or Python		
Course	This course provides	s a comprehe	ensive under	standing of d	igital image		
Summary	processing fundamen	tals, coverin	g topics such	as pixel stru	cture, image		
	formation, and types of images. Students will learn a range of image						
	processing techniques including intensity transformations, spatial						
	filtering, and frequen	cy domain fi	ltering, along	g with their ap	plications in		
	various industries suc	ch as medical	imaging and	l multimedia s	systems.		

CO	CO Statement	Cognitive	Knowledge	Evaluation
		Level*	Category#	Tools used
CO1	Define key concepts in image	U	С	Assignment /
	processing, including structuring			Instructor-
	elements, erosion, dilation, and basic			created exams /
	segmentation techniques			Quiz
CO2	Gain proficiency in image segmentation	U	Р	Practical
	methods. Explain the principles of			Assignment /
	thresholding, feature extraction, and			Instructor-
	color image processing, including color			created exams /
	models and Otsu's algorithm.			Quiz

CO3	Apply image segmentation algorithms and thresholding methods to analyze and process digital images effectively.	U	Р	Practical Assignment / Instructor- created exams / Quiz	
CO4	Analyze various data redundancies in image compression and evaluate different coding techniques	U	Р	Practical Assignment / Instructor- created exams / Quiz	
CO5	Evaluate computer vision techniques for feature detection, object recognition,motion detection in practical applications	U	С	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) 					

Module	Unit	Unit Content					
			(48+12)				
Ι		Morphological Image Processing and Image Segmentation	13	20			
	1	Morphological Image Processing - Structuring element, Erosion	2				
		and Dilation					
	2	Opening and Closing	2				
	3	Thinning and Thickening	2				
	4	Image Segmentation – Fundamentals, Point, Line, and Edge	3				
		Detection					
	5	Segmentation by Region Growing	2				
	6	Segmentation by Region Splitting and Merging	2				
II	T	hresholding, Feature Extraction and Color Image Processing	14	20			
	7	Thresholding - Basics of Intensity Thresholding, Basic Global	2				
		Thresholding					
	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	2				
		Temporal Redundancy, Irrelevant Information					
	16	Huffman Coding	2				
	17	Run-length Coding	2				
	18	Neural Networks Machine Learning and Deep Learning	2				
		(Definitions only)					
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	3					

Detailed Syllabus

	22	Instance Recognition, Category Recognition, Motion Detection	3]
V		Algorithmic Implementation of Digital Image	12	
		Processing		
	1	Image segmentation algorithms	12	
		Thresholding algorithms		
		Image Compression methods		
		Face Recognition methods		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	2	1	2	2	1	3	-	1	-	2	-	-
CO 2	1	2	1	2	2	1	1	2	-	3	1	-	1
CO 3	1	2	1	2	2	1	-	-	3	-	3	1	-
CO 4	3	2	2	2	2	1	3	-	1	-	-	-	-
CO 5	1	2	1	2	2	1	-	-	2	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

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	BCA								
Course Code	BCA6EJ304(1)								
Course Title	Applied Digital Imag	e Processing							
Type of Course	Elective								
Semester	VI								
Academic	300-399								
Level									
Course Details	Credit	Lecture	Tutorial	Practical	Total				
		per week	per week	per week	Hours				
	4	4	-	-	60				
Pre-requisites	1. Foundation in ma	thematics a	nd statistics,	including lin	ear algebra,				
	calculus, probability	theory, and s	ignal process	ing.					
	2. Proficiency in prog	gramming lar	guages such	as MATLAB	or Python				
Course	The course covers a c	omprehensiv	e study of me	edical, docume	ent, forensic,				
Summary	and satellite image pr	rocessing, in	cluding techr	niques such as	s multimodal				
	fusion, image registra	tion, reconstr	ruction, and e	enhancement,	emphasizing				
	the role of advanced a	algorithms an	d software to	ols in diagnos	sis, treatment				
	planning, document	analysis, fo	rensic invest	tigations, and	geographic				
	information systems	applications	. Students w	ill gain practi	ical skills in				
	image processing, pr	rogramming,	and analytic	cal thinking,	essential for				
	addressing real-world	d challenges	in healthcare	e, document n	nanagement,				
	law enforcement, and	l environmen	tal monitorin	ıg.					

BCA6EJ304(1) - Applied Digital Image Processing

Course Outcomes (CO):

CO	CO Statement	Cognitive	Knowledge	Evaluation
		Level*	Category#	Tools used
CO1	Define key concepts in medical imaging	U	С	Assignment /
	modalities, including X-Ray, CT, MRI,			Instructor-
	ultrasound, and their functional and			created exams /
	anatomical applications.			Quiz
CO2	Explain the processes involved in	Ap	Р	Practical
	medical image fusion, registration, and			Assignment /
	the architecture of CAD systems,			Instructor-
	including image pre-processing and			created exams /
CO2	Apply image processing techniques to	T	E	Quiz
COS	enhance and reconstruct medical images	U	Г	Assignment /
	as well as visualize 3D and 4D medical			Instructor-
	data for improved diagnosis and treatment			created exams /
	planning			Ouiz
CO4	Analyze document and text image	Ap	Р	Practical
	processing techniques, including Optical	1		Assignment /
	Character Recognition (OCR) and layout			Instructor-
	analysis			created exams /
				Quiz
CO5	Assess forensic image processing	U	С	Practical
	methods for contrast enhancement,			Assignment /
	geometric corrections, and detection of tampering while considering the legal			Instructor-
	and ethical implications involved in			created exams /
	forensic analysis.			Quiz
* - Re	member (R), Understand (U), Apply (Ap),	Analyse (An), Evaluate (E), (Create (C)
# - Fa	ctual Knowledge(F) Conceptual Knowledge	ge (C) Procedi	ural Knowledge	(P)
Metao	cognitive Knowledge (M)	-	0	

Detailed Syllabus

Module	Unit	Hrs	Marks	
		(48+12)		
Ι		Medical Image Processing	14	20
	1	Medical Images - Functional Modality - X- Ray, CT, MRI,	3	
		Ultrasound, Anatomical Modality - fMRI, SPECT, PET (Concept		
		only)		
	2	Multimodal Medical Image Fusion, Medical Image Registration	2	
	3	Architecture of CAD System - Image pre-processing, Region(s) of	3	
		Interest (ROI), Feature Extraction Segmentation and Classification		
	4	Image Reconstruction and Enhancement	2	
	5	3D and 4D medical image visualization	2	
	6	Role of Medical Image Processing in diagnosis and treatment	2	
		planning		
II		Document and Text Image Processing	10	15
	7	Importance of Document and Text Image Processing, Document	3	
		image acquisition, Optical Character Recognition (OCR)		
	8	3		
		Text classification		
	9	Document summarization, Content-based document image	3	
		retrieval, Text indexing		

	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	2	
		image		
	12	Contrast enhancement and Noise reduction, Sharpness and edge	2	
		enhancement,		
	13	Geometric and Photometric corrections of forensic images	2	
	14	Color balancing and Calibration, Foreground and Background	2	
		Segmentation		
	15	Detection of sophisticated tampering, Alterations, and	2	
		Manipulations	-	
	16	Image metadata, Identification of cloned regions, Splicing, and	3	
	17	Retouching, Hidden information analysis	1	
** 7	1/	Legal considerations and ethical issues in forensic image processing	1	
IV	10	Satellite and Aerial Image Processing	10	15
	18	Remote Sensing, Satellites and Image acquisition, Sensors types -	2	
	10	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	2	
		techniques for noise reduction and feature enhancement		
	21	Multiscale image decomposition, Object-based image analysis,	2	
		Image differencing, image rationing		
	22	Geographic Information Systems (GIS)	2	
V		Reviewing Applications of Image Processing	12	
	1	• Write a review paper either from medical image processing	12	
		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.		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	1	1	1	2	1	1	-	1	-	2	-	1
CO 2	2	3	3	2	2	1	1	2	-	3	1	-	-
CO 3	2	1	1	1	1	2	-	-	3	-	3	1	2
CO 4	2	1	1	1	1	2	3	-	1	-	-	-	-
CO 5	2	2	1	1	1	2	2	-	1	-	3	-	1

Correlation Levels:

-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

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. Computer Networks

Programme	BCA								
Course Code	BCA5EJ301(2)	BCA5EJ301(2)							
Course Title	Wireless Communica	tion							
Type of Course	Elective								
Semester	V								
Academic Level	300-399								
Course Details	Credit	Lecture	Tutorial	Practical	Total				
		per week	per week	per week	Hours				
	4	4	-	-	60				
Pre-requisites	 Basic computer sci Familiarity with ne basics. 	ence knowled etworking fur	dge ndamentals ar	nd Digital Co	mmunication				
Course Summary	The Wireless Commu a comprehensive und and their applications and technologies tha explores the evolutio trends such as Intern- into security and priv	unications con lerstanding of . The course of the form the b n from 2G to et of Things acy consideration	urse is design f wireless co covers fundar basis of mod b 5G and bey (IoT) and 6C ations in wire	ed for the stu- mmunication nental concep lern wireless yond, as well G. Students wi less communi	dents to gain technologies ts, protocols, networks. It as emerging Il also delve cations.				

BCA5EJ301(2) - Wireless Communication

Category#	used
Б	
Г	Practical
	Assignment /
	Instructor-created
	exams / Quiz
С	Practical
	Assignment /
	Instructor-created
	exams / Quiz
Р	Practical
	Assignment /
	Instructor-created
	exams / Quiz
М	Practical
	Assignment /
	Instructor-created
	exams / Quiz
Р	Practical
	Assignment /
	Instructor-created
	exams / Quiz
	. Г С Р М Р

* - 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
Ι		Introduction to Wireless Transmission	13	18
	1	Applications of wireless networks	1	
	2	History of wireless communication	2	
	3	Simplified Reference Model	2	
	4	Frequencies for radio transmission, signals, Antennas	3	
	5	Signal propagation and Multiplexing	2	
	6	Modulation, Spread Spectrum, Cellular systems	3	
II		Medium Access Control & Telecommunications Systems	12	17
	7	Motivation for specialized MAC	2	
	8	SDMA, FDMA	2	
	9	TDMA, CDMA	3	
	10	GSM-Mobile Services, Architecture, Protocols	3	
	11	DECT-System & Protocol Architecture	2	
III		Satellite Systems & Wireless LANs	12	18
	12	Satellite systems, Basics- GEO, LEO, MEO	2	
	13	Routing, Localization & Handover	2	
	14	Infra-red vs radio transmission	2	
	15	Infrastructure and ad-hoc network	2	
	16	IEEE 802.11	2	
	17	Bluetooth	2	
IV		Mobile Network & Transport Layer	11	17
	18	Mobile IP, DHCP	3	
	19	Mobile Ad-hoc networks	2	
	20	Traditional TCP	3	
	21	Classical TCP Improvements	2	
	22	TCP over 2.5/3G wireless networks	1	
V		Support for Mobility	12	
		• Various file systems such as NFS, AFS, Coda, Little Work,	12	
		Ficus, Mio-NFS, Rover, etc.		
		• World Wide Web- Problems and solutions when used in		
		mobile and wireless environment.		
		• Wireless Application Protocols, architecture, Wireless		
		Transaction Protocols, Markup language, Session Protocol,		
		etc.		
		• 4G, 5G, 6G and beyond: Future wireless Technologies		
		• IOT, Green Wireless Communications, Machine-to-		
		Machine (M2M) communications.		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
	1301	1502	1505	1304	1505	1500	101	102	105	104	105	100	107

CO 1	1	3	-	-	-	1	1	-	1	-	2	-	-
CO 2	1	2	-	-	-	1	1	2	-	3	1	-	1
CO 3	2	3	3	2	2	2	-	-	3	-	3	1	-
CO 4	2	3	3	-	2	2	3	-	1	3	-	-	1
CO 5	3	2	2	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- 1. "Mobile Communications" by Jochen H. Schiller, 2/e, Pearson Education, 2012.
- 2. "Wireless Communications: Principles and Practice" by Theodore S. Rappaport.
- 3. "Wireless Communications and Networks" by William Stallings.
- 4. "Wireless Communications" by Andrea Goldsmith, Cambridge University Press, 2005.
- 5. "5G NR: The Next Generation Wireless Access Technology" by Erik Dahlman, Stefan Parkvall, and Johan Skold.

Programme	BCA								
Course Code	BCA5EJ302(2)	BCA5EJ302(2)							
Course Title	Cryptography and Ne	twork Secur	ity						
Type of Course	Elective								
Semester	V								
Academic	300-399								
Level									
Course Details	Credit	Lecture	Tutorial	Practical	Total				
		per week per week Hours							
	4	4	-	-	60				
Pre-requisites	Basic understanding	g of comp	outer netwo	orks, cryptog	raphy, and				
	programming conce	pts. Famili	arity with	OSI model,	encryption				
	algorithms, and netwo	ork security 1	nechanisms	recommended	•				
Course	Cryptography and N	etwork Secu	rity course p	provides a con	mprehensive				
Summary	overview of security	principles a	nd encryptio	n techniques	essential for				
	securing computer ne	tworks. Upo	n completion	, students wil	l possess the				
	knowledge and skills	to analyse, ir	nplement, an	d maintain sec	cure network				
	environments, addres	sing contemp	oorary securi	ty challenges	effectively.				

BCA5EJ302(2) - Cryptography and Network Security

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used				
CO1	Understand the	U	F	Quizzes,				
	fundamental principles of cryptography			Assignments/Instructor- created exams				
CO2	Analyse security vulnerabilities in network systems	An	С	Case studies, Projects, Instructor-created exams				
CO3	Design and implement secure communication	An	P	Coding exercises, Projects				
CO4	Evaluate cryptographic techniques for different applications	E	C	Research papers, Critical reviews, Instructor-created exams/Quizzes				
CO5	Apply cryptographic principles to real-world scenarios	Ap	Р	Simulations, Scenario- based assessments, Presentations, Quizzes				
* - Re # - Fa Metao	scenarios Ap P Presentations, Quizzes * - 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	Mark
			(48+12)	

Ι	Intr	oduction To Security and Traditional Symmetric Key Encryption	11	15
		Techniques		
	1	Introduction To Security: The OSI Security Architecture Security	3	-
	1	Attacks. Security Services. Security Mechanisms. Cryptology. A	5	
		Model for Network Security.		
	2	Symmetric Cipher Model- Cryptography, Cryptanalysis and Brute-	2	7
		Force Attacks		
	3	Substitution Techniques - Caesar Cipher, Monoalphabetic Cipher,	3	
		Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One Time Pad		
	4	Cipher.	1	_
	4	Transposition Techniques – Rail Fence	1	_
	5	Stagenography Durpose Techniques	1	-
	0	Steganography-1 urpose, rechniques	1	
II		Modern Symmetric Key Encryption Techniques	15	15
	7	Stream Ciphers and Block Ciphers- Definitions, Difference, Block	3	1
		Cipher Structure - Feistel Cipher - Structure, Encryption and		
		Decryption.		_
	8	Data Encryption Standard (DES) – Encryption, Decryption,	3	
		Example, Strength Of DES		
	9	Advanced Encryption Standard (AES) – Encryption and	2	1
		Decryption, Transformation functions, Key Expansion, Example		
	10	Block Cipher Modes of Operations- Electronic Code Mode, Book	3	
		Cipher Block Chaining Mode, Cipher Feedback Mode, Output		
		Feedback Mode, Counter Mode		_
	11	Stream Cipher – Structure, RC4	4	
III	As	ymmetric Cipher and Cryptographic Data Integrity Algorithms	11	20
	12	Public Key Cryptography (Asymmetric Cryptography) –	2	1
		Encryption and Decryption		
	13	RSA Algorithm – Introduction, Encryption and Decryption, Example,	2	-
		Advantage and Disadvantage		
	14	Cryptographic Hash Functions – Concept, Applications	2	
	15	Secure Hash Algorithm- SHA 512	1	-
	16	Massage Authentication Code Concept Requirements Security	1	-
	10	Macs based on Hash Functions- HMAC	3	-
IV	17	Network and Internet Security	3 11	20
1 V	10	Web Security Considerations, Web Security Threads Web Traffic	1	- 20
	10	Security Approaches	1	
	19	Secure Socket Laver and Transport Laver Security- Concept.	3	-
		Working of SSL and TLS, Difference between SSL and TLS	-	
	20	HTTPS - Concept, Connection Initiation Connection Closure	1	1
	21	SSH- Concept, Transport Layer Protocol User Authentication Protocol	2	1
		Connection Protocol		
	22	Electronic Mail Security – PGP, S/MIME	4	
V		System Security	12	

• Intruders	
Malicious Software	
• Firewalls	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	2	-	1	-	-	-	3	-	2	-	-
CO2	1	1	2	3	-	-	1	2	-	3	1	-	1
CO3	_	2	3	3	-	1	-	-	3	-	3	1	-
CO4	-	-	1	2	2	2	3	-	1	-	-	-	1
CO5	-	2	-	-	1	1	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
GO 1	,	/	,	/
COI	\checkmark	\checkmark	\checkmark	√
CO2	\checkmark	\checkmark	\checkmark	\checkmark
CO3		\checkmark	\checkmark	\checkmark
CO4		\checkmark		\checkmark
CO5	\checkmark	\checkmark	\checkmark	\checkmark

References:

1. Cryptography And Network Security Principles and Practice, William Stallings, Pearson

Education- Fifth Edition

- 2. Cryptography and Network Security, Behrouz A. Forouzan Tata, McGraw-Hill.
- 3. Cryptography and Network Security, Atul Kahate, Tata McGraw Hill, 2019.
- 4. Cryptography: Theory and Practice by Douglas R. Stinson, CRC press.

BCA6EJ303(2) - Storage Area Network

Programme	Bachelor of Compute	r Application	ns (BCA)					
Course Code	BCA6EJ303(2)	BCA6EJ303(2)						
Course Title	Storage Area Networ	k						
Type of Course	Elective							
Semester	VI							
Academic	300-399	300-399						
Level								
Course Details	Credit	Lecture	Tutorial	Practical	Total			
		per week	per week	per week	Hours			
	4	4	-	-	60			
Pre-requisites	1. Basic understandin	g of compute	er networks					
	2. Familiarity with op	perating syste	ems and file s	ystems				
Course	This course provides a	an in-depth u	nderstanding	of Storage Ar	ea Networks			
Summary	(SANs) and their role in modern computing environments. Students will							
	explore the fundamental concepts, architectures, protocols, and							
	implementation strat	egies of SA	ANs. Practic	al aspects of	f designing,			
	managing, and troubl	eshooting SA	ANs will also	be covered.				

CO	CO Statement	Cognitive	Knowledge	Evaluation
CO1	Define the fundamental concepts and components of Storage Area Networks (SANs), describe the evolution of storage architectures and the role of SANs in modern computing environments.	U	Category# C	Practical Assignment / Instructor- created exams / Quiz
CO2	Design a basic Storage Area Network (SAN) architecture, considering storage devices, Fibre Channel technology, and SAN fabric components, implement zoning and LUN masking for secure and efficient data access in a SAN.	Ар	Р	Practical Assignment / Instructor- created exams / Quiz
CO3	Evaluate and compare different SAN protocols, including Fibre Channel Protocol (FCP), iSCSI, FCIP, and FCoE, analyze and troubleshoot common issues in SANs, applying knowledge of SAN components and protocols.	An	Р	Practical Assignment / Instructor- created exams / Quiz

CO4	Devise strategies for RAID configurations and data migration in a SAN, develop a comprehensive SAN security plan, integrating authentication, access control, and encryption.	R	Р	Practical Assignment / Instructor- created exams / Quiz				
CO5	Assess the performance of a Storage Area Network, identifying bottlenecks and implementing optimization techniques, critically evaluate emerging trends in SANs, such as basic, advanced and Backup software.	Ε	F	Practical Assignment / Instructor- created exams / Quiz				
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge (E) Conceptual Knowledge (C) Procedural Knowledge (P)								
Metao	Metacognitive Knowledge (M)							

Detailed	Syllabus

Module	Unit	Content	Hrs	Marks
т		Notworking and Storage Concents	(48+12) 10	15
I	1	OSI reference model	10	15
	2	Common network devices Network Topologies	3	
	2	MAC standards	2	
	<u> </u>	Need for Storage Networks, Storage Devices and Techniques	2	
	5	SAN Components and Building Blocks	2	
п	5	Fibre Channel and SAN Fundamentals	12	20
11	6	Fibre Channel Topologies Fibre Channel Lavers	3	20
	7	Classes of Services SAN topologies	3	
	8	SAN Operating Systems software and hardware	2	
	9	Types of SAN technology	2	
	10	SAN Protocols- FCP_iSCSL_FCIP_FCoE	2	
Ш	10	Storage networking architecture	13	20
	11	Storage in storage Networking- challenges, cost, performance	1	-0
	12	Keeping SAN storage Up & working	2	
	13	Network in storage Networking	2	
	14	Emerging SAN interconnect Technologies	2	
	15	Basic software for Storage Networking	3	
	16	File systems and Application Performances	3	
IV		Advanced and Backup softwares for SAN	13	15
	17	Advanced software for storage Networking- Data Replication	3	
	18	Synchronous & Asynchronous Replication	2	
	19	Cluster Data Models	2	
	20	Enterprise Backup Software for SAN	2	
	21	Enterprise Backup Architecture and Policies	3	
	22	Minimizing the Impact of Backup	1	
V		Design and Building a SAN	12	
	1	Design considerations and business requirements	12	
		 Physical layout, placement, storage, pooling 		
		• Data availability, connectivity, scalability, migration,		
		manageability		
		Fault Tolerance and resilience, Prevention of Congestion SAN accurity, basic accurity, guidelines, future of CANS		
		• SAN security- basic security guidelines, future of SANS.		

Bachelor of Computer Application

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	2	1	-	3	-	1	-	1	-	2	-	1
CO 2	1	2	1	-	3	-	1	2	-	3	1	-	-
CO 3	3	1	1	_	3	-	-	-	3	-	3	1	3
CO 4	3	1	1	-	3	_	3	-	1	-	-	-	-
CO 5	3	-	1	1	3	-	1	-	1	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

1. Meeta Gupta, Storage Area Network Fundamentals, Cisco Press.

2. Richard Barker and Paul Massiglia, Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs, Wiley India Pvt Ltd.

3. John R. Vacca, The Essential Guide to Storage Area Networks, 1st Edition, Prentice Hall.

4. Christopher Poelke and Alex Nikitin, Storage Area Networks for Dummies, 2nd Edition.

5. Tom Clark, Designing Storage Area Networks: A Practical Reference for Implementing Fibre Channel and IP SANs, 2nd Edition, Addison Wesley Professional.

6. Robert Spalding, Storage Networks: The Complete Reference, 1st Edition, Tata McGraw-Hill Education.

Programme	BCA				
Course Code	BCA6EJ304(2)				
Course Title	Internet of Things				
Type of Course	Elective				
Semester	VI				
Academic	300-399				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	4	-	-	60
Pre-requisites	1. Basic understandin	ig of compute	er science con	ncepts.	
	2. Familiarity with ne	etworking fur	ndamentals.		
	3. Proficiency in a pro-	ogramming l	anguage (e.g.	, Python, Java	a).
Course	A course on the Intern	net of Things	(IoT) typical	ly covers a rai	nge of topics
Summary	to provide students	with a co	omprehensive	e understand	ing of this
	interdisciplinary field	d like Basic	concepts and	d Component	s of an IoT
	system, IOT Architec	ture and com	munication p	rotocols, IOT	devices and
	1			·	

BCA6EJ304(2) - Internet of Things

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts and terminology related to the Internet of Things (IoT), including its characteristics, components, and the role of embedded systems	U	Р	Assignment / Instructor- created exams / Quiz
CO2	Explain the various IoT protocols, including SCADA, RFID, M2M, and WSN protocols, as well as the challenges associated with IoT standardization and security	R	Р	Assignment / Instructor- created exams /

CO3 Apply knowledge of IoT architecture U P Assignment / by identifying and describing the Instructor- Instructor- created exams components, stages, and layers Involved in designing IoT solutions, Quiz
CO4Identify and address security challenges in IoT systems. Analyze data management techniques in IoT, including data collection, storage, processing, and analytics, and assess ethical considerations in IoT design and deploymentAnPAssignment / Instructor- created exams Quiz
CO5Evaluate various cloud computing platforms for IoT solutions, comparing their capabilities for data management and analytics, and assess existing IoT platforms and middleware such as IoT- A and Hydra.ApPAssignment / Instructor- created exams Quiz
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
π - ractual Knowledge (r) Conceptual Knowledge (C) Flocedular Knowledge (r) Metacognitive Knowledge (M)

Detailed Syllabus

Module	Unit	Content	Hrs	Marks
			(48+12)	
Ι		Introduction to IoT	10	12
	1	Definition and characteristics of IoT	2	
	2	Components of IoT	2	
	3	Embedded Systems	3	
	4	Basics of IoT Networking	3	
II		IoT protocols	12	18
	5	Protocol Standardization for IoT	3	
	6	SCADA and RFID Protocols	3	
	7	M2M and WSN Protocols	2	
	8	Issues with IoT Standardization	2	
	9	IOT security and Liability	2	
III	IoT Architecture		13	20
	10	Components of IOT architecture	1	
	11	Stages of IOT solutions Architecture	2	
	12	Layers of IOT Architecture	2	
	13	IoT Open-source architecture (OIC)	2	
	14	OIC Architecture & Design principles	3	
	15	IoT Devices and deployment models	3	
IV		IoT Data Management	13	20
	16	Data collection, storage, and processing in IoT	1	
	17	Data analytics techniques for IoT data.	2	
	18	Ethical considerations in IoT design and deployment.	1	
	19	Cloud Computing for IoT	2	
	20	Overview of cloud platforms for IoT solutions	3	
	21	IoT data management and analytics in the cloud.	1	
	22	Existing IoT platforms /middleware, IoT- A, Hydra etc	3	

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V	Case studies based on IOT APPLICATIONS	12	
	 IoT applications for industry, Environment, Marketing 	12	
	Healthcare, smart cities, agriculture, and manufacturing.		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	-	1	-	3	-	1	-	1	-	2	-	1
CO 2	1	-	1	-	3	-	-	2	-	3	1	-	3
CO 3	3	-	1	-	3	-	-	-	3	-	3	1	-
CO 4	3	-	1	-	3	-	3	-	1	-	-	-	2
CO 5	3	_	1	-	3	-	1	-	3	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.

2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.

4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

5. David Hanes, Gonzalo Salgueiro, Patrick Grossetete "IOT Fundamentals: Networking Technologies, protocols and use cases for the internet of Things"

- 6. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
- 7. Adrian McEwen and Kakim Cassimally, "Designing the Internet of Things"

3. Cloud Computing

BCA5EJ301(3) - Cloud Computing

Programme	BCA				
Course Code	BCA5EJ301(3)				
Course Title	Cloud Computing				
Type of Course	Elective				
Semester	V				
Academic	300 - 399				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	4	-	-	60
Pre-requisites	Basic understanding	of computer i	networks, ope	erating system	is, and
	programming.				
Course	This course introd	luces stude	nts to the	fundamenta	l concepts,
Summary	technologies, and pra	actices of clo	oud computin	ng. It covers t	he basics of
	cloud infrastructure,	deployment r	models, and s	ervice models	S

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand fundamentals of cloud	U	C	Instructor-
	Computing			created exams / Quiz
CO2	Describe and compare Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)	U	С	Assignment / Seminar presentations/ Exams
CO3	Analyze various deployment models such as public, private, and hybrid clouds.	U	Р	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Understand the principles of virtualization and its role in cloud computing.	U	С	Instructor- created exams / Home Assignments
CO5	Compare and contrast different virtualization technologies, including hypervisors and containerization.	U	Р	Writing assignments/ Exams/ Seminar Presentations
* - Re # - Fa Metao	emember (R), Understand (U), Apply (Ap) actual Knowledge(F) Conceptual Knowledg cognitive Knowledge (M)	, Analyse (An ge (C) Proced	h), Evaluate (E), lural Knowledge	Create (C) (P)

Detailed	Syllahue
Duanu	by nabus

Module	Unit	Content	Hrs	Marks
			(48+12)	
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	2	
		Virtualisation		
	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		Cloud Platform in Industry	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		
		1		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1		2		-	1	1	2	-	1	-	2	-	-
CO 2	-	2	-	-	1	1	1	2	-	3	1	-	1
CO 3	-	1	-	-	1	1	-	-	3	-	3	1	-
CO 4	-	1	-	-	2	1	3	-	1	-	1	-	2
CO 5	1	1	-	-	2	1	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	End Semester Examinations
CO 1	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark		\checkmark
CO 4		\checkmark	\checkmark
CO 5		\checkmark	\checkmark

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	BCA							
Course Code	BCA5EJ302(3)							
Course Title	Security and Privacy	in Cloud						
Type of Course	Elective							
Semester	V							
Academic	300 - 399							
Level								
Course Details	Credit	Lecture	Tutorial	Practical	Total			
		per week	per week	per week	Hours			
	4	4	-	-	60			
Pre-requisites	Basic understanding of	of computer r	networks, ope	rating system	s, databases,			
	Cloud computing		Cloud computing					
Course	This course explores the security and privacy challenges in cloud							
Course	This course explore	s the securi	ity and priv	acy challeng	es in cloud			
Summary	This course explore computing environm	s the securitients. Studer	ity and priv nts will learn	acy challeng	es in cloud fundamental			
Summary	This course explore computing environm principles, technolo	s the securi ents. Studer ogies, and	ity and priv its will lear best practi	acy challengen about the ices for er	es in cloud fundamental nsuring the			
Summary	This course explore computing environm principles, technolo confidentiality, integr	s the securi ents. Studer ogies, and rity, and avail	ity and priv nts will learn best practi lability of dat	acy challeng n about the ices for er a in the cloud	es in cloud fundamental asuring the . The course			
Summary	This course explore computing environm principles, technolo confidentiality, integr also covers legal and	s the securi ents. Studer ogies, and rity, and avai l ethical con	ity and priv ts will learn best practi- lability of dat- siderations re-	acy challeng n about the ices for er a in the cloud elated to priva	es in cloud fundamental suring the . The course acy in cloud			

BCA5EJ302(3) - Security and Privacy in Cloud

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand fundamentals of security concepts (encryption, decryption)	U	С	Instructor- created exams / Quiz
CO2	Understand security design principles.	U	С	Assignment / Seminar presentations/ Exams
CO3	Analyze various threats to cloud security	U	Р	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	U	Р	Writing			
	mechanisms and management schemes			assignments/			
	to ensure security in cloud.			Exams/			
				Seminar			
				Presentations			
* - Re	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)						
# - Fa	# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)						
Metac	Metacognitive Knowledge (M)						

Detailed Syllabus

Module	Unit	Content	Hrs	Marks
			(48+12)	
I		Fundamentals of Security in Cloud	14	22
	1	Overview of Cloud Security- Security services- Confidentiality,	2	
		Integrity, Authentication, Non repudiation, Access control		
	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	2	
		data protection, end to end access control		
	8	Common attack vectors and threats	1	
	9	Network and storage- Secure Isolation strategies, Virtualisation	3	
		strategies, inter- tenant network segmentation strategies, data		
		protection strategies		
	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	2	
		Sign-on		
	15	Identity providers and service consumers	2	
	16	Storage and network access control options- OS Hardening and	3	
		minimization		
	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		Security Management in Cloud	12	
	1	Infrastructure security: Network level, host level, application level	4	
	2	Security management in the cloud	4	
	_			
	3	Audit and compliance	4	
1		F T T		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	2		-	1	1	1	-	1	-	2	-	-
CO 2	-	2	-	-	1	1	-	2	-	3	1	-	1
CO 3	-	1	-	-	1	1	-	-	3	-	3	1	-
CO 4	-	1	-	-	2	1	3	-	1	-	-	-	2
CO 5	1	1	-	-	2	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%)

	Internal Exam	Assignment	End Semester Examinations
CO 1	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark		\checkmark
CO 4		\checkmark	\checkmark
CO 5		\checkmark	\checkmark

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 | BCA | | | | |
|----------------|------------------------|-----------------|----------------|----------------|---------------|
| Course Code | BCA6EJ303(3) | | | | |
| Course Title | Storage Technologies | 5 | | | |
| Type of Course | Elective | | | | |
| Semester | VI | | | | |
| Academic | 300 - 399 | | | | |
| Level | | | | | |
| Course Details | Credit | Lecture | Tutorial | Practical | Total |
| | | per week | per week | per week | Hours |
| | 4 | 4 | - | - | 60 |
| Pre-requisites | Basic knowledge of c | computer system | tems and arcl | nitecture | |
| | Fundamental understa | anding of dat | a structures a | and algorithms | 8 |
| Course | This course introduce | es students to | o various stor | rage technolo | gies, storage |
| Summary | network technologies | s, storage ar | nd virtualizat | tion technolog | gies. Course |
| | also discuss various b | back up and r | ecovery strat | egies. | |

BCA6EJ303(3) - Storage Technologies

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts related to information storage, including the evolution of storage architecture, data center infrastructure, and cloud storage characteristics.	U	C	Instructor- created exams / Quiz
CO2	Explain various storage architectures such as Direct-Attached Storage (DAS), Network-Attached Storage (NAS), and Storage Area Networks (SAN), highlighting their functionalities and deployment models	U	С	Assignment / Seminar presentations/ Exams
CO3	Implement RAID techniques and evaluate different RAID levels, analyzing their impact on disk performance and storage provisioning in intelligent storage systems.	U	Р	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Analyze storage networking technologies, including Fibre Channel Storage Area Networks, and compare block-based, file-based, and object- oriented storage systems in terms of their components and architecture	U	C	Instructor- created exams / Home Assignments
CO5	Assess backup and archive strategies, including backup methods, architectures, and recovery considerations, to determine the best practices for securing storage infrastructure in virtualized and cloud	U	Р	Writing assignments/ Exams/ Seminar Presentations

	•								
	environments.								
* - Re	emember (R), Understand (U), Apply (Ap)), Analyse (An	n), Evaluate (E),	Create (C)					
# - Fa	# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)								
Metao	cognitive Knowledge (M)								

Module	Unit	Content	Hrs	Marks
			(48+12)	
Ι		Storage System	12	18
	1	Introduction to Information Storage- Information Storage,	2	
		Evolution of Storage Architecture		
	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)	2	
		Network-Attached Storage (NAS)		
	6	Storage Area Network (SAN)	2	
		Cloud storage architectures (Introduction only)		
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	1		
	11	2		
	12	Types of Intelligent Storage Systems	3	
III	Sto	orage Networking Technologies - Fibre Channel Storage Area	12	18
		Networks		
	13	Block based stored system, File based storage system, object	2	
		oriented based storage system (Introduction)	-	
	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	1	Storage Infrastructure	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	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	2		-	1	1	3	-	3	-	2	-	1
CO 2	-	2	-	-	1	1	1	2	-	3	1	-	-
CO 3	-	1	-	-	1	1	-	-	3	-	3	1	1
CO 4	-	1	-	-	2	1	3	-	1	-	-	-	3
CO 5	1	1	_	-	2	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	End Semester Examinations
CO 1	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark		\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References

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

Programme	BCA				
Course Code	BCA6EJ304(3)				
Course Title	Virtualization				
Type of Course	Elective				
Semester	VI				
Academic	300 - 399				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	4	-	-	60
Pre-requisites	Basic understanding	of cloud com	puting		
Course	This course introd	luces stude	nts to the	fundamenta	l concepts,
Summary	technologies, virtuali	zation, variou	ıs virtualizati	on tools and v	ritualization
	in storage, desktop, n	etwork and s	erver		

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts and terminology related to virtualization, including its purpose, types, and benefits	U	C	Instructor- created exams / Quiz
CO2	Explain the various types of virtualization, such as hardware, server, desktop, network, and storage virtualization, along with their advantages and limitations.	Ар	Р	Assignment / Seminar presentations/ Exams
CO3	Differentiate between various types of virtualization, including server virtualization, desktop virtualization, network virtualization, and storage virtualization	Ар	С	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Analyze the advantages and functions of network virtualization, including the use of VLAN and WAN architectures, and evaluate tools used for network virtualization	U	Р	Instructor- created exams / Home Assignments
CO5	Assess different virtualization tools (such as VMware, Microsoft Hyper-V, and Oracle VM VirtualBox) based on their features, performance, and suitability for various use cases, including SAN, NAS, and RAID configurations	U	Р	Writing assignments/ Exams/ Seminar Presentations
* - Re	emember (R), Understand (U), Apply (Ap)	, Analyse (Ar	n), Evaluate (E),	Create (C)
# - га Metac	cognitive Knowledge (M)	ge (C) Proced	iurai Knowiedge	(r)

Module	Unit	Content	Hrs	Marks				
incount	cint		(48+12)	1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.				
Ι		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	3					
		virtualization, paravirtualization						
	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	11 Uses of virtual server consolidation,						
	12	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		Virtualization tools (Any 3- 4 hours each)	12					
		VMWare-Amazon AWS						
		Microsoft HyperV						
		Oracle VM Virtual box						
		• IBM PowerVM						
		Google Virtualization						

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	2		-	1	1	1	-	1	-	2	-	2
CO 2	-	2	-	_	1	1	1	2	-	3	1	-	-
CO 3	-	1	-	_	1	1	-	-	3	-	3	1	1
CO 4	2	1	-	-	2	1	3	-	1	3	-	-	-
CO 5	-	1	-	-	2	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	End Semester Examinations
CO 1	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark		\checkmark
CO 4		\checkmark	\checkmark
CO 5		\checkmark	\checkmark

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

4. Data Science and AI

Programme	BCA							
Course Code	BCA5EJ301(4)	BCA5EJ301(4)						
Course Title	Data Analytics and	d Visualizatio	n					
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.Basics of Linear Algebra2. Basics of Statistics							
Course Summary	The data analytics course delves into techniques for analyzing data and extracting valuable insights, preparing participants for effective decision-making based on data-driven evidence across various domains.							

BCA5EJ301(4) - Data Analytics and Visualization

CO	CO Statement	Cognitive Level*	Knowledge	Evaluation			
			Category#	Tools used			
CO1	Explain the basic concepts	U	С	Instructor-			
	of data analytics			created exams /			
				Quiz			
CO2	Understand the supervised	U	С	Practical			
	learning algorithms and its			Assignment /			
	application			Group Tutorial			
				Work			
CO3	Understand the	U	С	Practical			
	unsupervised learning			Assignment /			
	algorithms and its			Group Tutorial			
	application			Work			
CO4	Enhance the idea of Big data	U	С	Instructor-			
	Anaytics tools			created exams /			
				Home			
				Assignments			
CO5	Implementation of	Ар	Р	Practical			
	Predictive and non			assignments			
	predictive algorithms			and practical			
				tests			
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)							
# - Fa	actual Knowledge(F) Conceptu	al Knowledge (C) Pr	ocedural Knowledg	ge (P)			
Meta	cognitive Knowledge (M)						

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Module	Unit Content		Hrs	Mark
T		Introduction to Data Analytics	(40+1 <i>2)</i> 10	10
-	1	Introduction to Data Analysis - Analytics Analytics Process	2	10
	-	Model	_	
	2	Analytical Model Requirements.	2	
	3	Data Analytics, Life Cycle overview	2	
	4	Basics of data collection	2	
	5	Sampling, Pre-processing and dimensionality reduction	2	
II		Supervised learning	16	20
	6	Regression	3	
	7	Classification	3	
	8	Naive Bayes	3	
	9	KNN	3	
	10	Linear Regression	2	
	11	Application of supervised learning	2	• •
III	10	Unsupervised learning	10	20
	12	Hierarchical clustering	2	
	13	K-means clustering	2	
	14	Principal Component Analysis	2	
	15	Association - Appion Algorithm	2	
137	10	Rig Data Analytics	2 12	20
1 V	17	Working of Big Data Analytics	2	20
	17	Types of Big Data Analytics	2	
	10	Big Data Analytics Technologies and Tools	2	
	20	Big Data Analytics recentioning Map Reduce and Apache Hadoop	2	
	21	Statistical Method for Visualization	2	
	22	Introduction to Big Data Analytics using Apache Cassandra,	2	
		Mongo DB		
V		Hands-on Training in Data	12	
	Langlage	Analytics		
	mpien	A prive the entire data analytics process to a real world dataset		
	•	Apply the entire data analytics process to a real-world dataset.		
	•	Perform clustering and association rule mining on a market basket dataset.		
	•	Implement big data analytics using Hadoop and Apache Spark.		
	•	Create insightful visualizations and perform statistical analysis using advanced tools.		
	•	Develop and implement advanced machine learning models on a complex dataset.		
	•	Significance of activation function like linear, tanh, Relu		
	•	Dimensionality reduction for data analysis- E.g.: Principal Component Analysis		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	
CO 1	1	1	1	-	1	2	2	-	1	-	2	-	2
CO 2	2	2	2	1	2	3	3	2	-	3	1	-	1
CO 3	2	2	1	1	2	3	-	-	2	-	3	1	-
CO 4	2	1	1	1	2	2	3	-	1	3	-	-	2
CO 5	2	3	3	3	3	3	1	-	-	-	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	Project Evaluation	End Semester Examinations
CO 1	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5			\checkmark	

References:

1. Bart Baesens," Analytics in a Big Data World: The Essential Guide to Data Science and

its Business Intelligence and Analytic Trends", John Wiley & Sons, 2013.

2. David Dietrich, "EMC Education Services, Data Science and Big Data Analytics:

Discovering, Analyzing, Visualizing and Presenting Data", John Wiley & Sons, 2015.

- 3. Jaiwei Han, MichelineKamber, "Data Mining Concepts and Techniques", Elsevier, 2006.
- 4. Christian Heumann and Michael Schomaker, "Introduction to Statistics and

DataAnalysis", Springer, 2016

- 5. Margaret H. Dunham, Data Mining: Introductory and Advanced Topics. Pearson, 2012.
- 6. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.

Programme	BCA							
Course	BCA5EJ302	BCA5EJ302(4)						
Code								
Course Title	Knowledge	Engineering						
Type of	Elective							
Course								
Semester	V	V						
Academic	300 - 399							
Level								
Course	Credit	Lecture per week	Tutorial	Practical	Total Hours			
Details			per week	per week				
	4	4	-	-	60			
Pre-	1. Und	erstanding of basic mat	hematics and star	tistics				
requisites	2. Basic understanding of computer science concepts							
Course	This course introduces students to the principles, techniques, and tools used in							
Summary	Knowledge	Engineering. It covers	the design and	development of l	knowledge-based			
	systems, inc	luding knowledge repr	esentation, reason	ning, and acquisi	tion.			

BCA5EJ302(4) - Knowledge Engineering

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	Ар	Р	Assignment / Seminar presentations/ Exams
CO3	Design and develop ontologies	Ар	Р	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Apply reasoning with ontologies and rules	Ap	Р	Instructor-created exams / Home Assignments
CO5	Understand learning and rule learning	U	С	Writing assignments/ Exams/ Seminar 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)

Module	Unit	Hrs (48+12)	Marks	
Ι		Reasoning under uncertainity	15	15
	1	Understanding the World through Evidence-based Reasoning: -	2	
		Evidence, Data, and Information, Evidence and Fact, Evidence		
		and Knowledge		
	2	Abductive Reasoning	1	
	3	Probabilistic Reasoning: - Enumerative Probabilities: Obtained	2	
		by Counting, Subjective Bayesian View of Probability		
	4	Belief Functions	1	
	5	Baconian Probability, Fuzzy Probability	3	
	6	Evidence-based Reasoning	2	
	7	Artificial Intelligence: - Intelligent Agents, Mixed-Initiative	2	
		Reasoning		
	8	Knowledge Engineering: - An Ontology of Problem-Solving	2	
		Tasks, Building Knowledge-based Agents		• •
11	Me	thodologies 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	2	
		Reasoning		
	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	4	
		Ontology Development, Domain Understanding and Concept		
		Elicitation, Modeling-based Ontology Specification		
IV	ļ	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	4	
	22	Matching	4	
	22	Learned Knowledge, Reasoning with Partially Learned Knowledge	4	
V		Learning for Knowledge-based Agents	12	
	1	Generalization and Specialization Rules	4	

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	2	Types of Generalizations and Specializations	4
	3	Analogy-based Generalization	4

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	1	-	-	1	1	2	-	1	-	2	-	1
CO 2	1	-	-	-	1	1	3	-	-	3	2	-	-
CO 3	1	3	1	1	2	3	-	1	2	-	3	1	2
CO 4	1	-	1	1	2	3	3	-	1	3	-	-	-
CO 5	1	-	-	-	2	3	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:
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	Internal Exam	Assignment	End Semester Examinations
CO 1	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark		\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

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

BCA6EJ303(4) - Advanced Python for Data Science

Programme	BCA	BCA							
Course	BCA6EJ303	BCA6EJ303(4)							
Code									
Course Title	Advanced P	ython for Data Science							
Type of	Elective								
Course									
Semester	VI	VI							
Academic	300 - 399	300 - 399							
Level									
Course	Credit	Lecture per week	Tutorial	Practical	Total Hours				
Details			per week	per week					
	4	4	-	-	60				
Pre-	1. Data	Science Concepts							
requisites	2. Pyth	on basics							
Course	This course provides insight into the basic concepts of Python required for Data								
Summary	Science. It includes array fundamentals, array transformations, and matrices								
	fundamenta	ls. The analysis of data	using Pandas wi	ll help the studen	ts to understand				
	the basics of	f data analysis							

CO	CO Statement	Cognitive	Knowledge	Evaluation Tools
		Level*	Category#	used
CO1	Identify and define key concepts	U	С	Instructor-created
	and functions in NumPy and			exams / Quiz
	Pandas, including array creation,			
	data frames, and basic operations.			

				1				
CO2	Explain the principles of array manipulation, including broadcasting,	Ар	Р	Modelling Assignments/ Case				
	reshaping, and the use of aggregate			Studies				
	functions in NumPy and Pandas.			~~~~~				
CO3	Apply NumPy and Pandas to perform data analysis tasks, including constructing data frames, processing CSV and JSON data, and conducting arithmetic operations on arrays and data frames.	U	С	Instructor-created exams / Quiz				
CO4	Analyze data sets by measuring central tendency, variance, and correlation using Python libraries, and interpret the results to derive meaningful insights.	An	Р	Modelling Assignments/ Case Studies				
CO5	Evaluate the performance and functionality of different Python libraries (such as Scipy, Scikit- learn, and TensorFlow) in data science applications, and assess their effectiveness in solving specific data-related problems.	U	С	Instructor-created exams / Quiz				
* - Re	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)							
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive								
Know	vledge (M)		_	-				

Module	UnitContentHrs				
		(48+12)			
Ι		Arrays, Matrix manipulation using NumPy	10	12	
	1	Array creation, sorting, concatenating	2		
	2	Shape and size of an array, basic arithmetic operations on an	2		
		array, broadcasting			
	3	Aggregate functions on arrays, Unique and count operations	2		
	4	Matrices using NumPy	2		
	5	Transpose, reverse, flatten and ravel	2		
II		Data Analysis and Manipulation using Pandas	12	18	
	6	Series - constructing from an array, using explicitly defined	2		
	7	Data Erama constructing from among distinguing structured	2		
	/	arrays, and series, Indexing of data frames	3		
	8	Arithmetic and Binary operations on Data frame	3		
	9	Broadcasting operations	2		
	10	Universal functions, melt() and pivot()	2		
III		Other Python packages for data science	10	14	
	11	Scipy, Scikit-learn, PyTorch, Seaborn, Scrapy, and Beautiful Soup.	3		
	12	Python Data Operations: Importing and Exporting Data, Data Cleansing	3		

	13	Processing CSV Data, Processing JSON Data, Processing XLS	2]				
		Data.						
	14	14Data Analysis: Measuring Central Tendency, Measuring2						
		Variance, and Correlation in Python						
IV		TensorFlow Fundamentals	16	26				
	15	Tensors, creation of tensors and random tensors, Tensors from	2					
		the Normal distribution, Poisson distribution, set_seed()						
	16	Tensor attributes, size, rank and reshaping of a tensor	2					
	17	Tensor arithmetic, relational, logical operations. Shuffle()	2					
	18	Reduce operations on tensor Dimension-wise	2					
	19	Ragged tensors, TensorArray, dynamic arrays,	2					
	20	unique(), fill(), concat(), gather(), ones(), ones_like(), zeros(),	2					
	21	eye(), range(), repeat, reverse(), roll(), slice(), sort(),	2					
	22	<pre>split(), squeeze(), tile(), stack(), unstack(), tensordot()</pre>	2					
V		Introduction to Python Libraries	12					
	1	Use Pandas and NumPy to efficiently process and analyze	4					
		CSV, Excel, or JSON data						
	2	Create compelling visual insights using Matplotlib, Seaborn, or Plotly	3					
	3	Case studies with Tensor flow	5					
	3		5					

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	-	-	2	2	2	2	-	1	-	2	-	1
CO 2	2	1	-	-	2	2	-	2	-	3	1	-	-
CO 3	1	-	2	-	2	2	-	-	2	-	3	1	2
CO 4	1	1	1	2	2	2	3	-	1	3	-	-	-
CO 5	2	-	-	-	2	2	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	Project Evaluation	End Semester Examinations
CO 1	\checkmark			\checkmark
CO 2	\checkmark	\checkmark	\checkmark	\checkmark
CO 3	\checkmark		\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark	\checkmark
CO 5	\checkmark			\checkmark

References:

- 1. VanderPlas, Jake. Python Data Science Handbook: Essential Tools for Working with Data. United States, O'Reilly Media, 2016.
- 2. Rogel-Salazar, Jesus. Data Science and Analytics with Python. United Kingdom, CRC Press, 2018.
- 3. https://numpy.org/doc/
- 4. https://pandas.pydata.org/docs/
- 5. https://www.tensorflow.org/guide

BCA6EJ304(4) - Neural Networks and Deep Learning

Programme	BCA	BCA						
Course Code	BCA6EJ3	BCA6EJ304(4)						
Course Title	Neural Ne	tworks and Deep Learning	g					
Type of Course	Elective							
Semester	VI							
Academic Level	300 - 399							
Course Details	Credit	Lecture per week	Tutorial	Practical	Total			
			per week	per week	Hours			
	4 4 - 60							
Pre-requisites	1. Mathematical Foundation for CS 2. Machine Learning							

Course Summary	Explores core principles and advanced methodologies in neural networks and
	deep learning, spanning from foundational concepts like perceptrons to
	specialized architectures such as CNNs and RNNs. Students will gain
	comprehensive knowledge of neural network design, training, and
	optimization, equipping them to tackle various theoretical and computational
	challenges within these frameworks.

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Identify and describe key concepts related to neural networks, including single- layer perceptrons, multi-layer perceptrons(MLPs), activation functions, and loss functions.	Ap	Р	Practical Assignment / Instructor created exams / Quiz
CO2	Explain the representation power of MLPs and the significance of activation functions such as Sigmoid, Tanh, ReLU, and Softmax in neural network training	Ар	Р	Practical Assignment / Instructor created exams / Quiz
CO3	Apply backpropagation to train MLPs and implement various optimization techniques, including Gradient Descent and Stochastic Gradient Descent, to minimize loss in neural networks.	Ap	Р	Practical Assignment / Instructor created exams / Quiz
CO4	Analyze the effects of overfitting, vanishing gradients, and exploding gradients in deep networks, and evaluate different regularization techniques to mitigate these issues.	Ар	Р	Practical Assignment / Instructor created exams / Quiz
CO5	Evaluate and compare the performance of convolutional neural networks (CNNs) and recurrent neural networks (RNNs) for specific applications, such as image classification and sequence prediction, and assess their effectiveness using relevant metrics.	Ap	Р	Practical Assignment / Instructor- created exams / Quiz
* - Rer Know (M)	nember (R), Understand (U), App vledge(F) Conceptual Knowledge	ly (Ap), Analyse (C) Procedural	e (An), Evaluate (E Knowledge (P) Me), Create (C) # - Factual etacognitive Knowledge

Detaile	d Sv	llabus
Detune	u D J	naous

Module	Unit	Content	Hrs (48+12)	Marks
Ι		Neural Networks and Deep Learning	10	15
	1	Introduction to neural networks -Single layer perceptrons, Multi- Layer Perceptrons (MLPs)	1	
	2	Representation Power of MLPs, Activation functions - Sigmoid, Tanh, ReLU, Softmax	3	
	3	Risk minimization, Loss function, Training MLPs with backpropagation	3	
	4	The Problem of Overfitting, Vanishing and exploding gradient problems	3	
II		Deep Learning and optimization technique	12	15
	5	Introduction to deep learning, Deep feed forward network	3	
	6	Training deep models. Eigen value, Eigen vector concepts.	3	
	7	2		
	8	2		
	9	Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods.	2	
III		Convolution Neural Networks	13	20
	10 Convolution operation, Motivation		1	
	11 Pooling, Convolution and Pooling as an infinitely strong prior		3	
	12 Variants of convolution functions		2	
	13	Structured outputs	2	
	14	Data types	1	
	15	Efficient convolution algorithms	3	
IV		Recurrent Neural Networks	13	20

				7
	16	Computational graphs	1	
	17	RNN design	1	
	18	Encoder – decoder sequence to sequence architectures	2	
	19	Deep recurrent networks	2	
	20	Recursive neural networks	3	
	21	Modern RNNs LSTM and GRU.	2	
	22	Practical use cases for RNNs.	2	
V		Neural Networks Applications	12	
	1	 Implement the tasks from the following: Implement and analyze single-layer and multi-layer perceptron's with activation functions, loss functions, and backpropagation. Investigate overfitting, vanishing gradients, and exploding gradients in deep networks, and explore solutions. Design and train a CNN for image classification, focusing on convolution, pooling, and efficient algorithms. Implement and train RNNs, including LSTM and GRU, for sequence prediction, and analyze their performance. Train a deep feed-forward network on a complex dataset, using eigenvalues and eigenvectors, and compare optimization techniques. 	12	

	0 -												
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	1	2	2	2	1	3	-	1	-	2	-	1
CO 2	2	1	3	2	2	2	3	2	-	3	1	-	-
CO 3	3	1	3	2	3	2	-	-	2	-	3	1	3
CO 4	3	2	3	3	3	3	3	-	1	3	-	-	2
CO 5	3	2	3	3	3	3	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		√
<u> </u>				
CO 5	\checkmark	\checkmark		\checkmark

References:

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

2. Neural Networks and Deep Learning, Aggarwal, Charu C., c Springer International Publishing AG, part of Springer Nature 2018

3. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms (1st. ed.). Nikhil Buduma and Nicholas Locascio. 2017. O'Reilly Media, Inc.

5. Computer Vision

BCA5EJ301(5) -FUNDAMENTALS OF COMPUTATIONAL VISION

Programme	BCA							
Course Code	BCA5EJ301(5)							
Course Title	Fundamentals of Con	nputational V	ision					
Type of Course	Elective	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 concepts involved in digital imageprocessing and computer vision.							
Course Summary	Implement fundamenta vision, Understand Ima applications	al image proc age formation	essing technic 1 process, Dev	ques required : velop compute	for computer r vision			

CO	CO Statement	Cognitive	Knowledge	Evaluation
		Level*	Category#	Tools used
CO1	Understand the fundamentals of digital	U	С	Assignment /
	image formation and low-level processing			Instructor-
				created exams
				/ Quiz
CO2	Develop proficiency in feature extraction	Ар	С	Practical
	for digital images effectively.			Assignment /
				Instructor-
				created exams
				/ Quiz
CO3	Analyze the components of digital image	An	С	Practical
	processing systems and their functions for			Assignment /
	pattern analysis			Instructor-
				created exams
				/ Quiz
CO4	Develop skills in implementing image	Ар	Р	Practical
	processing algorithms and different			Assignment /
	classifier models.			Instructor-
				created exams
				/ Quiz

CO5	Analyze and interpret digital images to	An	Р	Practical						
	extract meaningful information with the			Assignment /						
	concept of motion analysis.			Instructor-						
				created exams						
				/ Quiz						
* - Re	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)#									
- Fact	- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)									
Metac	cognitive Knowledge (M)		_							

Module	Unit	Content	Hrs	Marks
			(48+12)	
Ι		Digital Image Formation and low-level processing	10	15
	1	Overview and state-of-the-art, Fundamentals of image formation	1	
	2	Transformation: Orthogonal, Euclidean, Affine, Projective.	3	
	3	Fourier transform, Convolution and filtering	3	
	4	Image Enhancement, Restoration, Histogram Processing	3	
II		Feature Extraction	12	15
	5	Edges- Canny, LOG, DOG	3	
	6	Line detectors (Hough Transform), Corners-Harris and Hessian Affline	3	
	7	Orientation Histogram, SIFT, HOG, GLOH	2	
	8	Scale-Space Analysis- Image pyramids and Gaussian derivative Filters	2	
	9	Gabor filters and DWT.	2	
III		Pattern Analysis	13	20
	10	Clustering: K- Means, K-Medoids	1	
	11	Classification: Discriminant Function, Supervised, Un-	3	
		Supervised, Semi-Supervised		
	12	Classifiers: Bayes, KNN, ANN models	3	
	13	Dimensionality Reduction: PCA, LDA, ICA	3	
	14	Non- parametric methods.	3	
IV		Motion Analysis	13	20
	15	Background Subtraction and modeling	3	
	16	Optical Flow, KLT	3	
	17	Spatio-temporal Analysis, Dynamic Stereo		
			3	
	18	Motion parameter estimation	4	
V		Computer Vision in Realworld	12	
	1	• Case study : Analyze the importance of computer vision in real world scenarios.		

	PSO1	PSO2	PSO 3	PSO 4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	_	1	-	2	2	3	-	1	-	2	-	2
CO 2	1	-	1	-	2	2	-	2	-	3	1	-	1
CO 3	1	1	1	-	2	2	-	-	2	-	3	1	-
CO 4	3	3	2	1	2	1	3	-	1	3	-	-	-
CO 5	1	-	1	-	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	Practical Evaluation	End Semester Examinations
CO 1	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- 1. Computer Vision: Algorithms And Applications by Richard Szeliski, 2022
- 2. Concise Computer Vision: An Introduction to Theory and Algorithms by Reinhard Klette, 2014
- 3. Computer Vision: Principles, Algorithms, Applications, Learning by E. R. Davies, 2017

- 4. Computer Vision Metrics: Survey, Taxonomy, and Analysis, Scott Krig, 2014
- 5. Deep Learning for Vision Systems, Mohamed Elgendy, 2020

BCA5EJ302(5) - DEEP LEARNING FOR COMPUTER VISION

Programme	BCA	BCA						
Course Code	BCA5EJ302(5)							
Course Title	Deep Learning for con	mputer visior	1					
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 concepts involved of deep learning and computer vision.							
Course Summary	Implement fundamenta vision, Understand diff vision applications	Implement fundamental deep learning techniques required for computer vision, Understand different deep generative models, Develop computer vision applications						

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamentals of digital image formation and capturing	U	С	Assignment / Instructor- created exams / Quiz
CO2	Understand the concepts of deep learning in computer vision	Ap	С	Practical Assignment / Instructor- created exams / Quiz
CO3	Analyze the components of CNN and their functions.	An	С	Practical Assignment / Instructor- created exams / Quiz

CO4	Develop skills in implementing image processing algorithms and different generative models.	Ap	Р	Practical Assignment / Instructor- created exams / Quiz				
CO5	Analyze and interpret digital images to extract meaningful information with attention models.	An	Р	Practical Assignment / Instructor- created exams / Quiz				
* - Re - Fact Metac	 * - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M) 							

Module	Unit	Content	Hrs	Marks		
Ι		Introduction and Overview	10	15		
	1	Introduction to Image Formation, Capture and Representation.	2	-		
	2	2 Linear Filtering, Correlation, Convolution				
	3	3 Edge, Blobs, Corner Detection, Scale Space and Scale Selection				
	4	Pyramid Matching; Optical Flow	3	-		
II		Deep Learning and CNN	12	15		
	5	Multi-layer Perceptron, Backpropagation	3			
	6	Introduction to CNNs.	3			
	7	Evolution of CNN Architectures: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets	3			
	8	Visualization of Kernels; Backprop-to-image/Deconvolution Methods.	2			
	9	Deep Dream, Hallucination, Neural Style Transfer.	1			
III	Deep Generative Models		13	20		
	10	Deep Generative Models: GANs, VAEs.	4			
	11	Other Generative Models: PixelRNNs, NADE, Normalizing Flows.	3			
	12	3D Object Generation, Security.	3			
	13	Variants: CycleGANs, Progressive GANs, StackGANs, Pix2Pix.	3			
IV		Attention Models	13	20		
	14	Introduction to Attention Models in Vision.	3			
	15	Vision and Language: Image Captioning, Visual QA, Visual Dialog	3			
	16	Spatial Transformers; Transformer Networks	3			
	17	Self-Supervised Learning, Adversarial Robustness	4			
V		Trends in Deep learning	12			
	1	• Case study : Analyze the recent trends in deep learning for digital image augmentation.				

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO7
CO 1	1	-	1	-	2	2	3	-	1	-	2	-	1	1
CO 2	1	-	1	-	2	2	1	2	-	3	1	-	2	2
CO 3	1	1	1	-	2	2	-	-	2	-	3	1	-	-
CO 4	3	3	2	1	2	1	3	-	1	3	-	-	-	-
CO 5	1	-	1	-	2	2	1	-	-	-	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	Practical Evaluation	End Semester Examinations
CO 1	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- 1. Deep Learning for Computer Vision, Rajalingappaa Shanmugamani, 2018
- 2. Deep Learning for Computer Vision, Jason Brownlee, 2019
- 3. Fundamentals of Deep Learning and Computer Vision, Nikhil Singh, Paras Ahuja, 2020
- 4. Deep Learning in Computer Vision: Principles and Applications, Mahmoud Hassaballah, Ali Ismail Awad, 2020
- 5. Deep Learning (Adaptive Computation and Machine Learning series), Aaron Courville, Ian Goodfellow, 2016

BCA6EJ303(5) - COMPUTER VISION FOR EMBEDDED SYSTEMS

Programme	BCA							
Course Code	BCA6EJ303(5)	BCA6EJ303(5)						
Course Title	Computer vision for e	mbedded sys	tems					
Type of Course	Elective							
Semester	VI	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 concepts involved of computer vision with embedded systems.							
Course Summary	Implement fundamenta systems, Understand di computational vision.	Implement fundamental computer vision techniques required for embedded systems, Understand different networks for embedded systems in computational vision.						

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamentals of Embedded systems.	U	С	Assignment / Instructor- created exams / Quiz
CO2	Understand the concepts of interfacing and networking	Ар	С	Practical Assignment / Instructor- created exams / Quiz

CO3	Analyze the components of Embedded file	An	С	Practical				
	systems.			Assignment /				
				Instructor-				
				created exams				
				/ Quiz				
CO4	Develop skills in implementing image	Ap	Р	Practical				
	processing python libraries with			Assignment /				
	embedded systems.			Instructor-				
				created exams				
				/ Quiz				
CO5	Analyze the relations between machine	An	Р	Practical				
	learning and embedded systems.			Assignment /				
				Instructor-				
				created exams				
				/ Quiz				
* - Re	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)#							
- Fact	- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)							
Metac	cognitive Knowledge (M)							

Module	Unit	Content		Marks
			(48+12)	
Ι		10	15	
	1	Embedded system processor, hardware unit, software embedded	2	
		into a system, Example of an embedded system.		
	2	Embedded Design life cycle, Layers of Embedded Systems.	2	
	3	Embedded System modelling [FSM, MARTE], UML as Design tool, UML notation.	3	
	4	Requirement Analysis and Use case Modelling, Design Examples	3	
II		Component Interfacing & Networks	12	15
	5	Memory Interfacing, I/O Device Interfacing, Interrupt Controllers.	3	
	6	3		
	7	3		
	8	Evolution of Internet of things (IoT).	3	
III		Building Process for Embedded Systems	13	20
	9	Preprocessing, Compiling, Cross Compiling.	3	
	10	Linking, Locating, Compiler Driver.	4	
	11	Linker Map Files, Linker Scripts and scatter loading, Loading on the target.	3	
	12	Embedded File System.	3	
IV		Trends in Computer Vision	13	20
	13	Image data formats, OpenCV	3	
	14	Applications of computer vision in embedded systems	3	
	15	Datasets, bias, privacy, competitions, Machine learning and	3	
		PyTorch, Performance and resources (time, memory, accuracy)		
	16	Pruning and network architecture search, Tree modular networks, Vision in context, MobileNet	4	

V		Analyze the current Trends	12				
		in Computer Vision and					
	1 Case study. A polyce the engineer for the questions helps:						
	1	1. How to train and develop an image classification system using machine learning					
		 How to train and develop an object detection system using machine learning 					
		 How to deploy a machine learning model to a microcontroller 					
		microcontroller					

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	1	-	2	2	3	-	1	-	2	-	-
CO 2	1	-	1	-	2	2	1	2	-	3	1	-	2
CO 3	1	1	1	-	2	2	-	-	2	-	3	1	3
CO 4	3	3	2	1	2	1	3	-	1	3	-	-	-
CO 5	1	_	1	-	2	2	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark

CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

- 1. Embedded computer vision, Branislav Kisacanin, Shuvra S. Bhattacharyya, 2008
- Learning OpenCV 4 Computer Vision with Python 3 Paperback –Joseph Howse (Author), Joe Minichino (Author), 2020
- 3. Computer Vision: Algorithms and Applications (Texts in Computer Science)by Richard Szeliski , 2022
- 4. A Practical Approach for Machine Learning and Deep Learning Algorithms Paperback , Abhishek Kumar Pandey (Author), Pramod Singh Rathore (Author), Dr. S. Balamurugan (Author) 2019

Programme	BCA						
Course Code	BCA6EJ304(5)						
Course Title	Modern computer Vis	sion					
Type of Course	Elective						
Semester	VI	VI					
Academic Level	300-399	300-399					
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours		
	4	4	-	-	60		
Pre-requisites	Basic understanding of concepts involved of computer vision and 3D reconstruction of images.						
Course Summary	Implement fundamenta transformation and ima	Implement fundamental computer vision techniques required for geometric transformation and image reconstruction.					

BCA6EJ304(5) - MODERN COMPUTER VISION

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamentals of Learning.	U	C C	Assignment / Instructor- created exams / Quiz
CO2	Understand the concepts of CNN and RNN	Ap	С	Practical Assignment / Instructor- created exams / Quiz
CO3	Analyze the components of various types of detections used in image construction.	An	С	Practical Assignment / Instructor- created exams / Quiz
CO4	Develop skills in geometric transformation of images.	Ap	Р	Practical Assignment / Instructor- created exams / Quiz
CO5	Implement the concept of 3D reconstruction of images.	An	Р	Practical Assignment / Instructor- created exam/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	Marks
			(48+12)	
		10	15	
	1	Introduction to deep learning, Introduction to neuron	2	
	2	Multilayer perceptron (MLP), Gradient descent,	2	
	2	Backpropagation in MLP	2	
	3	Optimization and regularization, Regularization and	3	
		CNN properties CNN architectures. Introduction to recurrent	2	
	4	neural network (RNN) Encoder Decoder models in RNN	5	
п		Introduction to Detection	12	15
11	5	Spatial and frequency domain filtering. Edge detection	3	15
	6	I in a detection. Feature detectors. Harris corner detector	3	
	7	Plob detection, Feature detectors, frams conter detector	3	
	8	Low level vision Blob detection	3	
TIT	0	13	20	
111	0	Single view geometry 2D Coometric transformations	15	20
	10	Single-view geometry, 2D Geometric transformations	3	
	10	Fundamental matrix computation	3	
	11	Structure from motion	3	
TX7	12	3D Beconstruction	<u> </u>	20
1 V	13	Patch processing in SEM. Dance 2D reconstruction	13	20
	13	Deepnets for stores and SEM Mid-level vision Image	3	
	14	segmentation	5	
	15	Deepnets for segmentation High-level vision. Deepnets for object		
		detection	3	
	16	Applications of Optimal Estimation: Object Tracking and	3	
		Localization.		
V		Computer vision and	12	
		social media		
	1	Case study: Analyse the importance of Computer		
		vision systems in social media and entertainment		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	_	1	_	2	2	-	-	1	-	2	-	3
CO 2	1	-	1	-	2	2	1	2	-	3	1	-	-
CO 3	1	1	1	-	2	2	-	-	2	-	3	1	1

CO 4	3	3	2	1	2	1	3	-	3	3	-	-	2
CO 5	1	_	1	_	2	2	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- Modern Computer Vision with PyTorch Second Edition, V Kishore Ayyadevara, Yeshwanth Reddy, 2024
- 2. Modern Computer Vision with PyTorch: Explore deep learning concepts and implement over 50 realworld image applications, V Kishore Ayyadevara (Author), Yeshwanth Reddy (Author), 2020
- Computer Vision and Image Processing: Fundamentals and Applications Hardcover, Manas Kamal Bhuyan (Author), 2019
- 4. Computer Vision: A Modern Approach 2e, Forsyth / Ponce, 2015
- 5. Computer Vision: A Modern Approach, Forsyth David A. and Ponce Jean, 2003

6. Cyber Security

BCA5EJ301(6) - INTRODUCTION TO CYBER SECURITY

Programme	BCA									
Course Code	BCA5EJ301(6)									
Course Title	INTRODUCTION TO CYBER SECURITY									
Type of Course	Elective									
Semester	V									
Academic	300-399									
Level										
Course Details	Credit	Lecture	Tutorial	Practical	Total Hours					
		per week	per week	per week						
	4	4	-	-	60					
Pre-requisites	Basic understanding	of cyber secu	rity							
	_	-	-							
Course	This course covers the essential concepts of cyber security, including									
Summary	familiar with cyberse	curity tools,	environments	s, and depende	encies, as well					
	as Understand the rele	evant role of o	cybersecurity	. Also aimed a	at how security					
	defenses are layered t	hroughout di	ifferent system	m architecture	es					

CO	CO Statement	Cognitive	Knowledge	Evaluation
		Level*	Category#	Tools used
CO1	Familiarize with cybersecurity tools,	U	С	Instructor-
	environments, and dependencies.			created exams /
				Quiz
CO2	Acquire a basic knowledge to	U	С	Instructor-
	Identify trends in cybersecurity			created exams /
	events and protection techniques.			Quiz
CO3	Identify common security	U	С	Instructor-
	regulations and frameworks.			created exams /
				Home
				assignments
CO4	Categorize assets, risks, threats,	А	Р	Instructor-
	vulnerabilities, and exploits.			created exams /
				Home
				assignments
CO5	Understand protection for email	А	Р	Instructor-
	and other communication methods			created exams /
				Home
				assignments
* - Re	member (R), Understand (U), Apply (A	p), Analyse (An), Evaluate (E), Cr	eate (C)# -
Factua	al Knowledge(F) Conceptual Knowledg	e (C) Procedural	Knowledge (P)	
Metac	cognitive Knowledge (M)			

Module	Unit	Content	Hrs	Mark
			(48+1	
Ι		Cybersecurity Fundamentals	2)	15
	1	Understand the relevant role of cybersecurity and why it is important.	2	
	2	Describe how business stakeholders play a role in cybersecurity.	2	
	3	2		
	4	2		
	5	Explain security fundamentals including core security principles, critical security controls, and best practices	2	
II		Maintain Secure Infrastructure	L	15
	6	Apply methods to enforce cybersecurity governance.	2	
	7	Identify common security regulations and frameworks.	2	
	8	Explain how current security laws, regulations, and standards applied to cybersecurity and data privacy.	2	
	9	Recognize components of the NIST Cybersecurity Framework (CSF).	2	
	10	Recognize components of the Center for Internet Security Critical Security Controls (CSC).	2	
III		Software vulnerabilities		20
	11	Buffer and stack overflow	3	
	12	Cross site scripting(XSS), and vulnerabilities	3	
	13	SQL injection and vulnerabilities	2	
	14	Phishing	2	
	15	Third-party libraries	2	
	16	Web Services security: XML, SOAP, SAML, RFID	2	
IV		Security Defenses		20
	17	how security defenses are layered throughout different system architectures.	3	
	18	Identify common identity and access control protection techniques.	3	
	19	Determine patch levels for common systems/applications.	2	
	20	Describe the process and technique for applying patches and updates on computing devices	2	
	21	Understand protection for email and other communication methods	2	
	22	Analyze vulnerabilities and risks to those organizational assets.	1	
		Cyber Security Applications		
V		Case study: Applications of cyber security: Antivirus, Anti malware	12	
Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	2	-	1	-	1	-	2	-	1
CO 2	3	2	-	-	-	-	2	2	-	3	1	-	2
CO 3	1	2	-	-	-	-	-	-	2	-	3	1	-
CO 4	1	3	1	2	-	-	3	-	1	3	-	-	-
CO 5	1	3	1	2	_	-	1	-	-	-	2	-	-

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	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

- 1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
- 2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.
- 3. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

BCA6EJ302(6)- ADVANCED PYTHON SCRIPTING FOR CYBER SECURITY

Programme	BCA							
Course Code	BCA6EJ302(6)							
Course Title	ADVANCED PYTHON SCRIPTING FOR CYBER SECURITY							
Type of Course	Elective							
Semester	V							
Academic	300-399							
Level								
Course Details	Credit	Lecture	Tutorial	Practical	Total Hours			
		per week	per week	per week				
	4	4	-	-	60			
Pre-requisites	The use of Python to	automate the	process of p	erforming rec	onnaissance			
	on target environmen	ts						
Course	This course demonstr	ates the use	of Python fo	r network ana	lysis to detect			
Summary	and hijack suspicious	connections	. It also demo	nstrates the us	se of Python to			
	collect information on a system, including both user credentials and other							
	sensitive data							

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand Evolution Of Python In Cyber Security	U	С	Instructor- created exams / Quiz
CO2	Familiarize with Pythons high usability and large collection of libraries.	U	С	Instructor- created exams / Quiz
CO3	Understand advanced Python features for offensive and defense cybersecurity	U	С	Instructor- created exams / Home assignments

CO4	Understand how some of the advanced functionality in Python packages can be applied to cybersecurity	А	Р	Instructor- created exams / Home assignments				
CO5	Understand Advanced Python Scripting for Cybersecurity Skills Path builds on the Python for Cybersecurity skills path to demonstrate advanced applications of Python for cybersecurity.	A	Р	Instructor- created exams / Home assignments				
* - Re Factua Metac	* - 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	Mark
т		Dython for other convity	(48+12)	15
1	1	Python for cyber security	2	15
	I	Develop custom python scripts to automate cyber security tasks	2	
	2	Apply python to meet objectives throughout the cyber security attack life cycle	2	
	3	Automate common cyber-attack and defense activities with python	2	
	4	Mapped to the MITRE ATT&CK and shield framework	2	
	5		2	
		Code for achieving MITRE ATT&CK and shield techniques		
II		Exploration of python for PRE-ATT&CK matrix		15
	6	MITRE ATT&CK	2	
	7	Introduction to network Scanning	2	
	8	Introduction to Scapy- Python library	2	
	9	Introduction to open network databases	2	
III		Explore using python for initial access		20
	10	Introduction to valid accounts	3	
	11	Default account discovery	3	
	12	Introduction to replication through removable media	2	
	13	Autorun scripts	2	
IV		Python applications in cyber security		20
	14	Network scanning and analysis	3	
	15	Vulnarability analysis	3	-
	16	Penetration testing	2	-
	17	Malware analysis	2	-
	18	Intrusion detection and prevention	2	1
	19	Cryptography	2	1
	-	Python vs Cyber Security		
V		Case study: Role of python in cyber security	12	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	2	-	1	-	1	-	2	-	3
CO 2	3	2	-	-	-	-	1	2	-	3	1	-	-
CO 3	1	2	-	-	-	-	-	-	2	-	3	1	-
CO 4	1	3	1	2	-	_	3	-	1	3	-	-	2
CO 5	1	3	1	2	-	-	1	-	-	-	2	-	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	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

- 1. Black Hat Python: Python Programming for Hackers and Pentesters" by Justin Seitz
- 2. "Violent Python: A Cookbook for Hackers, Forensic Analysts, Penetration Testers and Security Engineers" by TJ O'Connor
- 3. "Python Penetration Testing Cookbook: Practical recipes on implementing information gathering, network security, intrusion detection, and post-exploitation" by Rejah Rehim
- 4. "Python for Offensive PenTest: A practical guide to ethical hacking and penetration testing using Python" by Hussam Khrais

BCA6EJ303(6)- CYBER SECURITY OPERATIONAL FUNDAMENTALS

Programme	BCA									
Course Code	BCA6EJ303(6)									
Course Title	CYBER SECURITY	CYBER SECURITY OPERATIONAL FUNDAMENTALS								
Type of Course	Elective									
Semester	VI									
Academic	300-399									
Level										
Course Details	Credit	Lecture	Tutorial	Practical	Total Hours					
		per week	per week	per week						
	4	4	-	-	60					
Pre-requisites	The Cybersecurity Op	perations Fui	ndamentals S	pecialization	gives basic					
	skills need to begin a	career as an	entry-level c	ybersecurity a	malyst					
Course	This Course offers a	foundational	knowledge	that organizat	ions require to					
Summary	protect their network.									
	Completing this Spe	cialization w	vill prepare t	o start career	as a Security					
	Operations Center Ar	nalyst.								

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used				
CO1	Familiarity with Ethernet and TCP/IP networking	U	C	Instructor- created exams / Quiz				
CO2	Familiarize the benefits of load balancing and web application firewalls	U	С	Instructor- created exams / Quiz				
CO3	Understand the Windows boot process, starting services, and registry entries.	U	C	Instructor- created exams / Home assignments				
CO4	Working knowledge of the Windows and Linux operating systems	А	Р	Instructor- created exams / Home assignments				
CO5	Understand the kill chain and the diamond models for incident investigations, and the use of exploit kits by threat actors.	А	Р	Instructor- created exams / Home assignments				
* - Re Factua Proce	* - 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	Mark
			(48+1	
			2)	
Ι		Security operations centre		15
	1	Introduce technical and procedural challenges in a SOC.	2	
	2	2		
	3	Working knowledge of the Windows and Linux operating systems	2	
	4	Familiarity with basics of networking security concepts.	2	
II		End points and systems		15
	5	Describe the history of the Windows operating system and vulnerabilities	2	
	6	The Windows OS architecture and components.	2	
	7	Windows processes, threads, and handles.	2	
	8	Describe the Windows boot process, starting services, and registry entries.	2	
	9	Access Windows network resources and perform remote functions.	2	
III		Network Security		20
	10	The purpose of Access List Control lists	3	
	11	Network based malware protection	3	
	12	The benefits of load balancing and web application firewalls-	2	
	13	basic models for implementing access controls over network	2	
IV		Threat Analysis		20
	14	Use the classic kill chain model to perform network security incident analysis	3	
	15	how the kill chain model can be applied to detect and prevent ransomware	3	
	16	how to apply the diamond model to perform network security incident analysis using a threat intelligence platform, such as ThreatConnect	2	
	17	Describe the MITRE ATTACK framework and its use	2	
	18	2		
	19	Understand the kill chain and the diamond models for incident investigations, and the use of exploit kits by threat actors.	2	
		Frameworks in Cyber Security		
V		Case study: Framework of MITRE ATTACK and its	12	
		use		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	2	-	-	-	1	-	3	-	1
CO 2	3	2	-	-	-	-	1	2	-	3	1	-	2
CO 3	1	2	-	-	-	-	-	-	2	-	3	1	-
CO 4	1	3	1	2	-	-	3	-	1	3	-	-	-
CO 5	1	3	1	2	-	-	1	-	3	-	2	-	3

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	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

5. Black Hat Python: Python Programming for Hackers and Pentesters" by Justin Seitz

- 6. "Violent Python: A Cookbook for Hackers, Forensic Analysts, Penetration Testers and Security Engineers" by TJ O'Connor
- 7. "Python Penetration Testing Cookbook: Practical recipes on implementing information gathering, network security, intrusion detection, and post-exploitation" by Rejah Rehim
- 8. "Python for Offensive PenTest: A practical guide to ethical hacking and penetration testing using Python" by Hussam Khrais

Programme BCA Course Code BCA5EJ304(6) Course Title ARTIFICIAL INTELLIGENCE IN CYBER SECURITY Type of Course Elective Semester VI 300-399 Academic Level **Course Details Total Hours** Credit Lecture Tutorial Practical per week per week per week 4 4 60 3. Basic understanding of artificial intelligence in cyber security **Pre-requisites** Course This course covers the essential concepts of cyber security in AI, including Modern Core AI Techniques In Cyber Security, Machine Learning Models, Summary as well as Opportunities And Advancements in AI cybersecurity.

BCA5EJ304(6)- ARTIFICIAL INTELLIGENCE IN CYBER SECURITY

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used			
CO1	Understand Evolution Of AI In Cyber Security	U	C	Instructor- created exams / Quiz			
CO2	Familiarize with Modern Core AI Techniques In Cyber Security	U	С	Instructor- created exams / Quiz			
CO3	Understand Threat Intelligence And Deception Technology	U	С	Instructor- created exams / Home assignments			
CO4	Familiarize with challenges in implementing AI.	А	Р	Instructor- created exams / Home assignments			
CO5	Understand the Socio economic effect	А	Р	Instructor- created exams / Home assignments			
* - Re Factua Metac	* - 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+1 2)	Mark
Ι	Evolu		15	
	1	Understand Evolution of AI-Turing machines and theoretical foundations	2	
	2	Early days of computing-Emergence of first computer virus	2	
	3	Response and birth of cyber security-Large language models	2	
	4	Identify Threat detection and response processing	2	
	5	Quantum Computing-Quantum advantage-implications of Encryption	2	
II	Mode	rn Core AI Techniques In Cyber Security		15
	6	Evolution of Machine learning- Data deluge and the internet era	2	
	7	Deep learning and Neural networks-CNN,RNN	2	
	8	Expert system-Foundations of expert system- role in cyber security and their relevance	2	
	9	Natural language processing and threat detection	2	
	10	Opportunities and Advancements	2	
III	Adap	tive learning and anomaly detection		20
	11	Signature based detection	3	
	12	Incidence response and mitigation	3	

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	13	Threat intelligence and deception technology	2	7
	14	Cloud security and encryption	2	
IV	So	cio Economic effect		20
	15	Societal impact	3	
	16	Potential misuse of AI	3	
	17	Cyber security workforce	2	
	18	Growing corporate altruism	2	
	19	Deception-Inscrutability-Exponential growth	2	
	20	Agentic autonomous artificial intelligence	2	
V		Challenges and IOT Threats		
		Case study: Challenges and ethical consideration-	12	
		Cyber-attacks, AI Expansion, IOT Threats		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	2	-	3	-	1	-	2	-	2
CO 2	3	2	-	-	-	-	1	2	-	3	1	-	1
CO 3	1	2	-	-	-	-	-	-	2	-	3	1	-
CO 4	1	3	1	2	_	_	3	-	1	3	-	-	-
CO 5	1	3	1	2	-	-	1	-	-	-	2	-	-

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / SeminarMidterm Exam
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	End Semester Examinations
CO 1	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

- Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers, 1998 -- another fine introductory textbook on artificial intelligence.
- Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Second Edition, Prentice-Hall, 2003 -- the leading introductory textbook in the field
- Frederick Hayes-Roth, "The Knowledge-Based Expert System: A Tutorial", *IEEE Computer*, Volume 18, Number 9, September 1984, pp. 11-28.
- Frederick Hayes-Roth, "Rule-Based Systems", *Communications of the ACM*, Volume 28, Number 9, September 1985, pp. 921-932.
- Peter Jackson, Introduction to Expert Systems, Third Edition, Addison-Wesley, 1998.

Basket of No Specialization Electives (for VII, VIIISemesters)

Programme	BCA						
Course Code	BCA7EJ401(1)	BCA7EJ401(1)					
Course Title	Theory of Computation	on					
Type of Course	Elective						
Semester	VII						
Academic	400-499						
Level							
Course Details	Credit	Lecture	Tutorial	Practical	Total Hours		
		per week	per week	per week			
	4	4	-	-	60		
Pre-requisites	4. Understanding of	basic mather	natical conce	epts such as s	ets, functions,		
	relations, logic and di	iscrete structu	ures.				
	5. Understanding of	fundamental	programmin	g constructs	such as loops,		
	conditionals, function	ns, and recurs	sion.				
Course	This course covers a	comprehens	ive exploration	on of fundam	ental concepts		
Summary	in computer science,	delving into	computation	al models, fo	rmal language		
	theory, and comput	ational com	plexity. Stu	dents learn	about various		
	computational model	s such as fin	nite automata	a, pushdown	automata, and		
	Turing machines, ga	ining insight	s into their o	capabilities an	nd limitations.		
	Through the study of	formal langu	ages and gra	mmars, stude	nts understand		
	the structure and prop	perties of reg	ular and cont	ext-free langu	lages.		

BCA7EJ401(1) - Theory of Computation

CO	CO Statement	Cognitive	Knowledge	Evaluation Tools
		Level*	Category#	used
CO1	Define key concepts in formal languages and automata, including the types of	U	Р	Practical Assignment /
	well as the basic properties of deterministic finite automata (DFA) and nondeterministic finite automata (NFA).			exams / Quiz
CO2	Explain the equivalence of different automata models, such as the relationships between DFA, NFA, and ε - NFA, and describe the significance of Mealy and Moore machines in the context of state machines.	Ар	Р	Practical Assignment / Instructor-created exams / Quiz
CO3	Construct finite automata from regular expressions and apply closure properties and the pumping lemma to analyze regular languages in practical scenarios.	Ар	Р	Practical Assignment / Instructor-created exams / Quiz

CO4	Analyze the equivalence of pushdown automata (PDA) and context-free grammars (CFG), utilizing tools such as the pumping lemma and closure properties to evaluate context-free languages.	Ар	Р	Practical Assignment / Instructor-created exams / Quiz		
CO5	Critically evaluate undecidability concepts, discussing implications of the Church-Turing hypothesis, Rice's theorem, and the classification of problems into classes P and NP, including assessing the complexity of specific NP-complete problems in various domains.	Ар	Р	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	Mark
			(48+12)	
Ι		FINITE AUTOMATA	10	16
	1	Formal Language: Definition, Chomsky classification of	2	
		Grammar, Language and Relation, Language and Automata	-	
	2	Finite Automata: DFA, NFA with and without €- moves	2	
	3	Equivalence of DFA and NFA	2	
	4	Equivalence of NFA and €-NFA	2	
	5	Mealy and Moore Models - Conversions	2	
II	F	REGULAR LANGUAGE, REGULAR EXPRESSION	10	18
	6	Regular Languages: Regular Expressions, Ardens Theorm	2	
	7	Conversion of Regular Expression to Finite Automata	2	
	8	Closure properties of RLs	2	
	9	Pumping lemma for RLs	2	
	10	Myhill-Nerode theorem	2	
III	PUSI	H DOWN AUTOMATA, CONTEXT FREE LANGUAGE	14	18
	11	Pushdown Automata - Instantaneous Description -	3	
		Transition Diagram		
	12	Deterministic and Non Deterministic PDA	3	
	13	Equivalence of PDAs and CFGs, Pumping lemma for CFLs	2	
	14	Closure properties of CFLs, Simplification of CFLs	2	
	15	Chomsky Normal form (CNF) and Greibach Normal form	2	
		(GNF)		
	16	CYK algorithm for CFL membership	2	
IV		TURING MACHINE, UNDECIDABILITY	14	18
	17	Turing Machine - Instantaneous Description - Transition Diagram	3	
	18	Variants of TMs - Equivalence of the various variants with basic model	3	
	19	Recursively Enumerable and Recursive languages	2	
	20	Church Turing hypothesis - Rices theorem	2	
	21	Undecidability of Posts correspondence problem	2	
	22	The Class P and NP	2	
V		Advanced Automation Theory	12	
*		1 Application of regular expressions in pattern matching and		
		text processing		
		2 Analysis of contact free languages using numping lamma		
		2. Analysis of context-free languages using pumping lemma		

and closure properties	
3. Investigation of undecidability and un-solvability using the halting problem and Rice's theorem.	
4. Notion of tractability: The Class P and NP, NP completeness of propositional satisfiability, other variants of satisfiability. NP-complete problems from other domains: graphs (clique, vertex cover, independent sets, Hamiltonian cycle), number problem (partition), set cover.	
5.Discussion of practical implications and applications of complexity theory.	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	3	2	1	-	-	2	-	1	-	2	-	2
CO 2	1	1	2	1	-	-	1	2	-	3	1	-	1
CO 3	-	3	1	1	-	-	-	-	2	-	3	1	1
CO 4	-	3	3	2	-	-	3	-	1	3	-	-	-
CO 5	-	1	3	3	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 Examination		
CO 1	\checkmark	\checkmark		\checkmark		
CO 2	\checkmark	\checkmark		\checkmark		

CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

Reference:

1. J.E. Hopcroft, R. Motwani and J.D Ullman, —Introduction to Automata Theory, Languages and Computations, Third Edition, Pearson Education, 2016.

2. Theory of Computer Science- Automata, Languages and Computation- K.L.P. Mishra, N Chandrasekaran, PHI

3. Theory of Computation, Sachin Agrawal, Vikas Publishing House

4. Micheal Sipser, —Introduction of the Theory and Computation, Thomson Brokecole, 3rd Edition, 2013.

5. J. Martin, —Introduction to Languages and the Theory of Computation, Third Edition, TMH, 2007.

6. An Introduction to Formal languages and Automata- Peter Linz.

BCA7EJ401(2) - Expert Systems and Fuzzy Logic

Programme	BCA					
Course Code	BCA7EJ401(2)					
Course Title	Expert Systems and I	Fuzzy Logic				
Type of Course	Elective					
Semester	VII					
Academic	400 - 499					
Level						
Course Details	Credit	Lecture	Tutorial	Practical	Total	
		per week	per week	per week	Hours	
	4	4	-	-	60	
Pre-requisites	1. Familiarity wit	h basic logic	and set theor	ies.		
	2. Understanding	the fundame	ntals of comp	puter science,	such as	
	algorithms and	d data struc	tures, can b	e beneficial	for the	
	implementation	aspects of e	xpert system	S.	fton required	
~	5. A basic unders	tanding of pr		statistics is o	iten required.	
Course	The Fuzzy logic and	expert system	ns course int	roduce two in	nterconnected	
Summary	fields in artificial intel	ligence: fuzz	y logic and e	expert systems	s. Fuzzy logic	
	deals with reasoning under uncertainty and imprecision, while expert					
	systems involve the de	systems involve the development of computer-based systems that emulate				
	human expertise in spe	ecific domain	IS	· · · · · · · · · · · · · · · · · · ·		

СО	CO Statement	Cognitive	Knowledge	Evaluation Tools used
<u>CO1</u>		Lever*	Category#	I oois used
	Define and describe fundamental concepts of fuzzy logic including fuzzy	U	Г	Instructor-
	sets membership functions and basic			Ouiz
	fuzzy operations such as union			Quiz
	intersection, and complement.			
CO2	Explain the principles of fuzzification	U	С	Practical
	and defuzzification, as well as articulate			Assignment /
	the differences between Mamdani and			Observation of
	Sugeno fuzzy inference systems (FIS)			Practical Skills
	and their respective structures and			
CO3	applications.	An	D	Dractical
COS	develop fuzzy rule-based systems using	Ар	1	Δ ssignment /
	SCILAB/MATLAB including the			Observation of
	creation of membership functions and			Practical Skills
	the execution of fuzzy inference for			
	practical applications.			
CO4	Analyze expert systems by identifying	Ар	Р	Practical
	their components, such as knowledge			Assignment /
	bases and inference engines, and by			Observation of
	applying reasoning techniques like			Practical Skills
	forward and backward chaining to solve			
005	problems.	•	0	T i i
COS	Critically evaluate the performance of	An	C	Instructor-
	systems, comparing their effectiveness			Ouiz
	in real-world applications such as			Quiz
	temperature control and diagnostic			
	systems, through simulation and			
	analysis of outputs in			
	SCILAB/MATLAB.			
* - Re	emember (R), Understand (U), Apply (Ap),	Analyse (An), Evaluate (E), C	Create (C)
# - Fa	ctual Knowledge(F) Conceptual Knowledg	ge (C) Procedu	ural Knowledge	(P)
Meta	cognitive Knowledge (M)			

Module	Unit	Content	Hrs (48+12)	Mark
Ι		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.	2	
		Fuzzification and defuzzification.		
	5	Linguistic variables and terms.	1	
II		Fuzzy Inference Systems (FIS) and Fuzzy Logic Applications		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. Comparison with Mamdani 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		Introduction 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	3	
		interface. Examples and applications of expert systems		
	14	Rule-based systems and production rules, Forward and backward chaining.	2	
	15	Inference mechanisms in expert systems, Examples of rule-based	2	-
IV		Introduction to SCIL AB/MATLAB	16	20
1 V		Programming	10	20
	16	SCILAB/MATLAB environment and basic navigation. Variables	3	-
	10	data types, and basic operations, Script files and running SCILAB/MATLAB code. Introduction to functions and function files.	0	
	17	Introduction to functions and function files, Conditional statements (if, else, elseif), Loop structures (for, while).	2	1
	18	Logical operators and relational expressions, Vectorized operations	2	1
	19	Introduction to arrays matrices and vectors Cell arrays and	2	-
	17	structures, Indexing and slicing in SCILAB/MATLAB. Working with	2	
		multidimensional arrays.		
	20	Basic file input/output operations, Reading and writing data files (text,	2	1
		CSV, Excel), Data visualization using plotting functions.		
	21	Statistical analysis and plotting techniques, Fuzzy logic toolbox in SCILAB/MATLAB.	2	
	22	Expert system development tools in SCILAB/MATLAB, Building	3	-
V		Lab Activities	12	-
		Implement the tasks from the following:	6	
		 Fuzzy logic using SCILAB/MATLAB 1. Membership Functions: Define triangular and transzoidal membership functions for a 		
		variable representing temperature. Plot these membership		
		 Write SCILAB/MATLAB code to calculate the membership values for a given temperature. Euzzy Logic Operations: 		
		 Implement the operations AND, OR, and NOT using fuzzy logic. 		
		 Use SCILAB/MATLAB to perform fuzzy logic operations on two fuzzy sets representing temperature and humidity. Puls Passed System: 		
		 Kule-Based System: Create a simple fuzzy rule-based system for a temperature control system. Define rules based on temperature and humidity 		
		 inputs. Implement the rule-based system using SCILAB/MATLAB and simulate different input scenarios. 		
		 Implement Mamdani and Sugeno fuzzy inference systems for a traffic light control system. 		

• Evaluate the systems with different input values and contract their outputs.	npare
Implement the tasks from the following:	6
Expert System using SCILAB/MATLAB	
1. Rule-Based System Initialization:	
• Define a knowledge base for a diagnostic expert system. In rules that link symptoms to possible diseases.	clude
• Implement the rule-based system in SCILAB/MATLAB	using
if-else statements or switch-case constructs.	
2. Rule Inference Engine:	
• Develop a rule inference engine that evaluates the rules in	in the
knowledge base based on user input.	
Use SCILAB/MATLAB functions to implement rule-based infe	erence
and determine the likely diagnosis for a set of symptoms.	

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	3	-	-	-	1	1	-	1	-	2	-	1
CO 2	1	3	-	_	1	-	1	2	-	3	1	-	2
CO 3	1	3	-	-	2	2	-	-	2	-	3	1	-
CO 4	1	3	-	-	2	2	3	-	1	3	-	-	-
CO 5	2	1	3	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	Assignment	Practical	End Semester		
Exam		Evaluation	Examinations		

CO 1	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark	\checkmark	\checkmark
CO 3	\checkmark	\checkmark	\checkmark	\checkmark
CO 4		\checkmark	\checkmark	\checkmark
CO 5		\checkmark	\checkmark	\checkmark

References:

- 2. "Fuzzy Logic with Engineering Applications" by Timothy J. Ross
- 3. "Expert Systems: Principles and Programming" by Joseph C. Giarratano and Gary D. Riley
- 4. "Fuzzy Sets and Fuzzy Logic: Theory and Applications" by George J. Klir and Bo Yuan
- 5. "Expert Systems: Principles and Case Studies" by Efraim Turban, Jay E. Aronson, and Ting-Peng Liang
- 6. "Introduction to Fuzzy Logic using MATLAB" by S.N. Sivanandam, S. Sumathi, and S. N. Deepa.
- 7. Nagar, S. (2017). Introduction to Scilab: For Engineers and Scientists. Apress.
- Sheth, T. (2016). Scilab: A Practical Introduction to Programming and Problem Solving. CreateSpace Independent Publishing Platform.
- 9. Gomez, C. (1999). Engineering and Scientific Computing with Scilab. Birkhäuser.

Programme	BCA								
Course Code	BCA7EJ401(3)	BCA7EJ401(3)							
Course Title	Modern Crypto	ography							
Type of Course	Elective								
Semester	VII								
Academic	400 - 499								
Level									
Course Details	Credit	Lecture per	Tutorial	Practical	Total Hours				
		week	per week	per week					
	4	4	-	-	60				
Pre-requisites	1. Basic unders	standing of con	nputer networ	ks					
Course	This course cov	vers the essenti	ial concepts of	f computer sec	urity, including				
Summary	various securit	various security threats and attacks, as well as different cryptographic							
	algorithms aim	ed at preservi	ing confidenti	ality, integrity	, and ensuring				
	message auther	ntication							

BCA7EJ401(3) - Modern Cryptography

Course Outcomes (CO):

CO	CO Statement	Cognitive	Knowledge	Evaluation
		Level*	Category#	Tools used
COI	Define key concepts in computer security, including the CIA triad (Confidentiality, Integrity, Availability), various security attacks, and the fundamental principles of security design	U	С	Instructor- created exams / Quiz
COD	Function the OSL security	TT	C	Traction
	architecture, identifying different types of security mechanisms and services, as well as discussing the significance of attack surfaces and attack trees in the context of network security.	0	C	created exams / Quiz
CO3	Apply symmetric key cryptography techniques, including substitution and transposition methods, to encrypt and decrypt data using traditional block cipher structures such as DES and AES.	U	С	Instructor- created exams / Home assignments
CO4	Analyze public key cryptographic systems, including the RSA algorithm and Diffie-Hellman key exchange, assessing their security features and vulnerabilities.	А	Р	Instructor- created exams / Home assignments
CO5	Evaluate cryptographic data integrity algorithms, including hash functions and digital signatures, discussing their properties, security requirements, and potential attacks, and applying this knowledge to assess email, IP, and web security measures.	A	Р	Instructor- created exams / Home assignments
* - Re	emember (R), Understand (U), Apply	(Ap), Analyse (A	An), Evaluate (E),	Create (C)
# - Fa	actual Knowledge(F) Conceptual Know	wledge (C) Proc	edural Knowledge	e (P)
Meta	cognitive Knowledge (M)			

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Marks
Ι		Computer and Network Security	9	15
	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	5 A model for Network security and standards 2						
II	Symmetric Key Cryptography 15							
	6	Symmetric Cipher model	3					
	7	Substitution and Transposition techniques	3					
	8 Traditional block cipher structure 2							
	9	9 Data Encryption standard- Algorithm, example, strength 3						
	10	10Advanced Encryption standard- structure, Transformation3						
		function, example						
	11	Key channel establishment for symmetric cryptosystems	1					
III		Public Key Cryptography	10	20				
	12	Principles of Public key crypto systems- public key crypto	4					

		systems, applications, requirements					
	13	13RSA algorithm2					
	14	Security of RSA algorithm	2				
	15	Diffie-Hellman key exchange	2	-			
IV		Cryptographic Data Integrity Algorithms	14	20			
	16	Cryptographic hash functions- applications	2				
	17	17Message Digest algorithm2					
	18	18Secure Hash Algorithm2					
	19	19Message Authentication Code -requirements, security2					
	20	20MACs based on Hash Functions2					
	21	Digital Signature – properties, attacks and forgeries, requirements	2				
	22	RSA-PSS digital signature algorithm	2				
V		Cryptography in Realworld	12				
	1	Email, IP and web security	12				

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	2	-	2	-	1	-	2	-	2
CO 2	3	2	-	-	-	-	1	2	-	3	1	-	1
CO 3	1	2	-	-	-	-	-	-	2	-	3	1	1
CO 4	1	3	1	2	-	-	3	-	1	3	-	-	-
CO 5	1	3	1	2	-	-	1	-	-	-	2	-	-

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	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

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

BCA					
BCA7EJ401(4)					
COMPUTER GRAPHIC	CS				
Elective					
VII					
400 - 499					
Credit	Lecture	Tutorial	Practical	Total Hours	
	per week	per week	per week		
4	4	-	-	60	
Basic knowledge in Matl	hematics and	Computer fund	damentals		
Computer graphics i	involves usin	ng computer	s to create an	nd manipulate	
visual images. It rep	resents imag	ges as collect	ions of pixel	s on a screen.	
Computer graphics is	a core techn	ology in digi	tal photograpl	ny, film, video	
games, digital art, cell phone and computer displays, and many specialized					
applications. A great	deal of spec	cialized hardy	ware and soft	ware has been	
developed, with the	displays of a	most devices	being driver	n by <u>computer</u>	
graphics hardware.					
	BCA BCA7EJ401(4) COMPUTER GRAPHIC Elective VII 400 - 499 Credit 4 Basic knowledge in Mat Basic knowledge in Mat Computer graphics is games, digital art, cel applications. A great developed, with the graphics hardware.	BCA BCA7EJ401(4) COMPUTER GRAPHICS Elective VII 400 - 499 Credit Lecture per week 4 4 Basic knowledge in Mathematics and the second	BCA BCA7EJ401(4) COMPUTER GRAPHICS Elective VII 400 - 499 Credit Lecture per week 4 4 4 4 5 Elective VII 400 - 499 Tutorial per week 4 4 4 4 5 Basic knowledge in Mathematics and Computer function Computer graphics involves using computer function Computer graphics is a core technology in digi games, digital art, cell phone and computer dis applications. A great deal of specialized hardwide veloped, with the displays of most devices graphics hardware.	BCA BCA7EJ401(4) COMPUTER GRAPHICS Elective VII 400 - 499 Credit Lecture per week per week per week per week Basic knowledge in Mathematics and Computer fundamentals Computer graphics involves using computers to create at visual images. It represents images as collections of pixels: Computer graphics is a core technology in digital photograph games, digital art, cell phone and computer displays, and ma applications. A great deal of specialized hardware and soft developed, with the displays of most devices being driver graphics hardware.	

BCA7EJ401(4) - Computer Graphics

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts in computer graphics, including the definitions of computer graphics, pixel, frame buffer, and different types of display systems (raster and random scan).	U	C	Instructor- created exams / Quiz
CO2	Explain various applications of computer graphics and describe the process of scan conversion, including the DDA algorithm and Bresenham's algorithms for line and circle drawing.	U	С	Instructor- created exams / Quiz
CO3	Apply two-dimensional transformation techniques (translation, rotation, scaling, reflection, shear) to manipulate graphical objects and represent them using homogeneous coordinates.	U	С	Instructor- created exams / Home assignments
CO4	Analyze and implement window-to- viewport transformations, including line clipping using the Cohen- Sutherland algorithm and polygon clipping with the Sutherland- Hodgman algorithm.	A	Р	Instructor- created exams / Home assignments

Module	Unit	Content	Hrs	Mark
			(48+12)	
Ι		Introduction to computer graphics	10	16
	1	computer graphics definition	2	
	2	Application	2	
	3	Pixel	2	
	4	Frame Buffer	2	
	5	Raster and Random Scan Display	2	
II		Scan Conversion of Line	10	18
	6	DDA Algorithm of Line Drawing	2	
	7	Scan Conversion of Circles	2	
	8	Bresenham"s Circle Generating algorithm	2	
	9	Polygon Filling	2	
	10	Scan Line Polygon Filling Algorithm	2	
III		Two-Dimensional Transformation	14	18
	11	Translation	3	
	12	Rotation	3	
	13	Scaling	2	
	14	Homogeneous Coordinates	2	
	15	Reflection	2	
	16	Shear	2	
IV		Window to Viewport Transformation	14	18
	17	Clipping, Line Clipping	3	
	18	Cohen Sutherland Line Clipping	3	
	19	Polygon Clipping	3	
	20	Sutherland and Gray Hodgman Polygon Clipping Algorithm	2	
	21	Color Models and Color Applications Light and Color	2	
	22	Different color models, RGB, CMY, YIQ. Introduction to GIMP	1	
V		Digital Computer Graphics	12	
		Case study: Digital model Design		

CO5	Evaluate different color models	А	Р	Instructor-		
	(RGB, CMY, YIQ) and their			created exams /		
	applications in computer graphics,			Home		
	and apply this knowledge in			assignments		
	practical projects, such as digital					
	model design, using software tools					
	like GIMP.					
* - Re	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# -					
Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)Metacognitive						
Know	Knowledge (M)					

Detailed Syllabus:

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	_	-	2	_	3	-	1	-	2	-	-
CO 2	3	2	_	-	-	_	1	2	-	1	1	-	-
CO 3	1	2	-	-	-	-	-	-	2	-	3	1	3
CO 4	1	3	1	2	_	_	3	-	1	3	-	-	-
CO 5	1	3	1	2	_	-	1	-	-	-	2	-	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	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

Reference books

- 1. Donald Hearn and M Pauline Baker, Computer Graphics, PHI, New Delhi.
- 2. Zhigang Xiang and Roy Plasock, Computer Graphics, Schaum"s Outlines.
- 3. Deborah Morley, Understanding Computer Today And Tomorrow, Introductory Edition.

Programme	BCA					
Course Code	BCA7EJ402(1)					
Course Title	Client Server Architec	cture				
Type of Course	Elective					
Semester	VII					
Academic Level	400 - 499					
Course Details	Credit	Lecture	Tutorial	Practical	Total	
		per week	per week	per week	Hours	
	4	4	-	-	60	
Pre-requisites	Knowledge in Fundar	mentals of N	etwork and C	Deprating Syst	em	
Course	The syllabus is prep	ared with th	ne view of p	reparing the	Bachelor of	
Summary	Computer Applicati	on Graduat	es to build	effective (Client/Server	
-	applications. This course aims at providing a foundation in decentralized					
	computer systems, using the client/server model. The course content is					
	decided to cover the	essential fun	damentals w	hich can be ta	aught within	
	the given slots in the	curriculum.				

BCA7EJ402(1) - Client Server Architecture

СО	CO Statement	Cognitive Level*	Knowled ge Category #	Evaluation Tools used
CO1	Define key concepts in client/server computing, including the driving forces behind client/server architectures, development tools, and security considerations.	U	С	Instructor-created exams / Quiz
CO2	Explain the different classifications of client/server systems, including two-tier and three-tier computing, and describe the principles behind client/server systems and their topologies.	U	С	Instructor-created exams / Quiz
CO3	Implement basic client/server applications using middleware and MVC architecture, demonstrating an understanding of service requests and the functionalities of various server types.	U	Р	Instructor-created exams / Quiz
CO4	Analyze the performance of client/server applications by examining factors such as availability, reliability, and	U	С	Instructor-created exams / Case studies

	scalability, as well as evaluating network management issues in a client/server environment							
CO5	Evaluate client/server architectures through a case study, assessing communication protocols and implementation strategies using sockets, and comparing different client/server communication methods.	U	Ρ	Instructor-created exams / Quiz Case studies				
* - Re	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)							
# - Fa	# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)							
Metac	ognitive Knowledge (M)							

Detailed Syllabus

Module	Unit	Content	Hrs	Marks			
			(48+12)				
I		Introduction to Client/Server computing	12	15			
	1	Introduction to Client/Server computing - Driving forces behind	2				
		Client/ Server, Client/ Server development tools	2				
	2	Development of client/server systems, Client/Server security	2				
	3	Organizational Expectations, Improving performance of client/server applications	2				
	4	Single system image, Downsizing and Rightsizing	3				
	5	Advantages of client server computing, Applications of Client/Server	3				
II		Client/Server Application Components	12	15			
	6	Classification of Client/Server Systems- Two-Tier Computing, Middleware, Three-Tier Computing	2				
	7	Model View Controller (MVC)	1				
	8	Principles behind Client/Server Systems	3				
	9	Client/Server Topologies	3				
	10	Existing Client/Server Architecture.	1				
	11	Architecture for Business Information System	2				
III		Client/ Server Systems Development	12	20			
	12	Client- Services, Request for services, RPC, Windows services, Print	2				
		services, Remote boot services, other remote services, Utility					
		Services.					
	13	Dynamic Data Exchange (DDE).	2				
	14	Object Linking and Embedding (OLE).	2				
	15	Common Object Request Broker Architecture (CORBA).	2				
	16	Server- Detailed server functionality	2				
	17	Network operating system, Available platforms, Server operating	2				
** *		system.	10	20			
IV	10	Client/ Server Systems Support	12	20			
	18	Reliability, Scalability, Observability, Agility, Serviceability.	2				
	19	Software Distribution, Performance, Network management.	2				
	20	Remote Systems Management- RDP, Telnet, SSH, Security.	3				
	21	LAN and Network Management issues, Training, Connectivity	2				
	22	Communication interface technology, Inter process communication	3				
V		Client Server Communication	12				
	CAS	SE STUDY: Client Server Architecture					
	Gen	eric Client/Server Classes					
	Client/Server Communication via Sockets						
	The	Server Protocol					
	The	Client Protocol					
	AT	wo-Way Stream Connection					

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	2	-	-	-	-	3	-	1	-	2	-	2
CO2	-	3	-	-	-	-	1	2	-	3	1	-	1
CO3	-	2	1	-	-	-	-	-	2	-	3	1	-
CO4	1	2	1	1	1	1	3	2	1	3	-	-	-
CO5	-	2	1	-	-	-	1	-	-	-	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
- Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

Reference:

- 1. Patrick Smith & Steave Guengerich, "Client / Server Computing", PHI.
- 2. Dawna Travis Dewire, "Client/Server Computing", TMH.
- 3. Jeffrey D.Schank, "Novell's Guide to Client-Server Application & Architecture" Novell Press.
- 4. Robert Orfali, Dan Harkey, Jeri Edwards, Client/Server Survival Guide, Wiley- India

Programme	BCA							
Course Code	BCA7EJ402(2)							
Course Title	Blockchain Technolo	Blockchain Technology						
Type of Course	Elective							
Semester	VII							
Academic Level	400 - 499							
Course Details	Credit	Lecture	Tutorial	Practical	TotalHours			
		per week	per week	per week				
	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	The syllabus is prepared with the view of preparing the Bachelor of Computer							
Summary	Application 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 c	ases etc.	-					

BCA7EJ402(2) - Blockchain Technology

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts in cryptography, including symmetric and asymmetric encryption methods (AES, RSA, and elliptic curve cryptography), digital signatures, and secure hash algorithms (SHA- 256).	U	C	Instructor-created exams / Quiz
CO2	Explain the components of blockchain technology, including its architecture, types, benefits, limitations, and the concept of consensus mechanisms used to achieve decentralization.	U	С	Instructor-created exams / Quiz
CO3	Apply cryptographic principles to real-world scenarios, such as creating and validating digital signatures, utilizing secure hash functions, and deploying smart contracts on	U	Р	Instructor-created exams / Quiz

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	blockchain platforms.						
CO4	Analyze various consensus algorithms, including crash fault tolerance and Byzantine fault tolerance, and evaluate their effectiveness in maintaining security and integrity within	U	С	Instructor-created exams / Case studies			
<u> </u>	blockchain networks.						
COS	Assess the implications of blockchain technology in various industries, such as healthcare and finance, and analyze use cases, including decentralized applications and smart contracts, within the context of emerging technologies like cloud computing and artificial intelligence	U	Р	Instructor-created exams / Quiz Case studies			
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)							
# - Fa	# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)						
Meta	Metacognitive Knowledge (M)						
Detailed Syllabus

Module	e Unit Content Hrs			
			(48+12)	
Ι		Fundamentals of Cryptography	12	15
	1	Introduction to Cryptography, Symmetric cryptography – AES.	3	
		Asymmetric cryptography –RSA. Elliptic curve cryptography,		
	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	2	
		and limitations.		
	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 -	2	
		Paxos, Raft. Byzantine fault tolerance (BFT) algorithms - Practical		
		Byzantine Fault Tolerance (PBFT),.		
	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,	2	
	22	Blockchain and allied technologies – Blockchain and Cloud	3	
V		Blockchain Platforms	12	
	CA	SE STUDV+ ΒΙ ΟCΚCΗΔΙΝ ΤΕCΗΝΟΙ ΟΩV		
	Soli	dity language		
	Etha	eny nuguage ereum platform		
	Luit			

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	2	-	-	-	-	2	-	1	-	2	-	3
CO2	-	2	-	-	-	-	1	2	-	3	1	-	-
CO3	1	2	3	3	-	-	-	-	2	-	-	1	-
CO4	-	2	3	3	1	1	3	-	1	3	-	-	1
CO5	-	1	1	-	2	3	1	-	-	-	2	-	1

Correlation Levels:

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

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.

6. Andreas M. Antonopoulos, Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, First edition, 2018.

BCA7EJ402(3)	- Data	Mining
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Programme	BCA							
Course Code	BCA7EJ402(3)							
Course Title	Data Mining							
Type of Course	Elective							
Semester	VII							
Academic	400 - 499							
Level								
Course Details	Credit	Lecture	Tutorial	Practical	Total			
		per week	per week	per week	Hours			
	4	4	_	-	60			
Pre-requisites	1. Basics of statistics							
Course	This course provides an introduction to the principles, techniques, and							
Summary	applications of data n	nining.						

CO	CO Statement	Cognitive	Knowledge	Evaluation				
		Level*	Category#	Tools used				
CO1	Define key concepts like Data Mining,	U	С	Instructor-				
	Knowledge Discovery in Databases			created exams /				
	(KDD), and differentiate between			Quiz				
	DBMS and Data Mining.							
CO2	Identify various types of data (e.g.,	U	Р	Assignment /				
	transactional data, database data) and			Seminar				
	patterns (e.g., classification, regression,			presentations/				
	cluster analysis) suitable for mining.			Exams				
CO3	Explain essential data preprocessing	U	Р	Seminar				
	methods, including data cleaning,			Presentation /				
	integration, reduction, and			Group Tutorial				
	transformation.			Work/ Viva				
				Voce				
CO4	Apply association rule mining	U	С	Instructor-				
	algorithms (e.g., Apriori) and classify			created exams /				
	data using decision trees and Bayes			Home				
	classification.			Assignments				
CO5	Describe various clustering techniques	U	Р	Writing				
	(K-means, hierarchical, density-based)			assignments/				
	and discuss outlier detection methods			exams/ Seminar				
	along with real-world applications in							
	case studies.							
* - Re	emember (R), Understand (U), Apply (Ap)	, Analyse (An	n), Evaluate (E),	Create (C)				
# - Fa	ctual Knowledge(F) Conceptual Knowled	ge (C) Proced	ural Knowledge	(P)				
Metao	cognitive Knowledge (M)							

Detailed Syllabus

Module	Unit	Content	Hrs (49, 12)	Marks
т		Introduction to Data Mining	(48+12)	15
I	1	Introduction to Data Winnig Introduction- Data mining defining, KDD vs Data mining,	2	15
		DBMS vs data mining		-
	2	What kind of data can be mined? - database data, data	2	
		warehouse, transactional data, other types		-
	3	What kind of patterns can be mined? - Class/Concept	3	
		Description: Characterization and Discrimination, Mining Frequent Patterns, Associations, and Correlations, Classification and Regression for Predictive Analysis, cluster analysis, outlier analysis		
	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		Applications of Datamining	12	

1	Real-world applications of data mining	
	Case studies and projects	
	• Ethical considerations in data mining	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	-	1	3	-	1	-	2	-	1
CO 2	1	_	-	_	1	1	1	2	-	3	1	-	1
CO 3	1	_	2	-	2	2	-	-	3	-	3	1	-
CO 4	1	-	1	-	1	1	3	-	1	3	-	-	-
CO 5	1	-	1	-	1	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	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark		\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

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

Programme	BCA									
Course Code	BCA7EJ402(4)									
Course Title	NATURAL LANGUAG	NATURAL LANGUAGE PROCESSING								
Type of Course	Elective									
Semester	VII									
Academic	400 - 499									
Level										
Course Details	Credit	Lecture	Tutorial	Practical	Total Hours					
		per week	per week	per week						
	4	4	-	-	60					
Pre-requisites	Ability to coo	de in popula	ar programm	ning language	es like C/C++,					
	Python, R, or J	ava	- -							
	Basic probabili	itv								
	Dusic production	lty								
Course	The Natural Langua	ge Processing	g course give	es you a detai	led look at the					
Summary	science of applying n	nachine learr	ing algorithr	ns to process	large amounts					
	of natural language d	lata. NLP is o	driving the g	rowth of the A	AI market, and					
	this course helps yo	ou develop t	the skills re-	quired to bec	come an NLP					
	Engineer.									

BCA7EJ402(4) - Natural Language Processing

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define fundamental concepts of syntax, semantics, and pragmatics in natural language understanding.	U	C	Instructor- created exams / Quiz
CO2	Explain different parsing methods, ambiguity resolution strategies, and challenges of using context- free grammar (CFG) in natural language processing (NLP).	U	С	Instructor- created exams / Quiz
CO3	Apply various semantic analysis tasks and strategies, including linking syntax and semantics for natural language understanding.	U	С	Instructor- created exams / Home assignments
CO4	Analyze how symbolic knowledge, model knowledge, and world knowledge influence discourse structure and natural language reasoning.	А	Р	Instructor- created exams / Home assignments
CO5	Evaluate the effectiveness of NLP applications such as machine translation, information retrieval, text categorization, and conversational agents in real-world scenarios.	А	Р	Instructor- created exams / Home assignments

Module	Unit	Content	Hrs (48+12)	Mark
Ι		Introduction to Natural Language	10	16
	1	Understanding		
	1	Levels of language analysis- Syntax, Semantics, Pragmatics.	2	
	2	Linguistic Background- An Outline of English Syntax.	2	
	3	Lexicons	2	
	4	POS Tagging, Word Senses.	2	
	5	Grammars and Parsing- Features, Agreement and Augmented Grammars	2	
II		Grammars for Natural Language	10	18
	6	Parsing methods and Efficient Parsing.	2	
	7	Ambiguity Resolution- Statistical Methods	2	
	8	Probabilistic Context Free Grammar	2	
	9	Classification of Symbols in CFG	2	
	10	Issues with using context-free grammar in NLP	2	
III		Semantics and Logical Form	14	18
	11	Parts of Semantic Analysis	3	
	12	Tasks involved in Semantic Analysis	3	
	13	Elements of Semantic Analysis	3	
	14	Linking Syntax and Semantics	3	
	15	Ambiguity Resolution	1	
	16	other Strategies for Semantic Interpretation, Scoping and the	1	
IV		Knowledge Representation and Reasoning	14	18
1 V	17	Symbolic Knowledge and Model Knowledge	3	10
	18	Linear Penrocentation	3	
	4.5			
	19	Local Discourse Context and Reference	3	
	20	Using World Knowledge- Discourse Structure	2	
	21	Defining a Conversational Agent	2	
	22	Applications- Machine Translation, Information Retrieval and	1	
X 7		Extraction, Text Categorization and Summarization.	12	
v		Case study: chatbot for customer support		
V * - Re	membe	Application of NLP Case study: chatbot for customer support r (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (0	C)#

Knowledge (M)

Detailed Syllabus:

Bachelor of Computer Application

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	2	-	1	-	1	-	2	-	3
CO 2	3	2	_	_	_	_	1	2	-	3	1	-	1
CO 3	1	2	-	-	-	-	-	-	2	-	3	1	-
CO 4	1	3	1	2	_	_	3	-	1	3	-	-	-
CO 5	1	3	1	2	-	_	1	-	-	-	2	-	2

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	\checkmark		\checkmark
CO 2	\checkmark		\checkmark

CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

Reference Books:

1.Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.

2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.

 Lawrence Rabiner And Biing-Hwang Juang, "Fundamentals Of Speech Recognition", Pearson Education, 2003.

4. Daniel Jurafsky And James H Martin, "Speech And Language Processing – An Introduction To Natural

Language Processing, Computational Linguistics, And Speech Recognition", Pearson Education, 2002.

5. Frederick Jelinek, "Statistical Methods Of Speech Recognition", MIT Press, 1997.

6. Breck Baldwin, -Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015

7. Richard M Reese, —Natural Language Processing with Java, OReilly Media, 2015.

8. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.

9. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

Programme	BCA									
Course Code	BCA7EJ403(1)									
Course Title	Research Methodology	Research Methodology in Computer Science								
Type of Course	Elective									
Semester	VII									
Academic Level	400 - 499									
Course Details	Credit	Lecture	Tutorial	Practical	Total					
		per week	per week	per week	Hours					
	4	4	-	-	60					
Pre-requisites	Knowledge of Planning	a research p	roject, proble	m formulation	n, framing					
	objectives									

BCA7EJ403(1) - Research Methodology in Computer Science

Bachelor of Computer Application

-											
Course	This course introduces and discusses approaches, strategies, and data collection										
Summary	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										

CO	CO Statement	Cognitive	Knowledge	Evaluation Tools							
CO1	Understand the psychology of research which includes different perspectives and necessity of research.	U U	Category#	Instructor-created exams / Quiz							
CO2	Apply the research knowledge to formulate a suitable problem statement by adopting different research methods and models	U	С	Instructor-created exams / Quiz							
CO3	Understand different methods of Collection, Validation and Testing of Data	U	Р	Instructor-created exams / Quiz							
CO4	To understand the data processing and analysis techniques	U	С	Instructor-created exams / Case studies							
CO5	Analyze the research outcome by using suitable statistical tool.	U	Р	Instructor-created exams / Quiz Case studies							
* - Ren Factual Metaco	* - 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
			(48+12)	
Ι		Introduction to Research Methodology	12	15
	1	Research Methodology: An Introduction to the Meaning of	2	
		Research and Objectives of Research		
	2	Motivation in Research, Types of Research	2	
	3	Research Approaches	2	
	4	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	2	
		Collection Methods: Questionnaire Designing		
	13	Construction Sampling Design & Techniques – Probability	2	
	1.4	Sampling and Non-Probability Sampling Scaling Techniques:	2	
	14	Meaning & Types Reliability: Test – Retest Reliability	2	
	15	Alternative Form Reliability	2	
	10	Internal Comparison Reliability and Scorer Reliability	2	
	1/	Validity: Content Validity, Criterion Related Validity and Construct	2	
TX 7		Validity	10	20
IV	10	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	2	
		Interpretation: Precaution in Interpretation	-	
	22	Significance of Report Writing Different Steps in Writing Report	3	
		Layout of the Research Report		
V		Case Study In Research Methodology	12	
	Met	hods of Research		
	An	plications of Statistical tools & Methods		
	Stri	icture and components of scientific reports		
	Silt	sectore and components of secondice reports		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	-	-	1	-	1	-	2	-	3
CO2	-	-	1	-	-	-	1	2	-	3	1	-	-
CO3	1	2	1	-	1	1	-	-	3	-	3	1	2
CO4	1	2	2	2	1	2	3	-	1	3	-	-	-
CO5	1	1	2	2	1	2	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
- Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

Reference:

1. C. R. Kothari, 'Research Methodology Methods & Techniques', Revised 2 nd Edn., New Age International Publishers.

2. Research Methodology and Scientific Writing by C George Thomas, Ane Books Pvt. Ltd.,

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

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

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

Programme	BCA				
Course Code	BCA70E401(1)				
Course Title	Ethical Hacking				
Type of Course	Elective				
Semester	VII				
Academic	400-499				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	4	-	-	60
Pre-requisites	1. Understanding of the	he fundamen	tal networkin	g and protoco	ols concepts.
	2. Familiarity with v	arious opera	ting systems	, file system	s and basic
	system administrat	ion tasks.		-	
Course	This course provides	the skills to	identify, anal	lyze, and add	ress security
Summary	vulnerabilities in systems, networks, and web applications. It aims to learn				
	to perform penetra	ation testing	g, conduct	reconnaissan	ice, exploit
	vulnerabilities, and m	naintain acces	ss ethically ar	nd legally.	

BCA7OE401(1) - Ethical Hacking

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts in information security, ethical hacking, and the various types of hackers and malware.	U	C	Instructor- created exams / Quiz
CO2	Apply ethical hacking tools and techniques to perform foot printing and reconnaissance, gathering information about potential targets.	Ар	Р	Assignment / Seminar presentations/ Exams
CO3	Analyze different hacking methodologies and attack types, evaluating their impacts and identifying common prevention mechanisms.	Ар	Р	Seminar Presentation/ Group Tutorial Work/ Viva Voce
CO4	Evaluate the effectiveness of penetration testing tools and methodologies in identifying vulnerabilities within systems and applications.	U	С	Instructor- created exams / Home Assignments
CO5	Design and implement a comprehensive ethical hacking plan that incorporates various attack techniques, tools, and countermeasures, with a focus on mobile, cloud, and IoT environments.	Ap	C	Writing assignments/ Exams/ Seminar 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)

Mark 2) 15
2) 15
15
20
•
20
15
15

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	1	-	-	1	1	2	2	1	-	2	-	1
CO 2	3	-	-	-	1	1	1	2	-	3	1	-	-
CO 3	1	3	1	1	2	3	-	-	3	-	3	1	1
CO 4	1	-	1	1	2	3	3	-	1	3	-	-	-
CO 5	1	-	-	-	2	3	1	3	-	-	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	\checkmark		\checkmark
CO 2	\checkmark		\checkmark
CO 3	\checkmark		\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

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

Programme	BCA						
Course Code	BCA7OE401(2)						
Course Title	Cyber Forensic						
Type of Course	Elective						
Semester	VII						
Academi	400-499						
cLevel							
Course Details	Credi	Lecture	Tutorial	Practica	Total		
	t	per	per	lper	Hours		
		week	week	week			
	4	4	_	-	60		
Pre-requisites	1. Understandin	ig concept C	omputer Har	dware, Opera	ting System		
	2. Knowledge	of inform	nation sec	curity conce	epts, including		
	confidentialit	y,integrity, a	and availabili	ity			
	3. Knowledge of	of legal and o	ethical issues	s surrounding	digital evidence		
	collection, p	reservation,	and analys	is is crucial	for conducting		
	forensic inve	stigations ir	complianc	e with appli	icable laws and		
	regulations.	C	•				
Course	This course provide	es an overv	iew of cybe	er forensics	and cyber laws,		
Summar	focusingon the princ	focusing on the principles, techniques, and legal considerations involved in					
v	investigating cyberci	rimes, preser	ving digital	evidence, and	navigating legal		
	frameworks governing	ng cybersecu	rity.	,			

BCA7OE401(2) - Cyber Forensics

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts and terminology in cyber forensics, including types of evidence, the role of computer forensics in law enforcement, and the importance of the chain of custody.	Ар	C	Instructor- created exams / Quiz
CO2	Apply computer forensics techniques to collect and analyze digital evidence, including the use of specific tools for data recovery and disk imaging.	Ар	Р	Assignment / Seminar presentations/ Exams
CO3	Analyze various cybercrime scenarios and evaluate the methods used for evidence collection, contamination control, and the legal implications of cyber forensics practices.	Ар	Р	Seminar Presentation/ Group Tutorial Work/ Viva Voce

CO4	Evaluate the effectiveness of different forensic tools and methodologies in the analysis and validation of digital evidence, assessing their strengths and limitations.	Ар	Р	Instructor- created exams / Home Assignments
CO5	Design and implement a comprehensive cyber forensics project that simulates a real-world cyber incident, integrating knowledge from various topics covered in the course.	E	М	Writing assignments/ Exams/ Seminar Presentations
* - Re	emember (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					
			(48+12)						
Ι		INTRODUCTION TO CYBER FORENSICS	10	15					
	1	Computer Forensics Fundamentals: What is Computer	2						
		Forensics? Use of Computer Forensics in Law Enforcement,							
		Computer Forensics Services							
	2	Computer Forensics Assistance: Human Recourses/Employment	2						
		Proceedings, Benefits of professional Forensics Methodology,							
		Steps taken by Computer Forensics Specialists							
	3	Computer Forensics Technology: Business Computer Forensic	2						
		Technology, Military Computer Forensic Technology, Law							
		Enforcement							
	4	Vendor and Computer Forensics Services: Types of services	2						
		provided by vendors, Criteria for selecting a computer forensics							
		vendor, Vendor Engagement and Contracts, Evaluation of							
		vendor capabilities, expertise and reputation							
	5	Cyber forensics tools and case studies: Disk Imaging (EnCase,	2						
		FTK), File Analysis (FileInsight and ExifTool),							
II		COMPUTER FORENSICS EVIDENCE	10	15					
	6	Computer forensics evidence and capture: Why Collect	2						
		Evidence, Types of Evidence, The Rules of Evidence, Volatile							
		Evidence,							
	7	Data Recovery: Definition, Data Back-up and Recovery, The	2						
		Role of Back-up in Data Recovery, The Data -Recovery Solution							
	8	General Procedure for Data Collection: Collection and	2						
		Archiving, Methods of Collection							
	9	Identification of Data: Timekeeping Forensic Identification and	2						
	-	Analysis of Technical Surveillance Devices Reconstructing Past	-						
		Events.							
	10	Controlling Contamination: The Chain of Custody.	2						
	10	Reconstructing the Attack. The digital crime scene. Investigating	-						
		Cybercrime. Investigating Web attacks. Investigating network							
		Traffic							
III		FORENSIC ANALYSIS AND VALIDATION	14	20					
	11	Computer image Verification and Authentication: Special needs	2						
		of Evidential Authentication,							
	12	Computer forensic analysis: Determining what data to collect	2						
		and analyse, validating forensic data, addressing data-hiding							
		techniques, performing remote acquisitions							
	13	Computer forensic validation: Validating forensic data,	2						
		addressing data-hiding techniques, performing remote							
		acquisitions							
	12	Network Forensics: Network forensic overview, Performing live	2						
		acquisitions, Developing standard procedures for network							
		forensics							
	13	Network Forensic Tools: Overview, Wireshark, tcpdump, and	2						

		NetworkMiner, Network Traffic Analysis Tools		
	14	Ethical Hacking: Essential Terminology, Windows Hacking,	2	
		Malware, Scanning, Cracking.		
	15	Tactics of the Military, Tactics of Terrorist and Rogues, Tactics	2	
		of Private Companies		
IV		CYBER CRIME AND CYBER LAW	14	
	16	Mobile device forensics: Understanding mobile device forensic,	2	20
		understanding acquisition procedures for cell phones and mobile		
		devices.		
	17	Cyber Crimes: Types of cybercrimes against individuals and	2	
		institution, States-various offenses and punishments		
	18	Digital Signature: Concepts of public key and private key,	2	
		Certification Authorities and their role, Creation and		
	10	authentication of digital signature.	2	
	19	E-contracting: Features of E-contracts, Formation of E-contracts	2	
	20	E covernance E covernance models E commerce selient	2	
	20	E-governance: E-governance models, E-commerce- salient	Z	
	21	Cuber Law: Understanding outer space. Defining outer law	2	
	21	Scope and jurisprudence	2	
	22	Indian Cyber Law: Overview of Indian legal system	2	
		Introduction to IT Act 2000, Amendment in IT Act.	_	
V		Cyber Forensics Techniques	12	
		1. Case Study.		
		2. Simulate real-world cyber incidents and develop		
		incident response plans.		
		3. An activity that emphasizes teamwork,		
		communication, and decision-making under pressure.		
		4. Work on a comprehensive cyber forensics project that		
		integrates concepts from multiple areas of study.		
		5. Apply forensic techniques to investigate a real or		
		simulated cyber incident and produce a detailed		
		report.		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	-	-	-	2	1	3	-	1	-	2	-	1
CO 2	2	-	-	-	2	1	1	2	-	3	1	3	-
CO 3	2	-	-	_	3	2	-	-	2	-	3	1	2
CO 4	1	-	-	_	1	1	3	-	1	3	-	-	-
CO 5	2		-		3	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, John R. Vacca, Charles River Media, 2005
- Cyber Forensics Concepts and Approaches, Ravi Kumar & B Jain,2006, ICFAI university press
- Understanding Cryptography: A Textbook for Students and Practitioners, ChristofPaar, Jan Pelzl, 2010, Second Edition, Springer's.
- 4. Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, Ali Jahangiri, First edition, 2009
- 5. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series: Computer Forensics), 2010.

Programme	BCA						
Course Code	BCA8EJ404(1)						
Course Title	Compiler Design						
Type of Course	Elective						
Semester	VIII						
Academic	400-499						
Level							
Course Details	Credit	Lecture	Tutorial	Practical	Total		
		per week	per week	per week	Hours		
	4	4	-	-	60		
Pre-requisites	1.Formal Languages	& Automata	Theory.				
	2.Data Structure and	Algorithms					
Course	This course covers th	e fundament	al concepts o	f different pha	ases of		
Summary	compilation such as l	exical analys	is, syntax ana	alysis, semant	ic analysis,		
	intermediate code generation, code optimization and code generation.						
	Students can apply the	his knowledg	ge in design	and developm	nent of		
	compilers.						

BCA8EJ404(1) - Compiler Design

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Analyse the phases of a compiler and the role of lexical analysis in the compilation process, distinguishing between the various components involved in token recognition and parsing.	Ар	P	Practical Assignment / Instructor- created exams / Quiz
CO2	Explain the roles of the syntax analyser and parser in the compilation process, including the significance of context-free grammars and the construction of parse trees.	Ар	Р	Practical Assignment / Instructor- created exams / Quiz
CO3	Apply basic parsing techniques, including top-down and bottom-up parsing methods, to analyze given grammars and demonstrate their implementations.	Ар	Р	Practical Assignment / Instructor- created exams / Quiz
CO4	Analyze and compare different parsing strategies, such as LL(1) and LR parsers, assessing their strengths and weaknesses in various contexts.	Ар	Р	Practical Assignment / Instructor- created exams / Quiz
CO5	Develop a small compiler that incorporates lexical analysis, syntax analysis, and code generation, implementing error handling and optimization strategies.	Ap	Р	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)	Mark
Ι		COMPILERS AND LEXICAL ANALYSIS	10	15
	1	Analysis of the source program - Analysis and synthesis	2	
		phases		
	2	Phases of a compiler, The grouping of Phases	2	
	3	Compiler writing tools. Bootstrapping.	2	
	4	Lexical Analysis: Parsing, Abstract stack machine, Role of	2	
		Lexical Analyser		
	5	Input Buffering, Specification of Tokens, Recognition of	2	
		Tokens.		
II		SYNTAX ANALYSIS	18	25
	6	Role of the Syntax Analyser, Role of the Parser	2	
	7	Context-free grammars, Prase Tree and Derivations, Eliminating Ambiguity	2	
	8	Basic Parsing Approaches – Eliminating left recursion, left factoring	3	
	9	Top Down parsing - Recursive Descent Parsing	2	
	10	Predictive Parsing – LL (1) Grammars	3	
	11	Bottom-up parsing -Handle Pruning - Shift Reduce Parsing - Operator Precedent Parsing	3	
	12	LR Parsers - SLR Parser- Canonical LR Parser - LALR Parser	3	
III	SE	MANTIC ANALYSIS AND INTERMEDIATE CODE GENERATION	10	15
	13	Syntax directed translation - Syntax directed definitions	2	
	14	S-attributed definitions, L-attributed definitions, Bottom- up evaluation of S-attributed definitions. Run-Time Environments	2	
	15	Source Language issues, Storage organization, Storage- allocation strategies.	2	
	16	Intermediate Code Generation - Intermediate languages, Graphical representations,	2	
	17	Three-Address code, Quadruples, Triples.	2	
IV	C	ODE OPTIMIZATION AND CODE GENERATION	10	15
	18	Code Optimization - Principal sources of optimization	2	
	19	Machine dependent and machine independent optimizations,	2	
	20	Local and global optimizations.	2	

	21	Code generation - Issues in the design of a code generator,	2	
	22	Target Language, A simple code generator.	2	
V		Phases of Compiler Design	12	
		 Learn the fundamentals of lexical analysis and parsing using Lex and Yacc, essential tools in compiler construction. Apply the concepts learned to develop a small compiler, 		
		progressively enhancing its functionality while implementing error handling and optimization strategies.		
		3. Apply the concept of Bootstrapping and its significance in compiler construction.		
		4. Understanding of run-time environments and storage allocation strategies.		
		5.Development of a simple code generator for translating intermediate code into target code.		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	1	2	2	2	-	3	2	1	-	2	-	1
CO 2	-	1	2	2	2	_	1	2	-	3	1	-	-
CO 3	1	1	2	3	3	-	-	-	3	-	3	1	1
CO 4	1	-	2	3	3	-	3	3	1	3	-	-	3
CO 5	1	-	2	2	2	-	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%)

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

Mapping of COs to Assessment Rubrics:

References:

1. Aho A.V., Ravi Sethi and D. Ullman. Compilers – Principles Techniques and Tools, Addison Wesley, 2006.

2. D.M. Dhamdhere, System Programming and Operating Systems, Tata McGraw Hill & Company, 1996.

3. Kenneth C. Louden, Compiler Construction – Principles and Practice, Cengage Learning Indian Edition, 2006.

4. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company,1984.

5. Compiler Design in C, Allen I. Holub, Prentice Hall (Software Series).

6. Crafting a Compiler with C, C. N. Fischer and R. J. LeBlanc, Pearson Education.

7. Allen I Holub, Compiler Design in C, 1st Edition, PHI Learning Pvt Ltd.

Programme	BCA				
Course Code	BCA8EJ404(2)				
Course Title	Mixed Reality				
Type of Course	Elective				
Semester	VIII				
Academic	400 - 499				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	4	-	-	60

BCA8EJ404(2) - Mixed Reality

Pre-requisites	No pre-requisites required
Course	This course explores the principles and applications of Mixed Reality-
Summary	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

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used				
CO1	Analyse key concepts and terminology related to virtual reality (VR) and augmented reality (AR), including definitions, history, and fundamental components.	U	С	Instructor- created exams / Quiz/Assignment/ Seminar				
CO2	Explain the human physiological and perceptual factors that influence the experience of virtual environments, including depth perception and motion perception.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar				
CO3	Apply geometric and optical principles to design and implement basic virtual worlds, incorporating light and shading models.	U	C	Instructor- created exams/ Quiz/Assignment/ Seminar				
CO4	Evaluate different tracking technologies used in AR and VR, analysing their characteristics, advantages, and limitations.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar				
CO5	Design and develop a VR or AR application that integrates navigation, interaction, and user interface considerations, demonstrating software engineering principles.	U	С	Instructor- created exams/ Quiz/Assignment/ Seminar				
* - Re # - Fa Metae	 * - 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		VR and AR	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	
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	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	_	-	_	-	_	3	-	1	-	2	-	3
CO 2	2	_	_	_	-	_	1	2	-	3	1	-	2
CO 3	2	2	-	_	-	-	-	-	3	-	3	1	-
CO 4	2	2	-	_	2	1	3	-	1	3	-	-	-
CO 5	1	-	_	_	2	_	1	-	-	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

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.

Programme	BCA								
Course Code	BCA8EJ404(3)	BCA8EJ404(3)							
Course Title	PRINCIPLES OF INFO	ORMATION S	SECURITY						
Type of Course	Elective								
Semester	VIII								
Academic	400-499								
Level									
Course Details	Credit	Lecture	Tutorial	Practical	Total Hours				
		per week	per week	per week					
	4	4	-	-	60				
Pre-requisites	6. Basic understandir	ng of comput	er networks						
Course	This course covers the	This course covers the essential concepts of computer security, including							
Summary	various security threats and attacks, as well as different wireless networks.								
	Also aimed at securit	y policies ,m	odels and sec	curity in curre	nt domain				

BCA8EJ404(3) - PRINCIPLES OF INFORMATION SECURITY

CO	CO Statement	Cognitive	Knowledge	Evaluation
001		Level*	Category#	I ools used
COI	Define concepts and terminology	U	C	Instructor-
	related to computer security, including			created exams /
	types of threats and access control			Quiz
	mechanisms, recall and define key			
	concepts and terminology related to			
	computer security, including types of			
GOO	threats and access control mechanisms.			T
CO2	Explain the various types of security	U	С	Instructor-
	policies and their significance in			created exams /
002	protecting information systems.	TT	C	Quiz
CO3	Apply knowledge of access control	U	C	Instructor-
	mechanisms to implement security			created exams /
	measures in operating systems and			Home
CO4	applications.	٨		Instructor
C04	Analyse software vulnerabilities and	А	P	Instructor-
	assess their impact on system security,			created exams /
	initiation and VSS			nome
COS	Design a communication account	٨	D	Instructor
COS	framework for a given application	A	P	instructor-
	integrating various security protocols			Lomo
	and policies to mitigate risks			
* D-	and poincies to initigate fisks.	n) Analyza (Ar	Evoluoto (E) Cr	assignments
Teatra	anember (K), Understand (U), Apply (A	p), Analyse (An (C)) D readed and (C)), Evaluate (E), Cr	eate (C)# -
Factua	ai Knowledge(F) Conceptual Knowledg	e(C) Procedural	Knowledge (P)	
wietac	cognitive knowledge (M)			

Detailed Syllabus

Module	Unit	Content	Hrs (48+12)	Mark
Ι		OVERVIEW OF COMPUTER SECURITY	10	16
	1	Introduction: Overview of computer security, Security concepts, Security concepts, Need of Security	2	
	2	Threats- Deliberate software attacks, Deviation in quality of service, Attacks- malicious code, brute force, Timing attack, sniffers	2	
	3	Access Control Mechanisms - Access Control, Access control matrix	2	
	4	Access control in OS-Discretionary and Mandatory access control	2	
	5	Role-based access control, case study SE Linux	2	
II		Security policies and models	10	18
	6	Three types of security policies: Concrete guidance on certain issues, strategic-high level blue prints, granular focus on particular systems	2	
	7	confidentiality policies	2	
	8	Bell-LaPadula model, Integrity policies	2	
	9	Biba model, Clark-Wilson models	2	
	10	Chinese wall model, waterfall model	2	
III		Software vulnerabilities	14	18
	11	Buffer and stack overflow	2	
	12	Cross site scripting(XSS), and vulnerabilities	2	
	13	SQL injection and vulnerabilities	2	
	14	Phishing	2	
	15	Third-party libraries	3	
	16	Web Services security: XML, SOAP, SAML, RFID	3	
IV		Security in current domains	14	18
	17	Wireless LAN security - WEP details.	3	
	18	wireless LAN vulnerabilities – frame spoofing.	2	
	19	Cellphone security - GSM and UMTS security	3	
	20	Mobile malware	3	
	21	bluetooth security issues.	2	
	22	Secure Electronics transactions: Framework, strength and weakness	1	
V		Current Security Trends	12	
		Case study: Security in current applications : Online banking , Credit Card Payment Systems.		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	2	-	1	-	1	-	2	-	2
CO 2	3	2	-	-	-	-	2	2	-	3	1	-	1
CO 3	1	2	-	-	-	-	-	-	3	-	3	1	2
CO 4	1	3	1	2	-	-	3	1	1	3	-	-	-
CO 5	1	3	1	2	-	-	1	-	-	-	2	-	-

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	\checkmark		\checkmark

CO 2	\checkmark		\checkmark
CO 3	\checkmark	\checkmark	\checkmark
CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

- 1. "Wireless Communications: Principles and Practice" by Theodore S. Rappaport.
- 2. "Wireless Communications and Networks" by William Stallings.
- 3. "Wireless Communications" by Andrea Goldsmith, Cambridge University Press, 2005.
- 4. Principles of Information Security By Michael E. Whitman and Herbert J. Mattord
- 5. Elementary Information Security By Richard E. Smith
- 6. Fundamentals of Information Systems Security By David Kim and Michael G. Solomon
- 7. Foundations of Information Security: A Straightforward Introduction By Jason Andress
- 8. Information Security: Principles and Practice By Mark Stamp
- 9. Management of Information Security By Michael E. Whitman and Herbert J. Mattord

Programme	BCA				
Course Code	BCA8EJ405(1)				
Course Title	Mastering Java Web	Developmen	t		
Type of Course	Elective				
Semester	VIII				
Academic	400 - 499				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	4	-	-	60
Pre-requisites	1. Knowledge in con	re concept of	Java Program	nming	
	2. Knowledge of dat	tabase conce	pt and SQL		
	3. Knowledge in bas	sic web conc	ept like HTM	L, CSS, Java	Script
Course	The aim of this course is to provide students with a thorough				
Summary	understanding of building dynamic web applications using Java				
	technologies. This c	ourse covers	essential co	oncepts, frame	eworks, and
	tools necessary for	developing 1	obust, scala	ole, and secu	re web
	applications.				

BCA8EJ405(1) - Mastering Java Web Development

СО	CO Statement	Cognitive	Knowledge	Evaluation
CO1	Explain and implement fundamental Core Java concepts, including classes, inheritance, constructors, exception handling, and multithreading, demonstrating their ability to build robust Java applications.	U	Category# C	Instructor- created exams / Home assignments
CO2	Demonstrate proficiency in using JDBC to execute SQL statements and manage transactions, effectively integrating database functionality into Java applications.	Ар	Р	Instructor- created exams / Home assignments
CO3	Apply their knowledge of JavaServer Pages (JSP) to create dynamic web applications, understanding the JSP lifecycle, syntax rules, and how to utilize JSP elements and standard actions for building user interfaces.	Ар	Р	Instructor- created exams / Home assignments
CO4	Design and implement web applications using the Spring MVC framework, covering project initialization, controller development, view design, form submission, validation, and exception handling, while understanding the advantages of the	Ар	Р	Instructor- created exams / Home assignments

	MVC architecture.			
CO5	Create and handle RESTful APIs and AJAX requests within Spring MVC applications, implementing real-time validation, server-side processing, and advanced techniques such as CORS and CSRF protection, culminating in a practical project that showcases their understanding of web development concepts.	Ар	Р	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)				

Module	Unit	Content	Hrs	Marks
-			(48+12)	2
I		Over View of Core Java	7	9
	1	Core Java Concept: Class, Inheritance, Constructor, Exception and Multithreading	3	
	2	Overview of JDBC: JDBC Concept, Execution of SQL Statements, Transaction Management	2	
	3	Introduction to Web Applications, Web Servers Overview of J2EE Technologies.	2	
II		Introduction to JSP	12	15
	3	Fundamental Concept of JSP: JSP & Servlet as Web Components, Servlets vs. JSP	2	
	4	Working with JSP: JSP Lifecycle, JSP Page Lifecycle Phases	2	
	5	General Rules of Syntax: JSP syntactic elements, JSP element syntax, Template content	3	
	6	JSP elements: Directives, Declarations, Expressions, Scriptlets, Actions	3	
	7	JSP Standard Actions: jsp:useBean, jsp:getPreoperty, jsp:setProperty, jsp:include, jsp:forward, jsp:plugin,jsp:param, Java Server Pages Standard Tag Library(JSTL).	2	
III		Introduction to Spring MVC	16	23
	8	Getting Started with Spring: Overview of the MVC Architecture, Spring Framework and its relevance in web development, Advantages and benefits of using Spring MVC for building web applications.	2	

Detailed Syllabus

	9	Initializing a Spring project with Spring Tool Suite: Simple Example and Sample example analysis, Spring Project Structure	2	
	10	Writing a Spring Application: Handling Web request, Defining the view, Testing the Controller, Building and Running application	2	
	11	Developing Web Application: Establishing the domain, creating the controller class, Designing the view, Form submission.	2	
	12	Working with View Controller: Declaring validation rule, Performing validation, Caching templates.	2	
	13	Working with Data: Working with JDBC, Defining the Schema and pre-loading data, Inserting data	2	
	14	Working with Spring Data JDBC: Adding Spring data JDBC, Defining the repository interface, Preloading data with CommandLineRunner	2	
	15	Exception Handling: Handling exceptions gracefully in Spring MVC applications, Implementing global exception handlers and custom error pages.	1	
	16	Securing Spring: Introduction to Spring Security, Configuring authentication, authorization, and access control.	1	
IV		Integrated Spring and AJAX	13	23
IV	17	Integrated Spring and AJAX Creating REST Service: Building RESTful APIs using Spring MVC controllers. Handling HTTP methods (GET, POST, PUT, DELETE) and request parameters.	13 2	23
IV	17	Integrated Spring and AJAX Creating REST Service: Building RESTful APIs using Spring MVC controllers. Handling HTTP methods (GET, POST, PUT, DELETE) and request parameters. Introduction to AJAX: Ajax Fundamentals, JavaScript Libraries, The Prototype Library, Technique Library, Form Completion	13 2 2 2	23
IV	17 18 19	Integrated Spring and AJAX Creating REST Service: Building RESTful APIs using Spring MVC controllers. Handling HTTP methods (GET, POST, PUT, DELETE) and request parameters. Introduction to AJAX: Ajax Fundamentals, JavaScript Libraries, The Prototype Library, Technique Library, Form Completion Validation: Realtime Validation, Propagating Client- Side View State, Direct Web Remoting	13 2 2 2 2 2	23
IV	17 18 19 20	Integrated Spring and AJAX Creating REST Service: Building RESTful APIs using Spring MVC controllers. Handling HTTP methods (GET, POST, PUT, DELETE) and request parameters. Introduction to AJAX: Ajax Fundamentals, JavaScript Libraries, The Prototype Library, Technique Library, Form Completion Validation: Realtime Validation, Propagating Client- Side View State, Direct Web Remoting Handling Ajax Requests in Spring MVC: Mapping Ajax request URLs using @RequestMapping annotations. Parsing request parameters and payloads in Spring MVC controllers. Implementing server-side processing logic for Ajax requests.	13 2 2 2 3	23
IV	17 18 19 20 21	Integrated Spring and AJAX Creating REST Service: Building RESTful APIs using Spring MVC controllers. Handling HTTP methods (GET, POST, PUT, DELETE) and request parameters. Introduction to AJAX: Ajax Fundamentals, JavaScript Libraries, The Prototype Library, Technique Library, Form Completion Validation: Realtime Validation, Propagating Client- Side View State, Direct Web Remoting Handling Ajax Requests in Spring MVC: Mapping Ajax request URLs using @RequestMapping annotations. Parsing request parameters and payloads in Spring MVC controllers. Implementing server-side processing logic for Ajax requests. Form Submission and Validation with Ajax: Submitting forms via Ajax requests in Spring MVC. Validating form inputs on the server-side usingSpring's validation framework. Displaying validation errors and messages to the user without page reloads.	13 2 2 2 3	23
IV	17 18 19 20 21 21 22	Integrated Spring and AJAXCreating REST Service: Building RESTful APIs using Spring MVC controllers. Handling HTTP methods (GET, POST, PUT, DELETE) and request parameters.Introduction to AJAX: Ajax Fundamentals, JavaScript Libraries, The Prototype Library, Technique Library, Form CompletionValidation: Realtime Validation, Propagating Client- Side View State, Direct Web RemotingHandling Ajax Requests in Spring MVC: Mapping Ajax request URLs using @RequestMapping annotations. Parsing request parameters and payloads in Spring MVC controllers. Implementing server-side processing logic for Ajax requests.Form Submission and Validation with Ajax: Submitting forms via Ajax requests in Spring MVC. Validation framework. Displaying validation errors and messages to the user without page reloads.Advanced Ajax Technique: Cross-Origin Resource Sharing, CSRF protection, Content Security Policy, caching, throttling, lazy loading	13 2 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	23
1	Discuss topics from the following:	8		
---	-----------------------------------------------------	---	--	
	Impact of Servlet			
	• The version of Spring MVC.			
	• Exception handling in Web Application.			
	• RESTful API.			
	 Basics of CRUD Operations 			
2	Project: Build a web application for library	4		
	management system using Spring MVC (Eg: Admin			
	Login, Inserting Book details, stock management,			
	Book issue, display book catelog)			

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	3	3	-	-	3	-	1	-	2	-	1
CO 2	1	-	3	3	-	-	1	2	-	3	1	-	1
CO 3	-	-	3	3	2	3	-	-	3	-	3	1	-
CO 4	-	-	2	3	-	-	3	-	1	3	-	3	-
CO 5	-	-	3	3	2	3	1	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	\checkmark			\checkmark
CO 2	\checkmark			\checkmark

CO 3	\checkmark	\checkmark	\checkmark
CO 4		\checkmark	\checkmark
CO 5		\checkmark	\checkmark

References:

- 1. Spring in Action, Sixth Edition by Craig Walls 2022
- Introducing Spring Framework 6: Learning and Building Java-based Applications with Spring
 2022 by Felipe Gutierrez, Joseph B. Ottinger
- 3. Pro Spring 3 (Expert's Voice in Spring) 2012 by Clarence Ho, Rob Harrop
- 4. Ajax: The Complete Reference by Thomas Powell

Programme	BCA							
Course Code	BCA8EJ405(2)							
Course Title	Social Network Anal	ysis						
Type of Course	Elective							
Semester	VIII							
Academic Level	400 - 499							
Course Details	Credit	Lecture	Tutorial	Practical	Total			
		per week	per week	per week	Hours			
	4	4	-	-	60			
Pre-requisites	Knowledge in Funda	imentals of E	Data Mining					
Course	The syllabus is prepa	ared with the	view of prep	aring the BSc	Computer			
Summary	Science Graduates to	o build a basi	c understand	ing of what so	cial network			
	analysis is and how i	it can be appl	ied. Topics c	overed includ	le network			
	structure and method	ls for social 1	network analy	ysis, link anal	ysis and			
	network community	detection, in	formation pro	opagation on t	the web and			
	some applications.							

BCA8EJ405(2) - Social Network Analysis

CO	CO Statement	Cognitiv	Knowledge	Evaluatio
		e	Category#	n Tools
		Level*		used

CO1 Define and explain key concepts in social network analysis, including its significance, research issues, and statistical properties, distinguishing between static and dynamic properties of networks.	U	С	Instructor- created exams / Quiz				
CO2 Apply random walk techniques on graphs to evaluate proximity measures, clustering, and semi supervised learning, demonstrating their ability to analyse social network structures and their implications in various applications	U	С	Instructor- created exams / Quiz				
CO3 Utilize core methods for community detection, including KL algorithms and Markov clustering, to identify and analyse communities in both static and dynamic networks, and address challenges related to heterogeneous and directed networks.	U	Р	Instructor- created exams / Quiz				
CO4 Implement various link prediction models, including feature-based and probabilistic approaches, and apply linear algebraic methods to calculate metrics such as Katz score, Hitting Time, and Rooted PageRank, to forecast potential connections in social networks.	U	С	Instructor- created exams / Case studies				
CO5 analyze social influence metrics and techniques for influence maximization in viral marketing contexts, integrating knowledge of social similarity and influence to design effective marketing strategies leveraging social network data.	U	Р	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	Hrs	Marks	
			(48+12)	
Ι		Introduction to Social Network Data Analytics	12	15
	1	Introduction to Social Network Analysis	2	-
	2	2		
	3	2		
	4	Static properties, Dynamic properties	3	-
	5	Challenges of Social Network Streams	3	
II		Random Walks in Social Networks	12	15
	6	Random walks on Graphics, Walks based on proximity measures	2	
	7	Other graph based proximity measures	1	
	8	Graph theoretic measures for semi supervised learning	3	-
	9	Clustering with random walk based measures	3	
	10	Applications in computer vision Text Analysis, Evaluation and datasets	1	
	11	Link prediction and data sources	2	
III		Community Discovery in Social Networks	12	20
	12	Communities in Context	2	
	13	Core Methods – KL Algorithm, Special algorithms	2	
	14	Markov Clustering, other approaches	2	
	15	Emerging Fields and problems: Community Discovery in dynamic networks	2	
	16	Heterogeneous networks Directed networks	2	
	17	Coupling content and relationship information for community	2	
	17	discovery	-	
IV		Link Prediction in Social Networks	12	20
	18	Background, Feature based Link Prediction, Bayesian Probabilistic Models	3	
	19	Probabilistic Relational Models	2	
	20	Linear Algebraic Methods	2	
	21	Link Predictions: The Katz Score, Hitting & Commute Time	2	
	22	Rooted PageRank, SimRank	3	
V		Social Influence Analysis	12	
	Infl	ience Related Statistics		
	Soc	al Similarity and Influence		
	Influ	ience Maximization in Viral Marketing		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	2	-	1	1	3	3	-	1	-	2	-	2
CO2	-	3	-	1	1	2	2	2	-	3	1	1	1
CO3	1	3	-	1	1	1	-	-	3	-	3	1	-
CO4	1	2	-	-	1	1	3	2	1	3	-	-	-
CO5	-	1	1	-	1	1	1	-	-	-	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
- Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

Reference:

1. Charu.C. Aggarwal, Social Network Data Analytics, Springer Science+Business Media, LLC 2011.

2. R. Zafarani, M. A. Abbasi, and H. Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014.

3. Krishna Raj P M, Ankith Mohan, K G Srinivasa, Practical Social Network Analysis with Python, Springer Liu, Bing. Web data mining. Springer-Verlag Berlin Heidelberg, 2007.

4. Chakrabarti, Soumen. Mining the Web: Discovering knowledge from hypertext data. Morgan Kaufmann, 2003.

5. Scime, Anthony, ed. Web mining: applications and techniques. IGI Global, 2005.

Programme	BCA						
Course Code	BCA8EJ406(1)						
Course Title	System Security						
Type of Course	Elective						
Semester	VIII						
Academic Level	400 - 499						
Course Details	Credit	Lecture	Tutorial	Practical	Total		
		per week	per week	per week	Hours		
	4	4	-	-	60		
Pre-requisites	Knowledge in Fundar	mentals of N	etwork and C	perating Syst	tem and COA		
Course	The syllabus is prepa	ared with the	e view of pre	eparing Bach	elor of Computer		
Summary	Application (BCA)	Application (BCA) Graduates to build effective an understanding of the					
	differences between	various form	s of compute	er system sec	urity, where they		
	arise, and appropriate	tools to ach	ieve them				

BCA8EJ406(1) - System Security

СО	CO Statement	Cognitiv e Level*	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts related to information security, including confidentiality, integrity, availability, and the principles of adequate protection.	U	С	Instructor-created exams / Quiz
CO2	Explain various security vulnerabilities and threats, including types of attacks on operating systems, databases, and networks, as well as the profiles of computer criminals.	U	С	Instructor-created exams / Quiz
CO3	Apply methods of defense and control mechanisms in security, such as hardware and software controls, to mitigate risks and vulnerabilities in computer systems.	U	Р	Instructor-created exams / Quiz

CO4	Analyze secure programming practices by identifying non- malicious program errors	U	С	Instructor-created exams / Case studies					
CO5	Evaluate the effectiveness of security policies and models in operating systems and databases, assessing requirements for integrity, confidentiality, and availability in multilevel database security.	U	Р	Instructor-created exams / Quiz Case studies					
* - Ren	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)# - Factual								
Knowle	edge(F) Conceptual Knowledge (C)	Procedural Know	ledge (P)						
Metaco	gnitive Knowledge (M)								

Detailed Syllabus

Module	Unit Content			Marks	
			(48+12)		
Ι		Notion of Different types of Securities	12	15	
	1	Information security - computer security - security goals, relation	3		
		between security, confidentiality, integrity, availability and			
		authorization, vulnerabilities - principles of adequate protection.	2		
	2	Notions of operating security, database security, program security,	3		
	3	The kind of problems intercention interruption modification	2		
	fabrication.				
	4	Computer criminals - amateurs, crackers, career criminals.	2		
	5	Methods of defence control, hardware controls, software controls, effectiveness of controls.	2		
II		Program Security	12	15	
	6	Secure programs - fixing faults, unexpected behaviour, types of flaws.	2		
	7	Non-malicious program errors - buffer overflows, incomplete	1		
	mediation.				
	8 Viruses and other malicious code - kinds of malicious code, how				
	viruses attach, how viruses gain control, prevention,				
	9	Control example - the brain virus, the internet worm, web bugs.	3		
	10	Targeted malicious code - trapdoors, Salami attack	1		
	11	Controls against program threats - development controls, peer reviews,	2		
		hazard analysis	10	20	
111	10	Operating System Security	12	20	
	12	Protected objects and methods of protection - memory address	2		
		protection - fence, relocation, base/bounds registers, taggedarchitecture,			
	12	segmentation, paging.	2		
	13	Control of access to general objects - directory, access control list	2		
	14	permissions	Z		
	15 Authentication authentication basics password authentication		2		
	10	process challenge - response, biometrics	-		
	16	Trusted operating systems - security policies for operating systems	2		
	17	Models of security - requirement of security systems. multilevel	2		
		security, access security, limitations of security systems			
IV		Database Security	12	20	

	18	Security requirements - integrity, confidentiality and availability of database	2	
	19	Reliability and integrity of database	2	
	20	Sensitive data, interface	3	
	21	Multilevel database	2	
	22	Proposals for multilevel database security	3	
V		Administrating security	12	
	Saa			

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	2	-	-	1	1	3	-	1	-	2	-	2
CO2	-	3	1	-	1	1	2	2	-	3	1	-	1
CO3	-	2	1	-	1	1	-	-	3	-	3	1	-
CO4	-	2	1	-	1	1	3	-	1	2	-	-	-
CO5	1	3	1	-	1	2	1	-	-	-	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
- Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

Reference:

1. C. P. Pfleeger and S. L. Pfleeger, Security in Computing, 4th Edition, Pearson India, ISBN: 9788131727256.

2. Matt Bishop, Computer Security: Art & Science, 1st Edition, Pearson, ISBN: 0201440997.

3. William Stallings, Cryptography and Network Security: Principles and Practice, 6th Edition, Pearson India, ISBN: 9332518777.

4. Michael E. Whitman and Herbert J. Mattord, Principles of Information Security, 4th Edition, Ceneage Learning India Pvt Ltd, ISBN: 8131516458.

Programme	BCA				
Course Code	BCA8EJ406(2)				
Course Title	Parallel Computing				
Type of Course	Elective				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	4	4	-	-	60
Pre-requisites	Knowledge in Funda	mentals of C	OA and Oper	ating System	

BCA8EJ406(2) - Parallel Computing

Course	The syllabus is prepared with the view of preparing the BSc Computer Science
Summary	Graduates to understand basic and advanced concepts of parallel
	computing. It covers Principles of Parallel Algorithm Design, Communication
	operations, Programming Using the Message Passing Paradigm, Programming
	Shared Address Space Platforms, Thread Basics,

СО	CO Statement	Cogni tive Leve	Knowledge Category#	Evaluation Tools used
CO1	Define key concepts and terminologies related to parallel processing platforms	l* U	С	Instructor-created exams / Quiz
CO2	Explain the characteristics of tasks and interactions in parallel computing	U	С	Instructor-created exams / Quiz
CO3	Apply basic communication operations in parallel programming, utilizing techniques such as broadcast, reduction, and scatter-gather operations to optimize data transfer	U	Р	Instructor-created exams / Quiz
CO4	Analyze and implement message-passing programming using the Message Passing Interface (MPI), focusing on principles like send/receive operations and overlapping communication with computation.	U	С	Instructor-created exams / Case studies
CO5	Evaluate parallel computing concepts, including heterogeneous computing and data parallelism, assessing their impact on performance and efficiency in parallel algorithm development.	U	Р	Instructor-created exams / Quiz Case studies
* - Re Factua Metac	emember (R), Understand (U), al Knowledge(F) Conceptual K cognitive Knowledge (M)	Apply (Ap), An Knowledge (C) P	alyse (An), Evaluate Procedural Knowledg	e (E), Create (C)# - ge (P)

Detailed Syllabus

Module	Un it	Content	Hrs (48+12)	Marks				
Ι	Princi	12	15					
	1	2	1					
	2	2	1					
	3	Mapping Techniques for Load Balancing	2	1				
	4	Methods for Containing Interaction Overheads						
	5	Parallel Algorithm Models.	3	1				
II	Comm	unication Operations	12	15				
	6	Basic Communication Operations - One-to-All Broadcast and All-to-One Reduction	2	-				
	7	All-to-All Broadcast and Reduction	1	-				
	8	All-Reduce and Prefix-Sum Operations	3	1				
	9	Scatter and Gather	3	-				
	10	1	1					
	11	2	-					
III	Progra	12	20					
	12	Principles of Message-Passing Programming, The Building Blocks: Send Operations	2	-				
	13	Receive Operations	2	-				
	14	MPI: The Message Passing Interface	2	-				
	15	Overlapping Communication with Computation	2	-				
	16	Collective Communication and Computation Operations	2	-				
	17	Groups and Communicators	2	-				
IV	Progra	amming Shared Address Space Platforms Thread Basics	12	20				
	18	Thread Basics, Why Threads? The POSIX Thread Application Programme Interface, Synchronization Primitives in POSIX, Controlling Thread and Synchronization Attributes	2	-				
	19	Thread Cancellation, Composite Synchronization Constructs	2	1				
	20	OpenMP: a Standard for Directive Based Parallel Programming, Specifying Concurrent Tasks in OpenMP	3					
	21	Synchronization Constructs in OpenMP	2	1				

	22 OpenMP Applications: Parallel algorithm development for Matrix multiplication	3							
V	Parallel Computing Concepts 12								
	Heterogeneous Parallel Computing								
	Data parallel computing								
	Device Global Memory and Data Transfer								
	Kernel Functions and Threading								

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	2	-	-	-	-	-	-	1	-	2	-	-
CO2	-	2	1	_	_	-	1	2	-	3	1	-	2
CO3	-	2	1	-	1	1	-	-	3	-	-	1	-
CO4	-	2	1	1	1	2	3	-	1	3	-	-	1
CO5	-	3	1	1	-	2	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
- Assignments (20%)
- Final Exam (70%)

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

Mapping of COs to Assessment Rubrics:

Reference:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, 2nd Ed, Addison-Wesley, 2003

2. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Handson Approach, 3rd Ed., Morgan Kaufman, 2016. References

3. Steven Brawer, Introduction to Parallel Computing, Academic Press, (1989)

4. Barbara Chapman, Gabriele Jost, Ruud van der Pas, Using OpenMP: Portable Shared Memory Parallel Programming, MIT Press, 2008.

Programme	BCA							
Course Code	BCA8EJ406(3)	BCA8EJ406(3)						
Course Title	ANDROID PROGRAM	/MING						
Type of Course	Elective							
Semester	VIII							
Academic	400-499							
Level								
Course Details	Credit	Lecture	Tutorial	Practical	Total Hours			
		per week	per week	per week				
			-	-	60			
Pre-requisites	Knowledge in OO &	Java Program	nming					
Course	This course covers the	e essential co	oncepts of an	droid develop	ment priciples			
Summary	to letting students deve	elop competer	nce and confid	lence in androi	d programming			
	and understand the enti	re Android A	pps Developm	ent Cycle, as v	well as it would			
	also enable the students to independently create Android Applications							

BCA8EJ406(3)- ANDROID PROGRAMMING

Course	Outcomes	(CO)	
Course	Outcomes	(UU)	

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used			
CO1	Define key concepts related to the Android operating system and its application development environment, including components, resources, and the structure of Android application.	U	C	Instructor- created exams / Quiz			
CO2	Explain the Android application lifecycle, including the activity lifecycle and how various components interact within an Android application	U	С	Instructor- created exams / Quiz			
CO3	Apply fundamental principles of UI development in Android by creating user interfaces using XML and code, and implementing common controls.	U	С	Instructor- created exams / Home assignments			
CO4	Analyze and implement data persistence techniques in Android applications, including the use of SharedPreferences and SQLite databases for storing and retrieving user data	A	Р	Instructor- created exams / Home assignments			
CO5	Evaluate the design and functionality of an Android application by conducting testing and debugging sessions, assessing the effectiveness of UI elements and data handling methods in a case study project.	A	Р	Instructor- created exams / Home assignments			
* - Re Factua Metac	* - Remember (R), Understand (U), Apply (Ap), Analyzed (An), Evaluate (E), Create (C)# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)						

Detailed Syllabus

Module		Unit	Hrs (48+12)	Mark
Ι		Android programming Environment	10	15
	1	Introduction to Android OS, Setting up the Android Application Development Environment	2	
	2	Creating, Testing and Debugging Applications, Android Stack,	2	
	3	Android applications structure, Activity life cycle,	2	
	4	Installing android development tools(ADT), Fundamental components,	2	

St. Thomas College (Autonomous), Thrissur

	5	Android virtual devices, Running on real device, Structure of android application, Application life	2	
II		Android resources	14	20
	6	Understanding android resources - String resources, Layout resources, Resource reference	4	
	7	syntaxDefining own resource IDsEnumerating keyandroid resources-string arrays, plurals, Colourresources, dimension resources, image resources	4	
	8	Understanding content providers - architecture of content providers, structure of android content URIs.	3	
	9	Understanding intents basics of intents, available intents, ACTION PICK,GET CONTENT, pending intents	3	
III		UI development and Common controls	14	20
	10	User interfaces development in android - building UI completely in code, UI using XML, UI in XML with code	3	
	11	Android common controls-	4	
	12	understanding adapters, adapter views, list view, grid view, spinner control, gallery control, styles and themes	4	
	13	Understanding layout managers	3	
IV		Menus, Fragments and Action bar	14	15
	14	Android Menus- Creation, Types, loading menu through XML file	4	
	15	15 Fragments in Android structure of fragment, fragment life cycle, fragment transaction and back stack, fragment		
	16	Using dialogs in android, implementing Action bar	3	
	17	Data persistence, shared preferences, SQLite	4	
V		Development of Android Application	12	
	Case \rightarrow Jav studio contr \rightarrow Da User	study : va based application Using eclipse/android visual o for app development with resources and common ols tabase based android app Which Contains Specific Interface and design Interface		

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	2	-	-	_	-	2	-	2	-	2	-	-
CO2	-	2	1	-	-	_	-	2	-	3	1	-	2
CO3	-	2	1	-	1	1	-	-	3	-	3	1	-
CO4	-	2	1	1	1	2	3	-	1	3	-	-	1
CO5	-	3	1	1	-	2	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
- Assignments (20%)
- Final Exam (70%)

Mapping of COs to A	Assessment Rubrics:
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	Internal Exam	Assignme nt	Project Evaluation	End Semester Examinations
CO 1	\checkmark			\checkmark
CO 2	\checkmark			\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4		\checkmark		\checkmark
CO 5		\checkmark		\checkmark

References:

- 1. SatyaKomatineni & Dave MacLean, Pro Android 4, Apress.
- 2. Retomeier, Professional Android 4 Application Development, Wrox.
- 3. ZigurdMednieks, Laird Dornin, G. Blake Meike, Programming Android, O'Reilly

General Foundation Courses

Multi-Disciplinary Course (MDC)

Programme	BCA						
Course Code	BCA1FM 105	BCA1FM 105					
Course Title	Digital Marketing						
Type of Course	MDC/MDE						
Semester	Ι						
Academic	100-199						
Level							
Course Details	Credit Lecture Tutorial Practical Total						
	per week per week Hours						
	3 3 - 45						
Pre-requisites	1. Basic Computer Literacy						
	2. Familiarity with Online Platforms						
Course	This course provides students with a foundational understanding of key						
Summary	concepts and techniques in the rapidly evolving field of digital marketing.						
	Through engaging lectures. Students will explore various digital						
	marketing channels, i	including sea	arch engine o	ptimization (S	SEO), social		
	media marketing, ema	ail marketing	g, and content	marketing.			

BCA1FM 105 – Digital Marketing

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the concept of digital marketing and its integration with traditional marketing	U	С	Instructor-Create Exams or Quiz
CO2	To understand customer value journey in digital context and behaviour of online consumers	А	Р	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.	А ,Е	Р	Discussions, Quizzes
CO5	To get overall idea in implementing basic digital marketing strategies to enhance	Ар	Р	Viva Voce Observation of

	online visibility and engagement.			practical skills
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* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive

Knowledge (M)

Modula	I Init	Content	Urc	Marks
Mouule	Umt	Content	ПГS (36±9)	1 VIAI KS
			(3017)	
Ι		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	

Detailed Syllabus		
	Detailed	Syllabus

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		Leveraging Trends in Digital marketing	9	
	1	Social 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	

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	\checkmark			\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark			\checkmark
CO 4	\checkmark			\checkmark
CO 5		\checkmark		\checkmark

References:

- 1. DeWald, R. (2021). Digital Marketing for Dummies.
- 2. Kotler, P., Kartajaya, H., & Setiawan, I. (2017). Marketing 4.0: Moving from

Traditional to Digital.

- Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation. Kogan Page Limited.
- 4. Kumar, S., & Kaur, S. (2020). Digital Marketing. Taxmanns.
- 5. Hill, R. (2024). Social Media Marketing 2024: Mastering New Trends & Strategies for Online Success.

Value-Added Course (VAC)

BCA4FV108 – Introduction to Cyber Laws

Programme	BCA						
Course Code	BCA4FV108						
Course Title	Introduction to Cyber	r Laws					
Type of Course	VAC						
Semester	IV	IV					
Academic	200-299						
Level							
Course Details	Credit Lecture Tutorial Practical Total						
	per week per week Hours						
	3 3 - 45						
Pre-requisites	1. Basic Computer Literacy						
	2. Familiarity with Online Platforms						
Course	Introduction to Cyber laws provides students with a foundational						
Summary	understanding of vari	ous concepts	S Cyber Crim	es and Cyber	laws against		
	them.						

CO	CO Statement	Cognitive	Knowledge	Evaluation Tools used				
		Level	Category#	1 oois useu				
CO1	To understand the concept of Cyber	U	С	Instructor-				
	Space, Cyber Crimes and cyber laws			Create Exams or Quiz				
CO2	To understand details of cybercrimes	А	Р	Discussions				
	and criminals		and Quizzes					
CO3 To examine various provisions in IT Act U F Instructor 2000 F Instructor or h assignment								
CO4	To Identify Intellectual Property right and E-commerce related issues.	A, E	Р	Discussions, Quizzes				
CO5	To get overall idea of cyber laws and	Ар	Р	Viva Voce				
	its enforcement mechanisms in India			Observation				
				ofpractical				
	skills							
* - Re	emember (R), Understand (U), Apply (Ap), Analyse (A	n), Evaluate (E), C	Create (C)				
# - Fa	ctual Knowledge(F) Conceptual Knowled	ge (C) Proced	lural Knowledge (l	P)				
Meta	cognitiveKnowledge (M)							

Module	Unit	Content	Hrs (36+9)	Marks
Ι		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			
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	India	n 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	Basic	s of IT law and its regulatory mechanisms	9	12

V		Cyber Crime in Social Media	9	
V		Cyber Crime in Social Media	9	
	17	Penalties and legal implications associated with cybercrimes under Indian law (basics only)	1	
	16	Understanding the process of reporting cyber crimes	2	-
	15	Overview of the Cyber Crime Investigation Cell (CCIC)	2	
	14	Regulatory Mechanisms and Enforcement	2	
	13	Key provisions of the Information Technology Act, 2000 related to cybercrimes and offenses	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	\checkmark			\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark			\checkmark
CO 4	\checkmark			\checkmark
CO 5		\checkmark		\checkmark

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	BCA					
Course Code	BCA6FV110					
Course Title	Business Intelligence	and Innovati	ion			
Type of Course	VAC					
Semester	VI					
Academic	300-399					
Level						
Course Details	Credit	Lecture	Tutorial	Practical	Total	
		per week	per week	per week	Hours	
	3	3	-	-	45	
Pre-requisites	1. Basic Understanding of Business Operations.					
	2. Foundational Knowledge of Data Analysis.					
	3. Awareness of I	T Infrastructu	re			
Course	This course offers a comprehensive exploration of Business Intelligence					
Summary	(BI), IT innovation, a	and startup co	ulture. It cove	ers fundamen	tal concepts,	
	tools, and strategies essential for navigating the modern business					
	landscape. Students delve into the importance of data-driven decision-					
	making and learn about data collection, analysis, and visualization					
	techniques. Addition	ally, the cou	rse delves in	nto the dynai	nics of	
	innovation ecosyste	ms, lean s	tartup meth	odologies, a	nd funding	
	strategies for entrepre	eneurial ventu	ures.		_	

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Acquire a comprehensive understanding of Business Intelligence and its applications	Ар	С	Instructor-Create Exams or Quiz
CO2	Students can implement data- driven decision-making processes in various business contexts.	E	С	Discussions and Quizzes
CO3	Develop customised Business Intelligence solutions tailored to specific organisational needs.	Ар	С	Instructor created exams or home assignments
CO4	Evaluate emerging trends and technologies in IT for potential business impact.	Ар	С	Discussions, Quizzes
CO5	Lead entrepreneurial initiatives by applying lean startup methodologies and securing	Ap	С	Viva Voce Observation of practical skills

funding.			
* - Remember (R), Understand (U), Apply	(Ap), Analyse	(An), Evaluate (E),	, Create (C)
# - Factual Knowledge(F) Conceptual Knowledge	owledge (C) Pro	cedural Knowledge	e (P)
Metacognitive Knowledge (M)	-	-	

Detailed Syllabus

Module	Unit	Content	Hrs (36+9)	Marks
		Introduction to Business Intelligence (BI)	9	
	1	Overview of Business Intelligence concepts, Business Intelligence technologies	2	
	2	Importance of Business Intelligence in Decision- making Processes	2	
Ι	3	Data-driven decision-making (Data Collection, Data Integration, Data Analysis, Data Visualisation, Decision Support), Benefits of Data-Driven Decision Making	2	10
	4	Tools and techniques for data collection, processing, and analysis	3	
		Exploring BI Tools and Applications	9	
	5	Application of Business Intelligence in different business domains	2	
п	6	Business Intelligence tools for Performance Monitoring (Tableau, Power BI, Qlik Sense, IBM Cognos Analytics, Oracle BI)	3	15
	7	Use of Business Intelligence tools for performance monitoring	2	
	8	Data visualization techniques	2	
		IT Entrepreneurship and Startup Culture	9	
	9	Innovation in IT and Startup Culture, Understanding Innovation Ecosystems	2	
Ш	10	Startup culture and lean startup methodology, Identifying opportunities for innovation in IT	2	
	11	Funding for Startups and Entrepreneurial Ventures, Sources of funding for startups	2	15
	12	Venture capital investment process, Bootstrapping strategies	1	
	13	Financial modelling and valuation techniques, Legal and regulatory considerations	2	
IV	IT	Innovation: Trends, Successes, and Challenges	9	10

	14	Innovations in IT, Entrepreneurial mindset and skills development	2	
	15	Emerging trends and technologies in IT	2	
	16	Case studies of successful IT innovations in India (Infosys, Tata Consultancy Services (TCS), Wipro Limited, HCL Technologies, Zoho Corporation)	3	
	17	Opportunities and challenges in adopting innovative technologies, Strategies for managing technological change.	2	
		BI Methodologies	9	
V		 Discuss from the following: Strategic Role of Business Intelligence. Next-generation Data Visualization Techniques and Tools. Understanding Innovation Ecosystems. Agile Methodologies and Lean Startup Principles for IT Innovation. Ethical Considerations in Data-driven Decision-making and Innovation Future Outlook: Anticipating Trends and Staying Ahead of the Curve 	9	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	3	2	1	-	-	-	-	1	-	2	-	1
CO 2	1	1	2	1	-	-	1	2	-	3	1	-	2
CO 3	-	3	1	1	-	-	-	-	3	-	3	1	-
CO 4	-	3	3	2	-	-	3	-	1	3	-	-	-
CO 5	-	1	3	3	1	-	-	-	-	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

Reference:

- 1. Business Intelligence Guidebook: From Data Integration to Analytics by Rick Sherman.
- 2. Business Intelligence: A Managerial Perspective on Analytics by Ramesh Sharda, Dursun Delen, and Efraim Turban.
- 3. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling by Ralph Kimball and Margy Ross.
- 4. Lean Analytics: Use Data to Build a Better Startup Faster" by Alistair Croll and Benjamin Yoskovitz.
- 5. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries.
- 6. Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist" by Brad Feld and Jason Mendelson.
- 7. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company" by Steve Blank and Bob Dorf.

Skill Enhancement Course (SEC)

Programme	BCA				
Course Code	BCA1FS111				
Course Title	Introduction to Comp	uters and Of	fice Automat	ion.	
Type of Course	SEC				
Semester	Ι				
Academic	100-199				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	3	3	-	-	45
Pre-requisites	Basic knowledge of co	omputers & I	Internet.		
Course	This course focuses	on the use	of computer	technology a	nd software
Summary	applications to automate routine office tasks and streamline business				
	processes. Students v	vill be able to	o use compu	ter technology	to enhance
	communication and d	lata managen	nent.		

BCA1FS111– Introduction to Computers and Office Automation

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamentals of computer Hardware and Software and Computer Networks.	U	С	Instructor- created exams / Quiz/ Assignment/ Seminar
CO2	Understand the fundamentals of word processing and its importance in office automation. Demonstrate proficiency in creating, editing, and formatting documents using word processing software. Explore advanced formatting options and features	Ap	Р	Practical Assignment / Instructor- created exams / Quiz
CO3	Understand the fundamentals of electronic spreadsheets and their role in data analysis, manipulation, and presentation. Demonstrate proficiencyin creating, saving, and editing workbooks and worksheets within electronic spreadsheet software. Utilize various data entry techniques. Handle operators in formulas and utilize a wide range of functions.	Ap	Р	Practical Assignment / Instructor- created exams / Quiz

CO4	Demonstrate proficiency in creating, manipulating, and enhancing slides within presentation software, including adding text, images, shapes, and multimedia elements. Expertise in utilizing organizational charts and various chart types to represent hierarchical structures and data trends effectively. Explore drawing tools to create custom shapes, diagrams, and illustrations.	Ар	Р	Practical Assignment / Instructor- created exams / Quiz	
CO5	To empower students to design and implement automation solutions inreal- world scenarios.	Ар	Р	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)					

Module	I Init	Content	Hrs	Marks
Mount	Omt	Content	(36+9)	IVIAI KS
I		Introduction To Computers	8	14
-	1	Types of Computers	1	
	2	Hardware: CPU, Input/Output Devices. Storage Devices, memory hierarchy, RAM, ROM, Secondary Memory, and Registers.	3	
	3	Software: Types of Software, computer languages, language translators, and Operating Systems.	2	
	4	Computer Networks: LAN, WAN, MAN, Client -Server	2	
II		Documentation Using a Word Processor (OpenOffice Writer / M.S. Word)	8	12
	5	Introduction to Office Automation, Word Processing Concepts - creating and editing documents, Formatting documents.	3	
	6	Finding and Replacing Text, Printing documents, Auto-text, Autocorrect, Spelling and Grammar Tools.	2	
	7	1		
	8	Advanced Features- Mail Merge, Macros, Tables, File Management, Printing, Styles, linking and embedding objects, Template.	2	
III		Electronic Spread Sheet (Open Office Calc/MS- Excel)	10	12
	9	Introduction to Spread Sheet, Spreadsheet Concepts, Creating, Saving, and Editing a Workbook.	2	
	10	Inserting, deleting worksheets, entering data in a Cell/Formula, Copying and moving data from selected Cells.	1	

Detailed Syllabus

	11	Handling Operators in Formula. Functions: Mathematical, Logical, Statistical Text Financial Date and Time Function Wizard	1	
	12	Formatting a Worksheet, Formatting Cells, and Changing Data alignments. Changing date, Character, Number, Currency format, Changing font.	2	
	13	Adding borders and colors, Printing Worksheets, Charts and graphs, creating previewing and modifying charts, Conditional Formatting, and Filters.	3	
	14	Advanced features – Pivot table & Pivot Chart, Linking and Consolidation	1	
IV		Presentation using (OpenOffice Impress/MS- Power Point)	10	12
	15	Presentations Creating Manipulating & Enhancing Slides	0	
	15	Fresentations, Creating, Manipulating & Enhancing Sindes.	2	
	16	Organizational Charts, Charts, Drawing objects, clip arts, Word Art, Layering art Objects.	4	
	13 16 17	Organizational Charts, Charts, Drawing objects, clip arts, Word Art, Layering art Objects. Inserting Animated Pictures or Accessing through Object, Inserting Recorded Sound Effect or In-Built Sound Effect.	4	
V	13 16 17	Organizational Charts, Charts, Drawing objects, clip arts, Word Art, Layering art Objects. Inserting Animated Pictures or Accessing through Object, Inserting Recorded Sound Effect or In-Built Sound Effect. Emerging Trends in Automation	2 4 4 9	
V	13 16 17 1	Organizational Charts, Charts, Drawing objects, clip arts, Word Art, Layering art Objects. Inserting Animated Pictures or Accessing through Object, Inserting Recorded Sound Effect or In-Built Sound Effect. Emerging Trends in Automation • Design and Implement Automation Solutions in real-world scenarios • Understand Future Trends in Automation	2 4 4 9 9	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	3	-	-	-	-	3	-	1	-	2	-	2
CO 2	3	2	-	-	3	-	-	2	-	3	-	-	1
CO 3	3	2	-	-	3	-	-	-	2	-	3	1	-
CO 4	3	2	-	-	3	-	3	-	1	3	-	-	-
CO 5	3	1	-	-	3	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- 1.P. K. Sinha and P. Sinha, "Foundations of Computing". BPB Publication.
- 2. Russell A. Stultz, Learn Microsoft Office, BPB Publication.
- 3.S. Sagman. "Microsoft Office 2000 for Windows". Pearson Education.
- 4. Turban, Mclean and Wetherbe. "Information Technology and Management John Weily and Sons.
- 5. H.M.Deitel, P. J. Deitel, et al., Internet & World Wide Web How to program, Prentice Hall.

Programme	BCA				
Course Code	BCA2FS112				
Course Title	Data Analysis using S	Spread Sheet			
Type of Course	SEC				
Semester	II				
Academic	100-199				
Level					
Course Details	Credit	Lecture	Tutorial	Practical	Total
		per week	per week	per week	Hours
	3	2	-	2	60
Pre-requisites	1. Familiarity with	Spreadsheet	Software.		

BCA2FS112 – Data Analysis using Spread Sheet

	2. Understanding of Basic Mathematical and Statistical Concepts
Course	After completing the course, students have a solid foundation in data
Summary	analysis using spreadsheets, empowering them to analyze data with
	confidence, derive meaningful insights, and communicate their findings
	effectively to stakeholders.

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will demonstrate proficiency in managing spreadsheets, including creating, formatting, and manipulating data within workbooks. They will be able to effectively navigate the spreadsheet interface and utilize toolbars.	Ар	Р	Instructor-Create Exams or Quiz
CO2	Learners will understand the importance of data organization and cleansing in spreadsheets. 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 datasets.	U	С	Discussions and Quizzes
CO3	Participants will acquire advanced data analysis skills like pivot tables, what-if analysis, and goal seek. They will be able to apply various spreadsheet functions and tools to perform complex calculations, analyze trends, and make informed decisions based on data analysis.	An	Р	Instructor created exams or Home assignments
CO4	Students will gain proficiency in data visualization techniques using spreadsheets. They will be able to create a variety of charts, design pivot charts, and dashboards for effective data analysis.	С	Р	Discussions, Quizzes
CO5	Learners will be able to implement form controls for interactive data manipulation in their visualizations, enhancing their ability to present and explore data dynamically.	Ар	Р	Viva Voce 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)

Module	Unit	Content	Hrs (30+30)	Marks	
	Introduction to Spreadsheet				
Ι	1	Overview of spreadsheet software (e.g., Microsoft Excel, Google Sheets), Basic spreadsheet navigation and interface	1	10	
	2	Entering and formatting data, Data types and cell formatting, Sorting and filtering data	2		
	3	Arithmetic operations and basic formulas, Common functions (SUM, AVERAGE, MIN, MAX, COUNT)	2		
	4	Text functions (CONCATENATE, LEFT, RIGHT, MID, TEXT), Date and time functions	2		
Π		Data Cleaning and Visualization	8		
	5	Logical functions (IF, AND, OR, NOT, IFERROR, IFS, SWITCH), Lookup and reference functions (VLOOKUP, HLOOKUP, INDEX, MATCH)	2	15	
	6	Financial functions (NPV, IRR, PMT), Array formulas (SUMPRODUCT, SUMIF, AVERAGE, TRANSPOSE, Array Multiplication, FILTER, IMPORTRANGE)	2		
	7	Handling missing values and duplicates, Data transformation techniques (text to columns, merging cells)	2		
	8	Using advanced text functions for data cleaning, Data validation rules and error-checking	1		
	9	Creating and customizing charts (bar, line, pie, scatter, Histogram), Conditional formatting for data visualization	1		
Ш	Pivot Tables and Pivot Charts				
	10	Sparklines and data bars, Advanced chart techniques (combination charts, dual-axis charts)	2	10	
	11	Creating and configuring pivot tables, Grouping and summarizing data in pivot tables	2		

Detailed Syllabus

	12	Creating and customizing pivot charts	2	
	13	Using slicers and timeline for interactive analysis	2	
	Data Analysis Technique			
IV	14	Descriptive statistics (mean, median, mode, standard deviation)	1	15
	15	Correlation and regression analysis with example, Data analysis tools (Solver, Analysis ToolPak)	2	
	16	Scenario analysis and what-if analysis (Goal Seek, Data Tables, Scenario Manager)	2	
	17	Introduction to DAX (Data Analysis Expressions) for complex calculations (Concept Only)	2	
	Practical Applications			
V	1	 Implement filter and sort operations. Perform basic Arithmetic operations (Sum, Difference, Product, Divides) Using a dataset of student grades in different subjects, calculate the average grade, highest grade (MAX), lowest grade (MIN), and the total number of grades recorded (COUNT). Create a spreadsheet with a list of full names in one column. Use text functions to separate the first names and last names into two new columns. Create a spreadsheet with a list of dates of birth and names. Using the appropriate date and time functions, calculate each person's current age. Perform Logical function on a given dataset. Using a dataset of students' information, create a bar chart to visualize the data. Customize the chart with titles, axis labels, and different colours for each bar. A list of 15 students with their hours of study per week and their corresponding exam scores, Use the CORREL function to Calculate the correlation coefficient. 	7	
9. Perform a simple linear regression to determine the relationship between advertising spend and sales.				
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10. Implement any one real life example.				

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	2	1	-	-	1	-	1	-	2	-	2
CO 2	1	-	2	1	-	-	-	2	-	3	1	-	-
CO 3	1	-	1	1	-	-	-	-	3	-	3	1	1
CO 4	2	-	3	2	-	-	3	-	-	3	-	-	-
CO 5	2	-	3	3	1	-	1	-	-	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark

CO 4	\checkmark	\checkmark	\checkmark
CO 5	\checkmark	\checkmark	\checkmark

References:

- 1. Alexander, M., Kusleika, R., & Walkenbach, J. (2018). Excel 2019 Bible. Wiley.
- 2. Winston, W. (2019). Microsoft Excel Data Analysis and Business Modeling. Microsoft Press.
- 3. Nigam, M. (2021). Data Analysis with Excel: Tips and Techniques. BPB Publications.
- 4. Alexander, M., & Kusleika, D. (2018). Excel 2019 Power Programming with VBA. Wiley.
- 5. McFedries, P. (2019). Excel Pivot Tables and Pivot Charts: Your visual blueprint for creating dynamic spreadsheets. Visual.

Programme	BCA									
Course Code	BCA3FS113									
Course Title	Website Designing us	Website Designing using Content Management System								
Type of Course	SEC									
Semester	III									
Academic	200-299									
Level										
Course Details	Credit	Lecture	Tutorial	Practical	Total					
		per week	per week	per week	Hours					
	2	2		2	(0)					
	3	2	-	2	60					
Pre-requisites	3 1. Familiarity with we	eb content m	- anagement sy	z (CMS)).					
Pre-requisites	31. Familiarity with we2. Basic knowledge	eb content m of internet to	- anagement sy echnologies 1	zystems (CMS) provides a for). undation for					
Pre-requisites	 Familiarity with we Basic knowledge learning web design. 	eb content m of internet to	- anagement sy echnologies	zystems (CMS) provides a for). undation for					
Pre-requisites Course	 Familiarity with we Basic knowledge learning web design. The course covers full 	eb content m of internet te	- anagement sy echnologies p veb design c	zystems (CMS) provides a for oncepts inclu). undation for ding HTML					
Pre-requisites Course Summary	 Familiarity with we Basic knowledge learning web design. The course covers fu and CMS principles, fi 	eb content m of internet to indamental v focusing on I	- anagement sy echnologies p veb design c Drupal as a ro	zystems (CMS) provides a for oncepts inclu bust Content I	b. undation for ding HTML Management					
Pre-requisites Course Summary	 Familiarity with we Basic knowledge learning web design. The course covers fu and CMS principles, fi System. Students with 	eb content m of internet to undamental v focusing on I ill learn to	- anagement sy echnologies p veb design c Drupal as a ro create and c	ystems (CMS) provides a for oncepts inclu bust Content I customize we	b. undation for ding HTML Management bsites using					
Pre-requisites Course Summary	 Familiarity with we Basic knowledge learning web design. The course covers fu and CMS principles, fi System. Students with Drupal, exploring its 	eb content m of internet to undamental w focusing on I ill learn to features such	- anagement sy echnologies p veb design c Drupal as a ro create and c as content ty	zstems (CMS) provides a for oncepts inclu bust Content I customize we ppes, themes, a	b. undation for ding HTML Management bsites using and modules					

BCA3FS113 – Website Designing using Content Management System

Course Outcomes (CO):

СО	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Cultivate a robust understanding of web design fundamentals, laying a strong	U	С	Assignment / Instructor-

	foundation for their journey into the dynamic world of digital design and development.			created exams / Quiz						
CO2	Attain comprehensive knowledge and practical proficiency in Content Management Systems (CMS), empowering to navigate and excel in the ever-evolving landscape of digital content creation and management.	U	C	Assignment / Instructor- created exams / Quiz						
CO3	Develop expertise in Drupal, a widely used CMS platform, gaining comprehensive understanding of its features, configuration, and installation processes, thus preparing them for proficient and innovative web development endeavors.	Ар	Р	Practical Assignment / Instructor- created exams / Quiz						
CO4	Impart a comprehensive understanding of website development using Drupal and facilitate the acquisition of expertise across various options within the Drupal ecosystem.	Ар	Р	Practical Assignment / Instructor- created exams / Quiz						
CO5	Gain an understanding of how to apply web design concepts to real-world scenarios, effectively designing and developing functional and aesthetically pleasing websites utilizing the Drupal CMS.	С	Р	Practical Assignment / Instructor- created exams / Quiz						
* - Re # - Fa	* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)									
Meta	cognitive Knowledge (M)		2							

Detailed Syllabus

Module	Unit	Content	Hrs	Marks
			(30+30)	
Ι		Introduction to Web Designing	6	10
	1	Basics of Web Designing -World Wide Web (WWW), W3C, Web	1	
		Browser		
	2	Web Server, Web Hosting, Web Pages, DNS, URL	2	
	3	3 Overview of HTML (Concept only) and its role in Web		
		Development		
	4	Open-Source S/W, Open-Source vs Closed Source Software, Open	2	

		Source Licenses (Concept only)		
II		Introduction to CMS	6	10
	5	Introduction to Content Management Systems (CMS) - Features of CMS	2	
	6	Web Content Management System	2	
	7	Components of Content Management System	2	
III		Introduction to Drupal	8	15
	8	Drupal - Features, Advantages and Disadvantages, Installation and Configuration	2	
	9	Content types and Field Drupal Architecture	2	
	10	User Management, Managing Comments	2	
	11	Creating and Customizing Themes	2	
IV		Building Website	10	15
	12	Website Development - Working with Templates and Template files	2	
	13	Articles, Creating Web Forms	1	
	14	Managing blocks, Add Links to Blocks, Moving Elements within Block	2	
	15	Blocks and Regions	1	
	16	Creating and Customizing Views, Installing and Configuring Modules	2	
	17	Static Pages, Creating Pages, Menu Management.	2	
\mathbf{V}		Practical	30	
		1. Install and configure Drupal on your computer.	30	
		2. Design a website of your college using Drupal and modify the basic site settings.		
		3. Add different menus to your website. The menus should		
		contain: home, news, gallery, about us and contact us.		
		4. Create user roles for your site and assign permissions.		
		5. Install and activate a new theme from the Drupal theme repository.		
		6. Add different blocks in to your website.		
		7. Create a new content type and add some fields to it.		
		8. Add new article to your site.		
		9. Install and configure the 'pathauto' module.		
		10. Create the mobile view of your website.		

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	3	1	1	3	1	3	-	1	-	2	-	1
CO 2	1	3	2	1	3	1	-	2	-	3	1	-	2

CO 3	1	3	1	1	3	2	3	-	1	-	2	-	-
CO 4	1	3	3	1	3	2	1	2	-	3	-	-	3
CO 5	3	3	3	1	3	2	-	-	3	-	3	1	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark
CO 5	\checkmark	\checkmark		\checkmark

References:

- 1. Jennifer Campbell, Jennifer T Campbell, Web Design: Introductory, Course Technology.
- 2. Jason Beaird and Alex Walker, The Principles of Beautiful Web Design, SitePoint.
- 3. Bob Boiko, Content Management Bible, Wiley.
- 4. Daniel Sipos, Drupal 9 Module Development, Packt Publishing Limited.

Programme	BCA						
Course Code	BCA5FS114	BCA5FS114					
Course Title	Professional Skill De	velopment fo	or IT Career E	Excellence			
Type of Course	SEC						
Semester	V						
Academic	300-399						
Level							
Course Details	Credit	Lecture	Tutorial	Practical	Total		
		per week	per week	per week	Hours		
	3	3	-	-	45		
Pre-requisites	1. Basic Mathem	natics					
	2. Basic English	reading and	Writing Skill	ls			
Course	The course provides	a comprehe	nsive overvie	ew of essentia	al skills and		
Summary	knowledge relevant	to success	in informatio	on technolog	y. It covers		
	various topics, inc	various topics, including personal development, communication,					
	quantitative reasonin	g, programn	ning, softwar	e developme	nt, and web		
	technologies.						

BCA5FS114 – Professional Skill Development for IT Career Excellence

Course Outcomes (CO):

CO	CO Statement	Cognitive	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	Category#	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	С	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.	Ар	С	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.	Ар	С	Assignment / Instructor- created exams / Quiz
CO5	Students will understand fundamental programming concepts, data	Ар	С	Assignment / Instructor-

structures, and database principles	,		created exams /			
and apply them to solv	e		Quiz			
computational problems and develo)					
software applications.						
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)						
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)						
Metacognitive Knowledge (M)						

Module	Unit	Content	Hrs (36+9)	Marks
	J	Introduction to Soft Skills and Academic Skills	10	
	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	
Ι	3	Job Interviews: Definition of Interview, Types of Interviews, Preparatory Steps for Job Interviews, Interview Skill Tips	2	15
	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	
		Basic Aptitude Skills	9	1
	6	Number System: HCF and LCM, Decimal Fraction, Problems on Age	2	l
II	7	Square Root, Cube Root, Problems on Numbers,	1	l
	8	Problems on Speed, Time and Distance, Percentage, Problems on Trains	2	15
	9	Profit and Loss, Ratio and Proportion, Partnership	2	1
	10	Simple Interest, Compound Interest, Chain Rule, Problems on Callender and Clock	2	
		Reasoning Skills Development	9	10

Detailed Syllabus

	11	Verbal Reasoning: Antonym and Synonym, Verbal Analogies, Spotting Errors, Ordering Words, Sentence correction, Fill in blanks, Replace the word, Idioms and Phrases	3	
III	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	
		Technical Skills and Programming Skills	8	
	14	Concept of Procedure-Oriented Programming and Object-Oriented Programming, Basic structure of C Programming	2	
IV	15	Data Structures: Array, Linked list, Stack, Queue, Tree and Graphs (Concept Only)	2	10
	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	
		Hands on Session on Skill Development	9	
V		 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. Writing Simple programming in any language. Assign students to research and analyse a realworld 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	PO7
CO 1	1	3	2	1	-	-	-	-	1	-	2	-	1
CO 2	1	1	2	1	-	-	1	2	-	3	1	-	2
CO 3	-	3	1	1	-	-	-	-	2	-	3	1	-
CO 4	-	3	3	2	-	-	3	-	1	-	-	-	-
CO 5	-	1	3	3	1	-	1	-	-	-	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	\checkmark	\checkmark		\checkmark
CO 2	\checkmark	\checkmark		\checkmark
CO 3	\checkmark	\checkmark		\checkmark
CO 4	\checkmark	\checkmark		\checkmark

CO 5	\checkmark	\checkmark	\checkmark

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.