Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur 440033

Scheme and Syllabus

Bachelor of Computer Applications

Submitted by

Board of Studies

Computer Science

FYUGP-Scheme I-VIII Semester
Bachelor of Computer Applications (Honors/Honors with Research)
(Bachelor of Computer Applications)
Four Year (Eight Semester Degree Course)

THE OBJECTIVES OF THE PROGRAM:

1. The primary objective of this program is to provide a foundation of computing principles for effectively using information systems and enterprise software.
2. It helps students analyze the requirements for system programming and exposes students for information systems.
3. This programme provides students with options to specialize in various software system.
4. To produce outstanding Computer Scientists who can apply the theoretical knowledge into practice in the real world and develop standalone live projects themselves.
5. To provide opportunity for the study of modern methods of information processing and its applications.
6. To develop among students the programming techniques and the problem-solving skills through programming.
7. To prepare students who wish to go on to further studies in computer science and related subjects.
8. To acquaint students to Work effectively with a range of current, standard, Office Productivity software applications.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

1. **Discipline knowledge:** Acquiring knowledge on basics of Computer Science and ability to apply to design principles in the development of solutions for problems of varying complexity.
2. **Problem Solving:** Improved reasoning with strong mathematical ability to Identify, formulate and analyze problems related to computer science and exhibiting a sound knowledge on data structures and algorithms.
3. **Design and Development of Solutions:** Ability to design and development of algorithmic solutions to real world problems.
4. **Programming a computer:** Exhibiting strong skills required to program a computer for various issues and problems of day-to-day scientific applications.
5. **Application Systems Knowledge:** Possessing a minimum knowledge to practice existing computer application software.
6. **Communication:** Must have a reasonably good communication knowledge both in oral and writing.
7. **Ethics on Profession, Environment and Society:** Exhibiting professional ethics to maintain the integrality in a working environment and have concern on societal impacts due to computer- based solutions for problems.
8. **Lifelong Learning:** Should become an independent learner. So, learn to learn ability.
9. **Motivation to take up Higher Studies:** Inspiration to continue educations towards advanced studies on Computer Science.

GENERAL COURSE STRUCTURE & CREDIT DISTRIBUTION

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hrs. Practical (P) per week	1 Credit

B. Course Code and definition:

Course Code	Definitions
TH	Theory
TU	Tutorial
P	Practical
DSC	Discipline Specific Courses
CC	Co-Curricular Courses
AEC	Ability Enhancement Courses
MDE	Multi-Disciplinary Elective course
IKS	Indian Knowledge System
VAC	Value added Courses
VEC	Value Education Courses
SEC	Skill Enhancement courses
DSE	Discipline Specific Elective
OE	Open Elective
OJT	On the Job Training
RP	Research Project

Course Name: Bachelor of Computer Applications, Bachelor of Computer Applications (Honors) and Bachelor of Computer Applications (Honors with Research)

Eligibility:

1) A student having a valid CET Score in BCA-CET or any other equivalent CET score and other norms laid down by AICTE/DTE from Time-to-time regarding admission process. **AND**
2) Any other Equivalent Examination of any State in (10+2) pattern with Science subjects, English and other Modern Indian Languages together **with Mathematics** or an examination recognized as

equivalent thereto in such subjects and with such standards of attainments as may be prescribed.

Course Level/Duration/System:

Undergraduate / Three or Four years/6 or 8 Semesters with multiple entry and exit. The following option will be made available to the students joining BCA Research Program:

- **One year**: Under Graduate Certificate in Computer Applications
- **Two years**: Under Graduate Diploma in Computer Applications
- **Three years**: Bachelor of Computer Applications (BCA)
- **Four years**: Bachelor of Computer Applications with Honors: BCA (Honors) or Bachelor of Computer Applications Honors with Research: BCA (Honors with Research)

Minimum Eligibility Criteria: Minimum eligibility criteria for opting the course in the fourth year will be as follows:

1. **BCA (Honors with Research):** Minimum 75% marks or equivalent CGPA in BCA Degree upto 6^{th} Semester.
2. **For BCA (Honors)**: BCA Degree

Note: The students who are eligible for BCA (Honors with Research) shall have choice to pursue either BCA (Honors) or BCA (Honors with Research).

SEMESTER WISE CREDIT DISTRIBUTION: Semester wise credit distribution of proposed BCA [BCA (Honors) and BCA (Honors with research)] program:

Semester	Discipline Specific Courses (DSC)	Ability Enhancement Courses (AEC)	Multi-Disciplinary Elective Course (MDE)	Indian Knowledge System (IKS)	Value Education Courses (VEC)	Skill Enhancement courses (SEC)	Value Added Course (VAC)	Discipline Specific Elective (DSE)	Co-Curricular Course (CC)	On the Job Training (OJT)	Research Project (RP)	Total
I	7	2	-	2	2	5	-	-	2	-	-	20
II	10	-	-	-	2	8	-	-	-	-	-	20
III	13	-	-	-	-	7	-	-	-	-	-	20
IV	15	-	-	-	-	4	1	-	-	-	-	20
V	2	-	-	-	-	-	-	15	-	4	-	21
VI	4	1	-	-	-	-	-	10	-	-	4	19
			BCA (Honors)									
VII	5	-	3	-	-	4	-	8	-	-	-	20
VIII	-	-	-	-	-	-	-	12	-	-	8	20
			BCA (Honors with Research)									
VII	6	-	-	-	-	-	-	10	-	4	-	20
VIII	-	-	-	-	-	-	-	-	-	-	20	20

3 Years BCA Program	**Total Credits = 120**
4 Years BCA (Honors) and BCA (Honors with Research)	**Total Credits = 160**

Note: Students can take extra credit course from their own department or from other department/university as per the Admitting Body / University norms.

STUDENT INDUCTION PROGRAM (SIP)

Student Induction Program (Mandatory)	
Induction Program for students to be offered right at the start of the first year.	• Physical Activity • Creative Arts • Universal Human Values • Literary • Basic of Information and Communication Technology • Proficiency Modules • Lectures by Eminent People • Visits to Local Areas • Familiarization to Department/Branch & Innovations

Mandatory Visits/ Workshop/Expert Lectures:

1. It is mandatory to arrange the industrial visits.
2. It is mandatory to conduct a workshop during the winter break after fifth semester on professional/ industry/ entrepreneurial orientation.
3. It is mandatory to organize at least one expert lecture from domain specific industry.

For Summer Internship / Projects / Seminar etc.

1. Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

Note: *The internal assessment is based on the student's performance in mid semester tests (two best out of three), quizzes, assignments, class performance, attendance, viva-voce in practical, lab record etc.*

Semester wise Structure and Curriculum for UG Course in BCA

Teaching and Examination Scheme

BCA Semester-I

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(TH)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Mathematics Foundation to Computer Science	BCA1T01	3	-	-	3	3	80	20	40	-	-	-
2	SEC	Problem Solving Techniques with C	BCA1T02	3	-	-	3	3	80	20	40	-	-	-
3	SEC	Problem Solving Techniques with C- **LAB/Practical 1**	BCA1P01	-	-	4	2	-	-	-	-	25	25	25
4	DSC	Basics of Computer Architecture	BCA1T03	3	-	-	3	3	80	20	40	-	-	-
5	DSC	Basics of Computer Architecture **LAB/Practical 2**	BCA1P02	-	-	2	1	-	-	-	-	25	25	25
6	AEC	English Compulsory	BAE1T01	2	-	-	2	3	50	50	40	-	-	-
7	VEC	Environmental Science	BVE1T01	2	-	-	2	3	80	20	40	-	-	-
8	IKS	Vedic Mathematics	BIK1T01	2	-	-	2	3	80	20	40	-	-	-
9	CC	Co-Curricular Courses (CC)	BCC1P01	-	-	4	2	-	-	-	-	-	100	50
10	AEC	Additional Course - Indian or Foreign Language Other than Mother Tongue and English (1-1- 0)) [optional course] *	BAE1T02	1	1	0	0*	2	-	50	20	-	-	-
Total				16	1	10	**20**		**450**	**200**		**50**	**150**	

Note 1: For Co-Curricular Courses (CC) - Refer Annexure – V (CC Basket)

2: Indian Languages: Sanskrit/Hindi/All Regional languages

Foreign Languages: (not limited to) Spanish/German/French/Korean/Mandarin etc.

(This is a non-credit course this course will not reflect in the marksheet of the student. If the student completes this course, then certificate for the same will be issued by the course conducting authority (College/Organization))

BCA Semester-II

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(TH)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Programming in C++	BCA2T04	3	-	-	3	3	80	20	40	-	-	-
2	DSC	Programming in C++ **LAB/Practical 1**	BCA2P03	-	-	4	2	-	-	-	-	25	25	25
3	DSC	Database Management System	BCA2T05	3	-	-	3	3	80	20	40	-	-	-
4	SEC	Data Structures	BCA2T06	3	-	-	3	3	80	20	40	-	-	-
5	SEC	Data Structures – **LAB/ Practical 2**	BCA2P04	-	-	4	2	-	-	-	-	25	25	25
6	DSC	Operating System and Linux	BCA2T07	2	-	-	2	3	80	20	40	-	-	-
7	SEC	Web Technologies	BCA2T08	2	-	-	2	3	80	20	40	-	-	-
8	SEC	Web Technologies – **LAB/ Practical 3**	BCA2P05			2	1	-	-	-	-	25	25	25
9	VEC	Constitution of India	BVE2T02	2	-	-	2	3	80	20	40	-	-	-
10	AEC	Additional Course - Indian or Foreign Language Other than Mother Tongue and English (1-1- 0)) [optional course] *	BAE2T03	1	1	0	0*	2	-	50	20	-	-	-
Total				16	01	10	**20**		**480**	**170**		**75**	**125**	

Note: Indian Languages: Sanskrit/Hindi/All Regional languages

Foreign Languages: (not limited to) Spanish/German/French/Korean/Mandarin etc

(This is a non-credit course this course will not reflect in the marksheet of the student. If the student completes this course, then certificate for the same will be issued by the course conducting authority (College/Organization))

After Year 1, Students are advised to take Social Responsibility & Community Engagement - encompassing Community Engagement with an NGO in the vacation time.

An UNDER GRADUATE CERTIFICATE IN COMPUTER APPLICATIONS will be awarded
If a student wishes to exit at the end of First year.

Exit Criteria after First Year of BCA Programme

Students will have the option to exit the Bachelor of Computer Applications (BCA) program after successfully completing the first year. Upon exit, they will be awarded a **UG Certificate in Computer Applications**. To be eligible for this certificate, students must complete an additional 04 credits in one of the following areas:

1. **Skill-Based Subject**: A course designed to enhance practical and technical skills in the field of computer applications.
2. **Work-Based Vocational Course**: A vocational course offered during the summer term that emphasizes hands-on training and workplace readiness.
3. **Internship/Apprenticeship**: A professional internship or apprenticeship program in a relevant field, with a minimum duration of 08 weeks, which will take place after the second semester.
4. **Social Responsibility & Community Engagement**: Active engagement with an NGO or community organization for a minimum duration of 08 weeks, focusing on real-world problem-solving, social responsibility, and community service.

The respective University/Admitting Body will determine the mode and specifics of these additional credits, and students will be required to complete the 08-week program during the summer term following their second semester.

The exiting students will clear the subject / submit the Internship Report as per the University schedule.

Re-entry Criteria in to Second Year (Third Semester)

The student who takes an exit after one year with an award of certificate may be allowed to re-enter in to Third Semester for completion of the BCA Program as per the respective University /Admitting Body schedule after earning requisite credits in the First year.

BCA Semester-III

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(TH)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Object Oriented Programming using JAVA	BCA3T09	3	-	-	3	3	80	20	40	-	-	-
2	DSC	Object Oriented Programming using JAVA-LAB/**Practical 1**	BCA3P06	-	-	4	2	-	-	-	-	25	25	25
3	DSC	Probability and Statistics	BCA3T10	2	-	-	2	3	80	20	40	-	-	-
4	SEC	Python Programming	BCA3T11	3	-	-	3	3	80	20	40	-	-	-
5	SEC	Python Programming-LAB/**Practical 2**	BCA3P07	-	-	4	2		-	-	-	25	25	25
6	DSC	Software Engineering	BCA3T12	2	-	-	2	3	80	20	40	-	-	-
7	DSC	Basics of Data Analytics using Spreadsheet	BCA3T13	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Basics of Data Analytics using Spreadsheet- LAB/ **Practical 3**	BCA3P08	-	-	4	2	-	-	-	-	25	25	25
9	SEC	SQL and PL/SQL	BCA3P09	-	-	4	2		-	-	-		50	25
Total				12	-	16	**20**		**400**	**100**		**75**	**125**	

BCA Semester-IV

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(TH)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Artificial Intelligence	BCA4T14	3	-	-	3	3	80	20	40	-	-	-
2	DSC	Artificial Intelligence **LAB/Practical 1**	BCA4P10	-	-	4	2	-	-	-	-	25	25	25
3	DSC	Computer Networks	BCA4T15	2	-	-	2	3	80	20	40	-	-	-
4	DSC	PHP	BCA4T16	3	-	-	3	3	80	20	40	-	-	-
5	DSC	PHP **LAB/Practical 2**	BCA4P11	-	-	4	2	-	-	-	-	25	25	25
6	DSC	Design and Analysis of Algorithm	BCA4T17	3	-	-	3	3	80	20	40	-	-	-
7	SEC	Data Visualization	BCA4T18	2	-	-	2	3	80	20	40	-	-	-
8	SEC	Data Visualization-LAB/ **Practical 3**	BCA4P12			4	2					25	25	25
9	VAC	Design Thinking and Innovation	BCA4P13	-	-	2	1	-					50	25
Total				13		14	**20**		**400**	**100**		**75**	**125**	

Note: For Design Thinking and Innovation –

- Students should choose the topic from the syllabus.
- Seminar will be conducted on chosen topic.
- Student will prepare short report.
- Marks will be allotted according to the performance of student.

Students can choose their specialization i.e. Stream with Discipline Specific Elective [DSE] from Third year onwards as indicated in Appendix – I.

Exit Criteria after Second Year of BCA Programme

Students will have the option to exit the Bachelor of Computer Applications (BCA) program after successfully completing the second year. Upon exit, they will be awarded a **UG Diploma in Computer Application**. To be eligible for this diploma, students must complete an additional 04 credits in one of the following areas:

1. **Skill-Based Subject**: A specialized course aimed at enhancing technical and practical expertise in computer applications.
2. **Work-Based Vocational Course**: A vocational course offered during the summer term, focused on building practical, industry-relevant skills.
3. **Internship/Apprenticeship**: A professional internship or apprenticeship with a minimum duration of 08 weeks, conducted after the fourth semester, offering hands- on experience in a relevant field.
4. **Social Responsibility & Community Engagement**: Involvement with an NGO or community-based organization for a minimum of 08 weeks, contributing to social initiatives and applying computer application knowledge to solve real-world challenges.
5. **Capstone Project**: Completion of a capstone project integrating the skills and knowledge gained during the first two years of the program, which can be an independent or group project.

The respective University/Admitting Body will decide the specific mode of completing the additional credits, and students will be required to complete the 08-week program or project during the summer term following their fourth semester.

Students opting for this exit will also be required to **submit an Internship/Apprenticeship Report** or complete the Capstone Project as per the schedule outlined by the University/Admitting Body before they are awarded the UG Diploma.

Re-entry Criteria in to Third Year (Fifth Semester)

The student who takes an exit after second year with an award of Diploma may be allowed to re-enter into fifth Semester for completion of the BCA Program as per the respective University / Admitting Body schedule after earning requisite credits in the Second year.

BCA Semester-V

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(TH)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSE	Professional Elective – I	BCA5T19	3	-	-	3	3	80	20	40	-	-	-
2	DSE	Professional Elective – I **Lab/Practical-1**	BCA5P14	-	-	4	2	-	-	-	-	25	25	25
3	DSE	Professional Elective – II	BCA5T20	3	-	-	3	3	80	20	40	-	-	-
4	DSE	Professional Elective – II **Lab/Practical-2**	BCA5P15			4	2					25	25	25
5	DSE	Professional Elective – III	BCA5T21	3	-	-	3	3	80	20	40	-	-	-
6	DSE	Professional Elective – III **Lab/Practical-3**	BCA5P16	-	-	4	2	-	-	-	-	25	25	25
7	DSC	Quantitative Techniques	BCA5T22	-	2	-	2	-	-	-	-	-	50	25
8	OJT	Internship/Capstone Project	BOJ5P01	-	-	8	4	-	-	-	-	100	100	100
9	RP	Major Project [Evaluation in sixth Semester]	BRP5P01	-	-	-	-	-	-	-	-	-	-	-
Total				**09**	**2**	**20**	**21**	**-**	**240**	**60**	**-**	**175**	**225**	**-**

BCA Semester-VI

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(TH)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Generative AI	BCA6T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Generative AI **Lab/Practical-1**	BCA6P17	-	-	4	2	-	-	-	-	25	25	25
3	DSE	Professional Elective -IV	BCA6T24	3	-	-	3	3	80	20	40	-	-	-
4	DSE	Professional Elective – IV **Lab/Practical-2**	BCA6P18	-	-	4	2	-	-	-	-	25	25	25
5	DSE	Professional Elective – V	BCA6T25	3	-	-	3	3	80	20	40	-	-	-
6	DSE	Professional Elective – V **Lab/Practical-3**	BCA6P19	-	-	4	2	-	-	-	-	25	25	25
7	AEC	Soft Skills	BAE6P04	-	1	-	1	-	-	-	-	-	50	25
8	RP	Major Project [Initiated in 5th Semester]	BRP6P02	-	-	8	4	-	-	-	-	100	100	100
Total				8	1	20	**19**		**240**	**60**		**175**	**225**	

1. BACHELOR OF COMPUTER APPLICATIONS Degree will be awarded, if a student wishes to exit at the end of Third year.

Exit Criteria after Third Year of BCA Programme

The students shall have an option to exit after 3rd year of Computer Application Program and will be awarded with a Bachelor of Computer Applications (BCA).

Re-entry Criteria in to Fourth Year (Seventh Semester)

The student who takes an exit after third year with an award of BCA may be allowed to re-enter in to Seventh Semester for completion of the BCA (Honors) or BCA (Honors with Research) Program as per the respective University / Admitting Body schedule after earning requisite credits in the Third year.

Minimum Eligibility Criteria: Minimum eligibility criteria for opting the course in the fourth year will be as follows:

1. **BCA (Honors with Research):** Minimum 75% marks or equivalent CGPA in BCA Degree upto 6th Semester.
2. **For BCA (Honors)**: BCA Degree

SEMESTER VII - (BCA (Honors))

Specialization – AI & ML

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(TH)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	MDE	Social Network Analysis	BMD7T01	3	-	-	3	3	80	20	40	-	-	-
2	DSC	Optimization of ML	BCA7T26	3	-	-	3	3	80	20	40	-	-	-
3	DSC	Optimization of ML **Lab/Practical-1**	BCA7P20	-	-	4	2	-	-	-	-	25	25	25
4	DSE	Professional Elective – VI	BCA7T27	3	-	-	3	3	80	20	40	-	-	-
5	DSE	Professional Elective – VI **Lab/Practical-2**	BCA7P21	-	-	4	2	-	-	-	-	25	25	25
6	DSE	Professional Elective– VII	BCA7T28	3	-	-	3	3	80	20	40	-	-	-
7	RP	Dissertation work [Evaluation in Eight Semester]	BRP7P03	-	-	-	-	-	-	-	-	-	-	-
8	OJT	Summer Internship II	BOJ7P02	-	-	8	4	-	-	-	-	100	100	100
Total				12	-	16	**20**		**320**	**80**		**150**	**150**	

SEMESTER VII - (BCA (Honors))

Specialization – Data Science

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(TH)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	MDE	Advanced Statistical methods for Data Science	BMD7T02	3	-	-	3	3	80	20	40	-	-	-
2	DSC	Python for Data Science	BCA7T26	3	-	-	3	3	80	20	40	-	-	-
3	DSC	Python for Data Science **Lab/Practical-1**	BCA7P20	-	-	4	2	-	-	-	-	25	25	25
4	DSE	Professional Elective – VI	BCA7T27	3	-	-	3	3	80	20	40	-	-	-
5	DSE	Professional Elective – VI **Lab/Practical-2**	BCA7P21	-	-	4	2	-	-	-	-	25	25	25
6	DSE	Professional Elective – VII	BCA7T28	3	-	-	3	3	80	20	40	-	-	-
7	RP	Dissertation work [Evaluation in Eight Semester]	BRP7P03	-	-	-	-	-	-	-	-	-	-	-
8	OJT	Summer Internship II	BOJ7P02	-	-	8	4	-	-	-	-	100	100	100
Total				12	-	16	**20**		**320**	**80**		**150**	**150**	

BCA SEMESTER VIII - (Honors)

(For Specialization AI-ML & Data Science)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(TH)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSE	Professional Elective – VIII	BCA8T29	3	-		3	3	80	20	40	-	-	-
2	DSE	Professional Elective – VIII **Lab/Practical 1**	BCA8P22	-	-	4	2	-	-	-	-	25	25	25
3	DSE	Professional Elective – IX	BCA8T30	3	-	-	3	3	80	20	40	-	-	-
4	DSE	Professional Elective – IX **Lab/Practical 2**	BCA8P23	-	-	4	2	-	-	-	-	25	25	25
5	DSE	Professional Elective – X	BCA8T31	2	-	-	2	3	80	20	40	-	-	-
6	RP	Dissertation work [Started in Seventh Semester]	BRP8P04	-	-	16	8	-	-	-	-	100	100	100
Total				8	-	24	**20**		**240**	**60**		**150**	**150**	

BCA SEMESTER VII - (Honors with Research)

SN	Cours Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(TH)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Advanced Data Analysis Tools	BCA8T32	-	2	-	2	3	80	20	40	-	-	-
2	DSE	Advanced Data Analysis Tools **Lab/Practical 1**	BCA8P24	-	-	4	2	-	-	-	-	25	25	25
3	DSC	Research Methodology	BCA8T33	2	2	-	4	3	80	20	40	-	-	-
4	DSE	Professional Elective – VII	BCA8T28R	2	2	-	4	3	80	20	40	-	-	-
5	DSE	Professional Elective – VIII	BCA8T29R	2	-	-	2	3	80	20	40	-	-	-
6	DSE	Professional Elective – VIII **Lab/Practical 2**	BCA8P22R	-	-	4	2	-	-	-	-	25	25	25
7	OJT	Research Internship Report and Viva –Voce	BOJ8P03	-	-	8	4	-	-	-	-	100	100	100
Total				6	6	16	**20**		**320**	**80**		**150**	**150**	

BCA SEMESTER VIII- (Honors with Research)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(TH)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	RP	Project Work Full Time	BRP8P04	-	-	-	16	-	-	-	-	200	200	200
2	RP	Seminar	BRP8P05	-	-	-	4	-	-	-	-	100	100	100
Total							**20**					**300**	**300**	

*****The Dissertation work will start from the beginning of fourth year of BCA (Honors with Research) Program. Students of Fourth Year shall be assessed for Project Work and Research Internship Report and Viva –Voce and Dissertation (For Research Track)

Proposed Streams with Discipline-Specific Electives (DSE)

Appendix-I

1. Artificial Intelligence & Machine Learning

Sr. No	Course Category	Semester	Course Code	Name of the Professional Elective
1	Elective-I	V	BCA5T19	Neural Network
2	Elective-II	V	BCA5T20	Digital Image Processing
3	Elective-III	V	BCA5T21	Natural Language Processing
4	Elective-IV	VI	BCA6T24	Deep Learning for Computer Vision
5	Elective-V	VI	BCA6T25	Predictive Analysis
6	Elective-VI	VII	BCA7T27	Explainable AI
7	Elective-VII	VII	BCA7T28	Evolutionary Algorithm
8	Elective-VIII	VIII	BCA8T29	Speech Recognition
9	Elective-IX	VIII	BCA8T30	Augmented Reality & Virtual Reality
10	Elective-X	VIII	BCA8T31	Security aspects of ML

2. Data Science

Sr. No	Course Category	Semester	Course Code	Name of the Professional Elective
1	Elective-I	V	BCA5T19	Introduction to Data Science
2	Elective-II	V	BCA5T20	Time Series Analysis
3	Elective-III	V	BCA5T21	Machine Learning
4	Elective-IV	VI	BCA6T24	Big Data Analytics
5	Elective-V	VI	BCA6T25	Exploratory Data Analysis
6	Elective-VI	VII	BCA7T27	Business Intelligence & Analytics
7	Elective-VII	VII	BCA7T28	Data Mining & Warehousing
8	Elective-VIII	VIII	BCA8T29	Advanced Data Visualization
9	Elective-IX	VIII	BCA8T30	Cloud Computing for Data Analytics
10	Elective-X	VIII	BCA8T31	Data Security & Privacy

SEMESTER – I

BCA Semester-I

DSC (Paper I)

BCA1T01

MATHEMATICS FOUNDATION TO COMPUTER SCIENCE

Credits: 3 **Duration: 45 Hours**

Course Objectives:

1 To cover certain sets, functions, relations and groups concepts for analyzing problems that arise in engineering and physical sciences.

2 To imparting to analyze the problems connected with combinatorics and Boolean algebra.

3 To solve calculus and integral calculus problems.

Course Outcomes:

1. Observe the various types of sets, functions and relations.
2. Understand the concepts of group theory.
3. Understand the concepts of combinatorics.
4. Understand the concepts of graph theory and its applications.
5. Learning logic and Boolean algebra. Using these concepts to solve the problems

UNIT I

Mathematical Logic: Propositional Calculus: Connectives, statement formulas and truth tables, well-formed formulas, Tautologies, Equivalence of formulas, duality law, Tautological Implications, functionally complete set of connectives, other connectives. **Normal Forms**: CNF, DNF, PCNF, PDNF.

UNIT II

Fundamentals: Sets and Subsets, operations on sets, sequences, Division of the integer, Matrices, Methods of Proof, Mathematical Induction. **Counting**: Permutations, Combinations, The pigeonhole Principle, Recurrence Relations.

UNIT III

Relations and Digraphs: Product sets and Partitions, Relations and Digraphs, Paths in Relations and Digraphs, Properties of Relations, Equivalence Relations, Operations of Relations, Transitive Closure and Warshall's Algorithms. **Functions**: Definition and Introduction, Permutation Functions, Growth of Functions.

UNIT IV

Order Relations and Structures: Partially Ordered Sets, Lattices. **Graph Theory:** Basic Concept of Graph Theory, Euler Paths and Circuits, Hamiltonian Paths and Circuits. **Tree**: Introduction, Undirected Tree, Minimal Spanning Trees. **Semigroups and Groups:** Binary Operations Revisited, Semigroups, Products and Quotients of Groups.

Books

1. Discrete Mathematical Structures By Bernard Kolman, Busby & Sharon Ross [PHI].
2. Discrete Mathematical Structures with Application to computer science By J. P. Tremblay & R. Manohar [Tata McGraw –Hill]
3. Discrete Mathematics with Graph Theory by Goodaire[PHI]
4. Discrete Mathematics by J.K.Sharma(McMillan)
5. Discrete Mathematics and its Applications by Kenneth Rosen (TMH)

BCA Semester-I

SEC (Paper II)
BCA1T02
PROBLEM SOLVING TECHNIQUES WITH C

Credits: 3 **Duration: 45 Hours**

Course Objectives:

1.To formulate simple algorithms for arithmetic and logical problems.
2.To translate the algorithms to programs (in C language).
3.To test and execute the programs and correct syntax and logical errors.
4.To implement conditional branching, iteration and recursion.
5.To implement operations on arrays, strings , structures, unions , functions and file handling.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Write simple algorithms for arithmetic and logical problems.
2. Write the C code for a given problem
3. Perform input and output operations using programs in C
4. Write programs that perform operations on arrays, strings , structures, unions , functions and file handling.

UNIT I

Programming Structure: Sequence, Selection, Iteration and Modular. Problem Solving techniques: Development Tools: Algorithm, Flowcharts and Pseudo code (Definition and its characteristics) Developing Algorithm and Drawing flowcharts

UNIT II

C Character set, Tokens, Data types, **Operators and Expressions:** Arithmetic, Relational, Logical, Bit-Wise, Increment, Decrement, Conditional and Special operators. typedef, Type Conversion, Constants, Declaring Symbolic Constants, Character Strings, Enumerated Data Types, Operator Precedence and Associativity. Library functions: Maths, string handling Functions. Control Structure: Compound Statement, Selection Statement: if, if-else, Nested if, switch. Iteration statement: for, while, do...while, Nested loops, Jump statements: break, continue, goto (Special emphasis on problem solving)

UNIT III

Arrays: Need, Types: Single and Two Dimensional Array. Strings: Strings Manipulation, Arrays of Strings, Evaluation order

Function: Function Components, Return Data type, Parameter Passing, Return by Reference, Default Arguments, Recursive Functions, Arrays with Functions, Storage Classes. (Special emphasis on problem Solving)

UNIT IV

Structure: Declaration, Definition, Accessing structure members, Initialization, Nesting of Structures. Union: Unions, Differences between Structure and Union. Pointer: Introduction, Address Operator (&), Pointer variables, void pointers, Pointer Arithmetic, Pointers to Pointers. File handling: Hierarchy of File Stream Classes, Opening & closing a file, Testing for errors, File Modes, File pointers and their manipulations, Sequential Access, Random Access, Command Line arguments.

Books :

1. The Art of programming through flowcharts & algorithm by Anil B. Chaudhari Firewall Media, Laxmi publication, New Publication.
2. Programming in C by E. Balagurusamy TMH Publications.

3. C Programming – Kernighen Ritche
4. Programming with C – Y. Kanetkar.
5. C Programming – Holzner, PHI Publication.
6. Programming in C – Ravichandran.

Credits: 2 **PRACTICAL LIST (BCA1P01)** **Duration: 60 Hours**

1. Write a Program in c to find largest of three numbers.
2. Write a Program in c to print Fibonacci Series up to n terms.
3. Write a Program in c to find if a number is prime or not.
4. Write a Program in c to find sum of digits of any entered number.
5. Write a Program in c to reverse the digit.
6. Write a Program in c to find frequency of occurrence of a given number from array of N elements.
7. Write a Program in c to insert an element in one dimensional Array at a given position.
8. Write a Program in c to delete an element from one dimensional array.
9. Write a Program in c to sort array elements using Bubble Sort.
10. Write a Program in c to search the element in an array of N elements using Linear Search method.
11. Write a Program in c to multiply Two Dimensional Array's (3*3matrix).
12. Write a Program in c to find largest element in Two Dimensional Array's (3*3matrix).
13. Write a Program in c to check if given String is Palindrome or not.
14. Write a Program in c to find Factorial of a number using Recursive function.
15. Write a Program in c using function to find sum of two numbers with no argument and no return values.
16. Write a Program in c using function to find sum of two numbers with argument and no return values.
17. Write a Program in c to swap values of two variables by passing pointers.
18. Write a program in c to demonstrate structure.
19. Program to calculate number of blanks ,vowel, and words from entered phrase
20. Program to create a sequential file and perform following operation fields are Roll, Name, M1, M2, M3
    i) Add records
    ii) Process & Display output

BCA Semester-I

DSC (Paper III)
BCA1T03
BASICS OF COMPUTER ARCHITECTURE

Credits: 3 **Duration: 45 Hours**

Course Objectives:

1. To provide the fundamental concepts associated with the digital logic and circuit design.
2. To introduce the basic concepts and laws involved in the Boolean algebra and logic families and digital circuits.
3. To familiarize with the different number systems, logic gates, and combinational and sequential circuits utilized in the different digital circuits and systems.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. To Understand the basics of Digital Electronics and Binary Number System
2. To Learn the implementation of Combinational Circuit.
3. To Learn the implementation of Sequential Circuit.
4. Realize and simplify Boolean Algebraic assignments for designing digital circuits using K-Maps and Design and implement Sequential and Combinational digital circuits as per the specifications.

UNIT I

Number System and Data Representation

Number System: Binary, Octal, Decimal, and Hexadecimal Number System and their Inter Conversion. Binary Codes: BCD, Excess3, Parity, Gray, ASCII, EBCDIC Codes and their advantages and disadvantages. Data Representation: Positive, Negative, Maximum and Minimum Number Representation (Related to 8-bit Number), Real Number Representation, Underflow, Overflow, Range, and Accuracy.

UNIT II

Binary Arithmetic & Logic Gates

Binary Arithmetic: Binary Addition, Decimal Subtraction Using 9's and 10's Complement, Binary Subtraction Using 1's and 2's **Logic Gates:** Truth Table, Properties and Symbolic Representation of NOT, AND, OR, NOR, NAND, EX-OR, EX-NOR Gates. NOR and NAND Gates as Universal Gates.

UNIT III

Combinational Circuits and Boolean algebra

Combinational Circuits: Half Adder, Full Adder, Parallel Adder, Half Subtractor, Full Subtractor, 4-Bit Binary Adder Subtractor, Multiplexer, DE multiplexer, Decoder, Encoder.

Boolean Algebra: Laws and Identities of Boolean Algebra, Demorgan's Theorem, Use of Boolean Algebra for Simplification of Logic Expression, K-Map for 2, 3, 4 Variables, Simplification of SOP and POS Logic Expression Using K-Map.

UNIT IV

Sequential Circuits and Counters

Sequential Circuits: Flip-Flops Construction and Working of RSFF, DFF, TFF, JKFF and JKMSFF.
Counters: Construction and Working of Asynchronous, Synchronous, Up-Down Counter, Shift Registers and Their Types, Ring Counter, Johnson Counter with their Time Diagram.

Books:

1. Gothman, "Digital Electronics", PHI.
2. Navaneeth,, Kale and Gokhale, "Digital and Analog Technique",ISBN-81-225-0153-2

References:

1. Soumitra Mandal,"DigitalElectronics",TMH,ISBN0-07015382-5
2. Bram, "Fundamental of Microprocessor and Microcomputer", Dhanpat Rai Pub.
3. Liu.Gibson, "Microcomputer System: The8086/8088 Family",ISBN-1-55623-874-6

Credits: 1 **PRACTICAL LIST (Using Simulator) (BCA1P02)** **Duration: 30 Hours**

1. To Study and Design the characteristics of basic gates (AND, OR, NOT).
2. To Study and Design the characteristics of Universal gates (NAND, NOR).
3. To Study and Design the Derived gates (EX-OR, EX-NOR)
4. To Study and Design the basic gates (AND, OR, NOT) using a Universal NAND gate.
5. To Study and Design, the basic gates (AND, OR, NOT) using a Universal NOR gate.
6. To Study and Design the basic gates (EX-OR, EX-NOR) using Universal NAND gate.
7. To Study and Design the derived gates (EX-OR, EX-NOR) using Universal NOR gate.
8. To Study and Design NOR gate using NAND gate.
9. To Study and Design NAND gate using NOR gate.
10. To Study and Design RSFLIP FLOP using NAND gate.
11. To Study and Design RSFLIP FLOP using NOR gate.
12. To Study and Design JKFLIPFLOP.
13. To Study and Design JKMS FLIPFLOP.
14. To Study and Design the Half-adder.
15. To Study and Design the Full-adder.
16. To Study and Design the half subtractor.

Hardware

1. Familiarize the computer system layout: marking positions of SMPS, motherboard, FDD, HDD, CD, DVD and add on cards.
2. Identify the Computer Name and Hardware Specification (RAM capacity, Processor type, HDD, 32 bit/ 64 bit)
3. Identify and Troubleshoot the problems of RAM, SMPS and motherboard
4. Configure BIOS settings- disable and enable USB and LAN
5. Adding additional RAM to the system. (expanding RAM size).
6. To Study mother board layout of a system.
7. Demonstrate the assembly of a PC
8. Demonstration of various ports: CPU, VGA port, PS/2 (keyboard, mouse), USB, LAN, Speaker, Audio.
9. Install and configure windows OS
10. To study the installation of Printer and trouble shooting.

B.Sc/B.Sc(IT)/BCA/B.Sc (Data Science)/B.Sc(AI)
SEMESTER-I

SYLLABUS FOR COMPULSORY ENGLISH
(ABILITY ENHANCEMENT COURSE)

(As per NEP 2020)

(To be implemented from the Academic Session 2024-2025 and onwards)

COURSE OUTCOMES:

- Students will be able to enhance their awareness of correct usage of English language in writing and speaking.
- Students will improve their speaking ability in English both in terms of fluency and comprehensibility.
- Students will enlarge their vocabulary.
- Students will review the grammatical forms of English and the appropriate use of these forms in specific communicative contexts.
- Students will develop their ability as critical readers and connect issues discussed in the text with life.
- Students will attain and enhance competence in the four modes: writing, speaking, reading & listening
- Students will develop skills that enable them to present their ideas clearly and logically to achieve a specific purpose.

Theory Exam: 50 Marks
Continuous Internal Evaluation (CIE): 50 Marks
Total : 100 Marks

Prescribed Text : *Stepping Stone* – Board of Editors
(Published by Macmillan Education India Pvt. Ltd.)

SEMESTER – I

UNIT-1

1. Grassroots Innovation and Social Enterprise – Saji Varghese
2. Two Gentlemen of Verona – A. J. Cronin
3. Go, Kiss the World – Subroto Bagchi

UNIT-2

4. Little Girls Wiser than Men – Leo Tolstoy
5. The Narmada
6. Old Man at the Bridge – Ernest Hemingway

UNIT-3 (LANGUAGE SKILLS-1)

- Greetings and Introduction
- Countries and Nationalities
- Interesting Products
- Activities and Interest
- Food
- My Family

UNIT-4 (LANGUAGE SKILLS-2)

- Preparing a Flyer for an Event, Preparing Advertisement for a Product, Preparing a Handout for a Social Cause/Issue
- Resume Writing

Continuous Internal Evaluation (CIE): 50 Marks

A Continuous Internal Assessment of 50 marks shall be based on the different oral communication skills activities regularly conducted by the Teacher and the worksheets/written assignments/creative projects to be submitted by the students. The students are required to actively participate in these activities and mandatorily submit the worksheets/written assignments/creative projects. The guidelines and some suggested items for the activities/assignments are given in the prescribed Text Book, 'Stepping Stone'.

QUESTION PAPER PATTERN
THEORY EXAM
(50 MARKS)

Q.1 Answer any Two (Out of Three) of the given questions in about 50 words each. (UNIT-1) (2 X 5 Marks = 10)

Q.2 Answer any Two (Out of Three) of the given questions in about 50 words each. (UNIT-2) (2 X 5 Marks = 10)

Q.3 (A) Five Very Short Answer Questions to be answered in one or two sentences each (UNIT-1) (5 X 1 Mark = 5)

(B) Five Very Short Answer Questions to be answered in one or two sentences each (UNIT-2) (5 X 1 Mark = 5)

Q.4 Writing a script of the dialogue of any ONE (Out of Two) of the conversational situations. (UNIT-3) (1 X 10 Marks = 10)

Q.5 Attempt any ONE (Out of Two) of the Questions based on the items prescribed in UNIT-4 (1 X 10 Marks = 10)

Indian Knowledge System (IKS)

Semester 1: VEDIC MATHEMATICS

(BIK1T01)

Course Outcomes: This course will enable the students to

1. Improve speed and accuracy in numerical calculations
2. Acquire IQ skills and high-end technical knowledge
3. gain test taking skills & creativity of calculations

UNITS	TOPICS	HOURS
Unit 1	(i)Addition - Subtraction - Combined operations - Beejank (ii) Multiplication methods: Urdhwatiryagbhayam, Nikhilam, Ekanyunen, Ekadhiken, Antyayordashakepi. (iii) Vinculum - Operations. (iv) Awareness of 1 to 5 Vedic sutras as per Shankaracharya Bharthikrishan Teerthji Swamiji's book.	**8**
Unit 2	(i) Division methods : Nikhilam, Paravartya Yojayet, Dhwajank(ii) GCD and LCM (iii) Expression of GCD in terms of two numbers.	**8**
Unit 3	(i) Divisibility tests, Osculation & Reverse osculation. (ii) Division Algorithm, Quotient & Remainder. (iii) Duplex method.	**7**
Unit 4	i) Squares & Square-roots for 6 digit number. (ii) Cubes & Cube-roots for 6 digit number, Contribution of Indian Mathematicians in Arithmetic.	**7**
	TOTAL	**30 HRS**

Reference Books:

1. Tirthaji B.K. (1965) Vedic Mathematics, MotilalBanarsidass
2. Bidder G.P. (1856) On Mental Calculation. Minutes of Proceedings, Institution ofCivil Engineers (1855-56), 15, 251-280
3. Scripture E.W. (1891) American Journal of Psychology. Vol. IV 1-59
4. Mitchell F.D. (1907) American Journal of Psychology. Vol. XVIII 61-143
5. Aitken A.C. (1954) The Art of Mental Calculation: With Demonstrations. Transactions of the Society of Engineers. 45, 295-309
6. Dow A. (1991) A Unified Approach to Developing Intuition in Mathematics, Scientific Research on the Transcendental Meditation and TM-Sidhi Program Vol 5,3386-3398
7. Williams K.R. (1984) Discover Vedic Mathematics. Vedic Mathematics Research Group
8. Nicholas, Williams, Pickles (1984) Vertically and Crosswise, Inspiration Books

BCA SEMESTER – I
BVE1T01: ENVIRONMENTAL SCIENCE

COURSE OUTCOMES: At the end of the course, students shall be able to:

- Explain the basics of Environmental Science and Atmospheric Science along-with the components of Environment
- Explicate the importance of Environmental Education.
- Elucidate the fundamentals of atmospheric science including formation, depletion and effects of ozone layer and acid rain on environment.
- Describe the various physical and chemical characteristics and properties of Water and Soil
- Understand the Ecology and its allied branches
- Comprehend about Population and Community Ecology
- Study the changes in Population by understanding the concept of Population ecology

Unit-I: Basics of Environmental Science (7.5 Hrs)

A. Introduction of Environmental Science: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.
B. Environmental Education: Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness.
C. Components of Environment: Atmosphere (Structure and composition),hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere.

Unit-II: Basics of Atmospheric Science (7.5 Hrs)

A. Atmospheric Chemistry: Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.
B. Green House Effect: Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. Ozone depletion: chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.
C. Acid Rain: Chemistry of Acid Rain, effect of acid rain on ecosystem control measures. Precipitation – Form of precipitation (rain, drizzle, snow, sleet and hail), types of precipitation (conventional, orographic, and cyclonic).

Unit-III: Basics of Ecology (7.5 Hrs)

A. Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.
B. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.
C. Biotic Factor: Inter specific relationship Positive: Mutualism (symbiosis), commensalism, proto-cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism.

Unit-IV: Ecosystems and food chain (7.5 Hrs)

B. Ecosystem: Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)

C. Food chain: Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological pyramids (number biomass and energy), energy flow in ecosystem (Y- shaped). Energy flow and the law of thermodynamics.

D. Biogeochemical Cycles: Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

Reference Books:

1. Text Book of Environment: K M Agrawal, P.K. Sikdar, and S.C. Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C. Dash and P.C. Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C. Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K. Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S. Dara, S.Chand Publication ,New Delhi.
6. Environmental Chemistry: A.K. Dey, New Age International Publishers,2001.
7. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr

P.U. Meshram, Allied Publishers, New Delhi.

1. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi,1996.
2. Animal Ecology and Distribution of Animals: Veer Bala Rastogi , Rastogi Publication, Meerut (U.P).
3. Ecology and Environment: P.D.Sharma, Rastogi Publication ,Meerut (U.P).
4. Fundamentals of Environmental Biology: S. Arora, Kalyani Publishers.
5. Environmental Biology: P.K.G. Nair, Himalaya Publication.
6. Environmental Biology: K. C. Agrawal. Agro Botanical Publisher, Bikaner, 1994

SEMESTER – II

BCA Semester-II

DSC (Paper I)
BCA2T04
PROGRAMMING IN C++

Credits: 3 **Duration: 45 Hours**

Course Objectives:

1. To provide basic characteristics of OOP through C++.
2. To impart skills on various kinds of overloading and inheritance.
3. To introduce pointers and file handling in C++ together with exception handling mechanism.

Course Outcomes: After completion of this course, students will be able to:

1. Realize the need and features of OOP and idealize how C++ differs from C.
2. Infer knowledge on various types of overloading.
3. Choose suitable inheritance while proposing solution for the given problem.
4. Handle pointers and effective memory management.
5. Illustrate application of pointers in virtual functions.

UNIT I

Object Oriented Methodology: Elements of Object-Oriented programming, Objects, Classes, OOPs features. **Classes & Objects:** Specifying a Class, Creating Objects, Accessing Class members, Defining member function, Outside Member Functions as inline, Accessing Member Functions within the class, Static data member, Access specifiers: private, protected and public Members.

UNIT II

Constructors & Destructors: Introduction, Parameterized Constructors, Constructor Overloading, Constructors with Default Arguments, Copy Constructor, Destructor, Order of Construction and Destruction, Static data members with Constructor and Destructors. **Operator Overloading:** Definition, Overloadable Operators, Unary Operator Overloading, Unary & Binary overloading, Rules for Operators Overloading

UNIT III

Dynamic Objects: Pointers to Objects, Creating and Deleting Dynamic Objects: New and Delete operators, Array of Objects, Array of Pointers to Objects, Pointers to Object Members, this Pointer**.**
Inheritance: Defining, Abstract classes, Single, Multilevel, Multiple, Hierarchical, Hybrid Inheritance, Constructor and Destructor in Derived Classes.

UNIT IV

Virtual Functions: Need for Virtual Functions, definition, Pure Virtual Functions, Abstract Classes, Rules for Virtual Functions.
Exception Handling: Exception Handling Model, List of Exceptions, Handling Uncaught Exceptions, Fault Tolerant Design Techniques, Memory Allocation Failure Exception, Rules for Handling Exception Successfully.

Books

1. Mastering C++ by K R Venugopal Tata McGraw-Hill, New Delhi.
2. The C++ Programming Language –Bjarne Stroustrup
3. Programming with C++ - Ravichandran
4. Programming with C++ - Robert Lafore
5. Object Oriented Programming with C++ by E. Balagurusamy, McGraw Hill

Credits: 2 **PRACTICAL LIST (BCA2P03)** **Duration: 60 Hours**

1) Program to demonstrate, defining member functions inside outside the class.
2) Program to demonstrate, static data members and member functions.
3) Demonstrate the usage of Constructor and Destructor.
   Define a class data with data member acct_no, balance containing constructor data to initialize data member and a member function display for output.
4) Program to demonstrate usage of a constructor and Destructor function. Declare a class with public data member count. The class containing one constructor and destructor to maintain updated information about active objects i.e. i) No of objects created. ii) No of objects Destroyed.
5) Program to accept the distance between city 1^{st} & 2^{nd}, city 2^{nd} & 3^{rd}. calculate the distance between city 1^{st} & 3^{rd}. Define a class road with private data member km, m, d1, d2, d3 containing member function getdata to accept values of d1, d2 and calculate for calculating distance.
6) Demonstrate the use of operators overloading (string manipulation: + for concatenation and relational operators for alphabetical comparison).
7) In a bank N depositor deposit the amount, write a program to find total amount deposited in the bank. Declare a class deposit with private data member Rupee and Paisa containing member function getdata, putdata.
   i. Use array of objects
   ii. Use Operator '+' overloading.
8) Declare class event and accept time of first event and second event and find the difference between 1^{st} and 2^{nd} event. Containing public member function getdata and display with private data member hour, minute, second and total.
   i.Use Operator '-'overloading.
9) Program to demonstrate Single Inheritance. Declare a class B and derive publically class D from B.
   i.The class B contains private data member a, public data member b with member function get_ab, get_a, show_a.
   ii. The derived class D contains data member c with member function mul and display.
10) Program to demonstrate Multiple Inheritances. Declare class M and N and derive publically class P from M and N.
   i)Declare a class M with protected data member m and public member function get_m.
   ii) Declare a class N with protected data member n containing member function get_n.
   i. Declare class P containing member function display.
11) Program to demonstrate Multilevel Inheritance. Declare a class student and derive publically a class test and derive publically class result from class test.
   i.The class student contains protected data member roll_number with public member functions get_number and put_number.
   ii.The class test containing protected data member sub1, sub2 with public member function get_marks and put_marks.
   iii.The class result contains data member total and public member function display.
12) Program to demonstrate Hierarchical Inheritance. Declare a class Side and derive publically class Square from base class side and also derive publically class cube from base class side.
   i.Class Side contains protected data member L with a member function set_values.
   ii.Class Square contains member function sq.
   iii.Class Cube contains member function cub.
13) Program to demonstrate usage of normal virtual function and pure virtual Function with abstract class.
14) Program to determine whether the input is +ve or –ve through exception.
15) Program to raise exception if an attempt is made to perform divide-by-zero.

BCA Semester-II
DSC (Paper II)
BCA2T05
DATABASE MANAGEMENT SYSTEM

Credits: 3 **Duration: 45 Hours**

Course Objectives:

The objective of this course is to provide students with a comprehensive understanding of database management systems (DBMS) and their role in modern information management. The course aims to develop students' skills in designing, querying, and managing relational databases.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand the concepts and principles of database management systems.
2. Design and create ER diagrams and understand the concept of strong and weak entity sets.
3. Study about the relational data model.
4. Apply normalization techniques to ensure data integrity.

UNIT I

DBMS: Definition: Databases, DBMS, Problems with traditional file processing system, Objectives of the database systems, three level architectures of DBMS, Component of DBMS, Database Administrator, Database Users, Data model, Different types of data models, Concepts of Hierarchical, Network Models.

UNIT II

E-R Models: Basic Concepts, Entity, Attributes, Relation Ship, Mapping, Keys, Weak and Strong Entity Set, Problems on E-R Diagrams, Extended E-R Features: Specialization, Generalization, Aggregation, Problems on Reduction of an E-R Schema to Tables, Tabular representation of Strong, Weak entity Sets and Relationship Sets.

UNIT III

Relational Model: Structure, Relational Algebra, Fundamental Operations, Set – Intersection, Natural Join, Division and Assignment Operation. Extended Relational Algebra Operations, Aggregate Functions.

UNIT IV

Functional Dependency: Functional Dependency, Fully Functional Dependency, Partial Dependency, Transitive Dependency, Multi Valued Dependency. Normalization, Normal Forms (1NF, 2NF, 3NF, BCNF, 4NF, 5NF). Problems on Normal forms.

Text Books:

1. Data Base System Concepts By A Silberschatz By Henry Korth And S. Sudarshan Mcgraw-Hill ltd. New Delhi 3rd Edition.
2. Introduction to Data Base Management by NAVEEN PRAKASH [Tata McGrawHill ltd.

Reference Books:

1. Bipin C. Desai, An Introduction to Database Systems, Galgotia Publications.
2. Raghu Ramakrishnan & Johannes Gerhrke, "Data Base Management Systems", Mc Graw Hill International Edition, 2000
3. Muzumdar, Introduction to Database Management Systems. TMH

BCA Semester-II

SEC (Paper III)

BCA2T06

DATA STRUCTURES

Credits: 3 **Duration: 45 Hours**

Course Objectives:

1. To understand basic data structures linked structures, stacks, queues, trees, and graphs
2. To understand algorithms for linked structures, stacks, queues, trees, and graphs
3. To understand the computational efficiency of the principal algorithms for sorting and searching

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms
2. Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs
3. Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs
4. Demonstrate different methods for traversing trees
5. Compare alternative implementations of data structures with respect to performance
6. Describe the concept of recursion; give examples of its use
7. Discuss the computational efficiency of the principal algorithms for sorting and searching

UNIT I

Linked List: Linked List, Representation of Single, Double, Header, Circular Single and Double Linked list, All possible operations on Single and Double linked List using Dynamic representation, Polynomial Representation and its Manipulation.

UNIT II

Stacks: Stacks terminology, Representation of Stacks in Memory, Operation on Stacks, Polish Notations, Translation of infix to postfix & prefix expression, Infix to Postfix Conversion, Evaluation of Postfix Expression, Recursion, Problems on Recursion, Quick Sort and Tower of Hanoi Problem.

UNIT III

Queue: Representation of Queues in Memory, Circular Queue, Dequeue and Priority Queue. Operations of above Structure using Array and Linked Representation. **Sorting and Searching:** Selection Sort, Insertion Sort, Merge Sort, Efficiency of Sorting Methods, Big-O Notations. Hash Tables, Hashing Technique, Collision Resolution Technique.

UNIT IV

Trees: Basic Terminologies, Representation of Binary Trees in Memory, Traversing of Binary tree, Binary Search Tree, Operation on Binary Search Tree, Heap Tree, Operation on Heap Tree, Heap Sort Method. **Graphs:** Basic Terminologies, Definition and Representation of Graphs in Memory: Linked List and Matrix Representation. Traversing graphs: BSF, DFS Method.

Text Books

1. Classic Data Structures: D. Samanta, PHI, New Delhi.
2. Data Structure: Schaum Lipschutz, Outline Series

Reference Books

1. Data structure Using C++: Y. Kanetkar
2. Data Structures Using C++: Tanenbaum
3. Data structures by Tremblay Sorenson
4. Data structures by Bhagatsingh Naps

Credits: 2	**Practical List (BCA2P04)**	**Duration: 60 Hours**

1) Program to insert a node at the beginning of the given linked list.
2) Program to insert a node at the end of the given linked list.
3) Program to insert a node at the middle of the given linked list.
4) Program to delete a node at the beginning of the given linked list.
5) Program to delete a node at the end of the given linked list.
6) Program to delete a node in the middle of the given linked list.
7) Program to search a value in the given linked list.
8) Program to insert a node at the beginning, at the end and in the middle of a given double linked list.
9) Program to delete a node from the beginning, end and middle of a given double linked list.
10) Program to push and pop an element into / from a stack implemented using Array.
11) Program to evaluate postfix expression.
12) Program to sort an array using quick sort.
13) Program for calculating factorial of given no using Recursion
14) Write a Program to print n terms of Fibonacci sequence using Recursion.
15) Program to solve Towers of Hanoi problems using recursion.
16) Program to perform insertion and deletion operation in linear queues.
17) Program to sort an array using Selection sort.
18) Program to traverse inorder of a binary tree.
19) Program to traverse preorder of a binary tree.
20) Program to traverse postorder of a binary tree.

BCA Semester-II

DSC (Paper IV)

BCA2T07

OPERATING SYSTEMS AND LINUX

Credits: 2 **Duration: 30 Hours**

Course Objectives:

1. To introduce the Operating system concepts and designs to provide the skills required to implement the OS services.
2. To describe the trade-offs between contradictory objectives in large scale OS system design.
3. To develop the knowledge for application of the various OS design issues and services.
4. To understand structure of Linux OS and commands.

Course Outcomes: After completion of this course, students will be able to:

1. Describe the various OS functionalities, structure and layers.
2. Usage of system calls related to OS management and interpreting different stages of various process States.
3. Design CPU scheduling algorithms to meet and validate the scheduling criteria.
4. Apply and explore the communication between inter process and synchronization techniques.
5. Implement memory placement strategies, replacement algorithms related to main memory and virtual memory techniques.
6. Differentiate the file systems; file allocation, access techniques.
7. Learn the concepts to identify create and maintain the basic command in operating systems

UNIT I

Structure of Operating System, Operating System functions, Characteristics of Modern OS. Process Management: Process states, Creation, Termination, Operations on Process, Concurrent process, Processes Threads, Multithreading, Micro Kernels CPU Scheduling: Schedulers, Scheduling Methodology, CPU Scheduling Algorithm: FCFS, SJF, RR, Priority Scheduling.

UNIT II

Performance comparison : Deterministic Modeling , Queuing analysis, Simulators. Deadlock and Starvation: Resource Allocation Graph, Conditions for Dead Lock, Dead Lock Prevention, Dead Lock Detection, Recovery from Deadlock.

UNIT III

Memory Management: Logical Vs. Physical Address Space, Swapping, Memory Management Requirement, Dynamic Loading and Dynamic Linking, Memory Allocation Method: Single Partition allocation, Multiple Partitions, Compaction, paging, segmentation, File Management: File Management system, File Accessing Methods, File Directories, File Allocation Methods

UNIT IV

Anatomy of Linux OS, Directory Structure, /usr Directory, File Types: User datafiles, System data files, Executable files. Naming files and directories. Shell: Creating User Account, Shell Program, bash shell, Changing shell prompt. Commands: Basic Syntax for a command, Exploring the Home Directory, ls, kdir, rmdir, stat, cat, rm, mv, cp, Managing users accounts, Changing Password, Creating group accounts.

Text Books:

1. Operating Systems by P. Balakrishna Prasad [Scitech Publication]
2. Operating System Concept : Silbershaz (Addision Education)
3. SAMS Teach Yourself Linux by Craig and Coletta Witherspoon [Techmedia]

Reference Books:

1. Operating Systems - H.M. Deitel - Addision Wesley.
2. Operating Systems- John J. Donoven.
3. Operating System : A. S. Godbole (TMH)
4. Modern Operating Systems : Tenenenbaum (Pearson Education)

BCA Semester-II
SEC (Paper V)
BCA2T08
WEB TECHNOLOGIES

Credits: 2 **Duration: 30 Hours**

Course Objectives

1. To introduce the fundamentals of Internet, and the principles of web design
2. To understand the basics of Web Designing using HTML, DHTML, and CSS.
3. To introduce the fundamentals of Internet, and the principles of web design.
4. To understand the development of webpages using DHTML
5. To build dynamic web pages with validation using Java Script event handling mechanisms.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand web application architecture and can develop basic websites using HTML and Cascading Style Sheets.
2. Gain skills in different programming control structures and functions for development of dynamic client-side web applications.
3. To build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms

UNIT I

Introduction to Internet, History of Internet, Internet users, Internet working, Information on Internet, Requirements for connecting to Internet, Basic Internet Terms, Introduction to world wide web, Evaluation of world wide web, basic features, web browsers, popular web browsers, web servers, HTTP, URL, Search Engines, Search Engines categories, how to use Search Engines, Searching criterion.

UNIT II

HTML: Introduction, Objective, HTML Browsers, Windows Switching, HTML Command Tags, URLs, links, new web page creation, main body of the text, putting headers, adding paragraph, formatting text in HTML and font mechanism: Color settings, superscripts and subscripts and other manipulations on text and paragraphs, using directory and menu lists, creation of links, inserting graphics, using images, all manipulations on tables and its display, Detailed working with forms, allowing visitors to upload files, active images, working with frames & framesets, Frames handling, scroll bars, alternatives to frames.

UNIT III

Introduction to browsers, Working with e-mail, Parts of e-mail text, working with messages. DHTML: using DHTML in internet explorer, heading and horizontal line, hidden message, the message at the center of the page, moving boxes, changeable box.

UNIT IV

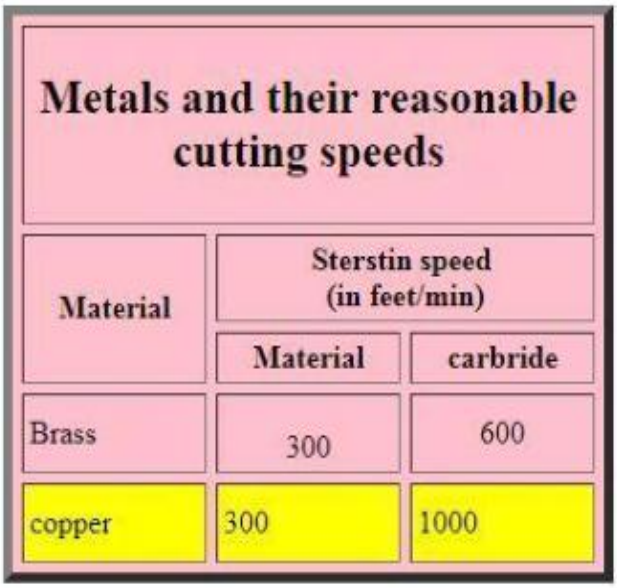
Cascading Style Sheets Introduction to CSS, creating style sheets, common tasks with CSS, Colors, the font family, font metrics, length units, absolute units, relative units, the pixel unit ,percentages as values, keywords as values, various properties such as the font -size property, font size property etc, Assigning classes, tags and attributes for applying classes, applying classes to an HTML tag, applying classes to other document parts ,the layer tag, CSS Tags.

Reference Books:

1. Internet and web design by R Bangia, Second edition , firewall media
2. Multimedia and Wed technology by R Bangia
3. Internet and web designing by ITELS (Macmillan)
4. Web Enabled Commercial Application Development Using HTML, DHTML, JS, Perl by Ivan Bayross
5. Deitel, Deitel & Nieto, Internet and Worldwide Web how to Program, Pearson Education, PHI.
6. Internmet Programming with VBScript and Java Script. Kathhleen Kalata, (Thomsaon Publication) 7. Programming the World Wide Web By. Robert W. Sebesta. (Pearson) 8. Web Technology Theory and Practice By: M Srinivasan (Pearson Publication)

Credits: 1	PRACTICAL LIST (BCA2P05)	Duration: 30 Hours

1. Write a program in html to create Resume
2. Write a program in html to illustrate use of hyperlinks.
(Direction: it should have two pages.page1 should contain image link to page 2.
Page 2 should contain image link to page 1.)
3. Create time table with row span and colspan using table tag
4. Write a html program to create table shown below



Metals and their reasonable cutting speeds		
Material	Sterstin speed (in feet/min)	
	Material	carbride
Brass	300	600
copper	300	1000

5. Write a program in html to create registration form
6. Write a program in html to illustrate frames
(Direction: frames should divide screen both horizontally and vertically.
One frame should divide horizontally and three frames should divide vertically)
7. write program in DHTML to change heading and horizontal line on click event
8. Write program in DHTML to illustrate changeable box
9. Write program in DHTML to illustrate moving boxes
10. Write a program in DHTML to display message exactly at the center of page
11. Write a program to explore font properties, background image and hover effect using external CSS
12. Write a program to illustrate CSS layer(z-index)
13. Write a program in CSS with multiple classes using external CSS
14. Write a program using inline CSS to display different text properties
15. Write a program to create resume using embedded CSS

BCA Semester II
CONSTITUION OF INDIA (BVE2T02)

Credits: 2 **Duration: 30 Hours**

UNIT – I:

- Historical Background to the Framing of the Indian Constitution: General Idea about the Constituent Assembly of India.

UNIT – II

- Preamble – Nature and key concepts/Constitutional values, Socialism, Secularism, Democracy, Justice, Liberty, Equality and Fraternity
- Salient Features of the Constitution of India

UNIT – III

- General study about the kinds, nature and importance of; Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

UNIT –IV

Introduction of the Constitutional Institutions and Authorities;

- Central Legislature and Executive (Parliament of India, President of India and Council of Ministers)
- State Legislature and Executive (State legislative Assemblies, Governors and Council of Ministers)
- Higher Judiciary (Supreme Court of India and High Courts)

SEMESTER – III

BCA Semester-III

DSC (Paper I)
BCA3T09
OBJECT ORIENTED PROGRAMMING USING JAVA

Credits: 3 **Duration: 45 Hours**

Course Objectives:

1. To understand the basic concepts and fundamentals of platform independent object-oriented language.
2. To demonstrate skills in writing programs using exception handling techniques and multithreading.
3. To understand streams and efficient user interface design techniques.

Course Outcomes: After successful completion of the course, the students are able to:

1. Use the syntax and semantics of java programming language and basic concepts of OOP.
2. Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages.
3. Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes.
4. Design event driven GUI and web related applications which mimic the real word scenarios.

UNIT I

Fundamentals of Object-Oriented Programming: Basic Concepts of Object-Oriented Programming (OOP), Benefits and Applications of OOP. Introduction to Java: History of Java, Features of Java, Getting Started with Java. Java programs: Introduction of Application & Applets. **Variables:** Variable naming, variable initialization, assign values, Rules of variables, Scope of variable. **Operators:** Arithmetic, Assignment, Unary, Comparison, Shift, Bitwise, Logical, Conditional, New, Special, Relational. Data types: Integers, Char, String, Float, etc. Typecasting: **Tokens:** Java tokens Order of precedence of operators Streams: - Input and output.

UNIT II

Creating a class & subclass: Declaring a class, Naming class, Rules to assign Class & Subclass, Creating a new object, Class of an object. **Data members:** Declaring data members, Naming variables, using class members. **Methods:** Using data members, Invoke a method, passing arguments to a method, calling method. Access Specifier & Modifiers: Public, Private, Protected, Static & Final. Overloading: Method overloading, Constructor overloading. **Java class library:** Different types of classes. **Decision making & loops:** If-then-else, Switch, ? : operator, While-loop, do- while loop, for. **Array:** Creating an array, one-dimensional array, two-dimensional array. String: String array, string methods. Inheritance: Single & multiple inheritances **Interfaces:** - Defining interfaces, extending interfaces, implementing interfaces.

UNIT III

Packages: Java API packages, creating packages, accessing packages, adding a class to packages. **Import statement:** Introduction & implementation of import statement. **Applets:** Introduction to Applets & Application, how applets application are different creating An applet. Applets life cycle, designing a web page, creating an executable applet, running the applet, applet tags, passing a parameter to an applet, HTML tag, Converting applet to application. **Threads:** Overview of threads, single & multiple threads, lift cycle of threads, stopping & blocking threads, working with threads, priority to thread, synchronization. **Exceptions & Errors:** Introduction, types of error, exception, syntax of exception, handling techniques, exception for Debugging.

UNIT V

Event: Event-driven programming, handling (AWT) events. Graphic class: Introduction, the graphic classes, drawing & filling of lines, rectangles, circles & ellipses, arcs, polygons, text & fonts, creating a font class, font objects, text, colouring objects. **Streams:** Introduction, Abstract stream classes, file input & output. **AWT Applications:** Creating a GUI using AWT toolkit, using component class, frames. **Components & Control:** Textfield, textarea class, label, button, choice,

list, checkbox, class, and combo. Menus: Creating a popup menu. Image: Type of image, Properties of an image, Displaying an image. **Layouts:** Using Window Listener interface, Different types of Layout, Layout manager, Flow manager, Grid manager. Container: Different types of container (Frame, Dialog, Panel)

Reference Books:

1. Programming with Java a primer II edition: E Balaguruswamy (Tata McGraw-Hill)
2. Java Programming (For absolute beginners) Russell PHI
3. Black Book on Java
4. Java-Complete References

Credits: 2	**PRACTICAL LIST (BCA3P06)**	**Duration: 60 Hours**

1. Write a program in JAVA to find the GCD of two numbers.
2. Write a program in JAVA to Check If a Number is a Neon number or not. (A neon number is a number where the sum of digits of the square of the number is equal to the number. The task is to check and print neon numbers in a range.)
3. Create a JAVA class called Student with the following details as variables within it. a. USN, NAME, BRANCH, PHONE, PERCENTAGE b. Write a JAVA program to create n Student objects and print the USN, Name, Branch, Phone, and percentage of these objects with suitable Headings.
4. Write a program in JAVA to add Two Complex Numbers.
5. Write a program in JAVA to accept any 10 numbers from the user to store it in an Array and print the largest of all.
6. Write a program in JAVA to demonstrate multilevel Inheritance.
7. Write a program in JAVA to find the area of rectangle, square, and cylinder using the concept of method overloading.
8. Write a program in JAVA to calculate the area of the circle and rectangle using the interface.
9. Write a program in JAVA to remove duplicates from Sorted Array.
10. Write a Java program to find the Fibonacci series & Factorial of a number using recursive and non-recursive functions.
11. Create an applet to draw different shapes using Graphics class.
12. Write a program in JAVA to demonstrate the parameterized applet.
13. Write a program in JAVA to demonstrate multiple inheritance using the interface.
14. Write a program in JAVA for finding the cube of a number using a package for various data types and then import it into another class and display the results.
15. Write a program in JAVA to define a user-defined exception sal_out_of_range and write a class named employee with fields id, name, sal, phno and accept details of the user according to id and store it in the variables, if sal exceeds 10000, sal_out_of_range should be thrown and handled properly
16. Write a program in JAVA to draw rectangles using the applet.
17. Write a program in JAVA to demonstrate font class.
18. Write a program in JAVA that constructs several colors and draws various objects using these colors using applets
19. Write a program in JAVA to demonstrate List components.
20. Write a program in JAVA to demonstrate the menu bar.

BCA Semester-III
DSC (Paper II)
BCA3T10
PROBABILITY AND STATISTICS

Credits: 2 **Duration 30 Hours**

Course Objectives:

1. To provide students with a framework that will help them choose the appropriatedescriptive methods in various data analysis situations.
2. To analyse distributions and relationships of real-time data.
3. To apply estimation and testing methods to make inference and modeling techniques fordecision making.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Have an understanding of the probability concepts.
2. Analyze the problems connected with statistics.
3. Understand how to make the transition from a real problem to a probability model for that problem.
4. Expose students to practical applications.

UNIT I

Introduction - Meaning and Scope: Origin and Development of Statistics, Definition of Statistics, Importance and Scope of Statistics, Limitations of Statistics, Distrust of Statistics, Frequency Distribution, Continuous Frequency Distribution, Graphic Representation of a Frequency Distribution Basic concepts of Statistics, Measures of Central Tendency: Requisites for an Ideal Measure of Central Tendency, Arithmetic Mean, Weighted mean, Median, Mode, Geometric Mean, Harmonic Mean.

UNIT II

Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation and Root Mean Square Deviation, Co-efficient of dispersion, Co-efficient of variation, Skewness and Kurtosis: Absolute Measures of skewness, relative measures of skewness, Karl Pearson's co-efficient of skewness, Bowley's Co-efficient of skewness and Kurtosis.

UNIT III

Correlation and Regression - Definition of Correlation, Scatter Diagram, Karl Pearson Coefficient of Correlation, Limits for Correlation Coefficient, Definition of Regression, Lines of Regression, Regression Curves, Regression coefficients, properties of Regression coefficients, Correlation Analysis vs. Regression Analysis.

UNIT IV

Theory of Probability: Introduction, Definitions of Various Terms Mathematical or Classical Probability, Statistical or Empirical Probability. Axiomatic Approach to Probability: Random Experiment (Sample space), Event, Some Illustrations, Algebra of Events. Probability - Mathematical Notion, Multiplication Law of Probability and Conditional Probability, Bayes Theorem, Geometric Probability. **Random Variable and Distribution Function:** Discrete Random Variable: Probability Mass Function, Discrete Distribution Function. Continuous Random Variable: Probability Density Function, Mathematical Expectation, Expectation of a Function of a Random Variable, Addition Theorem of Expectation, Multiplication Theorem of Expectation.

Books

1. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor (2000): 10/e, Sultan Chand and Sons.
2. Business Management and Statistics,N G Das, J K Das, McGraw-Hill.

3. Principals of mathematical Analysis, Walter Rudin, McGraw-Hill.
4. StatisticalTechniquesDr.Pramod Fating, Dr. Milind Gulhane, Dr. Vijay Badge, Dr.SarangJavkhedkar – Sir Sahitya Kendra, Nagpur
5. Business Mathematics and Statistics, Dr. S. R. Arora, Dr.Kavita Gupta, Business Mathematicsand Statistics, Taxmann.
6. Business Mathematics,Mrintunjay Kumar, Vikas Publishing House Pvt. Ltd.
7. Mathematics & Statistics, Ajay Goel, AlkaGoel, Taxmann.

BCA Semester-III

SEC (Paper III)
BCA3T11
PYTHON PROGRAMMING

Credits: 3 **Duration: 45 Hours**

Course Objectives:

1. To develop modular Python programs.
2. To apply suitable Python programming constructs, built-in data structures using Python libraries to solve a problem.
3. To understand basic Data visualization and File handling in Python.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand Python syntax, data types, and basic programming constructs.
2. Write programs using functions, control structures, and loops.
3. Handle files and exceptions effectively in Python.
4. Develop real-time applications using libraries and modules.
5. Apply object-oriented principles using classes and objects.

UNIT I

Introduction: History and Application areas of Python; Structure of Python Program; Identifiers and Keywords; Operators and Precedence; Basic Data Types and type conversion; Statements and expressions; Input/Output statements. **Strings**: Creating and Storing Strings, Built-in functions for strings; string operators, String slicing and joining; Formatting Strings.**Control Flow Statements:** Conditional Flow statements; Loop Control Statements; Nestedcontrol Flow; continue and break statements, continue, Pass and exit.

UNIT II

Functions: Built-In Functions, Function Definition and call; Scope and Lifetime of Variables, Default Parameters, Command Line Arguments; Lambda Functions; Assert statement; Importing User defined module; **Mutable and Immutable objects:** Lists, Tuples and Dictionaries; Commonly used Functions on Lists, Tuples and Dictionaries. Passing Lists, tuples and Dictionaries as argumentsto functions. Using Math and Numpy module for list of integers and arrays.

UNIT III

Files: Types of Files; Creating, Reading and writing on Text and Binary Files; The Pickle Module, Reading and Writing CSV Files. Reading and writing of csv and JSON files. **Exception Handling:** Try-except-else-finally block, raise statement, hierarchy of exceptions, adding exceptions. Data visualization: Plotting various 2D and 3D graphics; Histogram; Pi charts; Sine and cosinecurves.

UNIT IV

Class: Polymorphism, Operator Overloading, Function Overloading, Encapsulation, Data Hiding, Data Abstraction, Modifier and accessor methods, Composition. **Inheritance:** Single inheritance, Hierarchical inheritance, Multiple inheritance, Abstract Methods.

Recursion: Factorial by recursive approach, Fibonacci series by recursive approach, Reversing a string, Pattern within a pattern.

Text Books:

1. Sheetal Taneja & Naveen kumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson, 2017.
2. Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House, 2021.
3. Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House, 2023.

Reference Books:

1. Think Python, by Allen Downey, 2nd edition, 2015, O'Reilly. https://drive.google.com/file/d/1p9Pul6d5UvnQrO9-Q-LE2_p4YvMk5cIg/view
2. An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ.
3. Introduction to Computation and Programming using Python, by John Guttag, 2 nd edition,2016, PHI India.

Web Resources:

1. https://www.learnpython.org/
2. https://www.w3schools.com/python/default.asp

Credits: 2	**PRACTICAL LIST (BCA3P07)**	**Duration: 60 Hours**

1. Write a program to find whether a number is a prime number.
2. Write a program to print m raise to power n, where m and n are read from the user.
3. Write a program having a parameterized function that returns True or False depending on whether the parameter passed is even or odd.
4. Write a program to print the summation of the following series upto n terms:1-2+3-4+5-6+7 ---------- n
5. Write a menu driven program to perform the following operations on strings using string built in functions.

a. Find the frequency of a character in a string.
b. Replace a character by another character in a string.
c. Remove the first occurrence of a character from a string.
d. Remove all occurrences of a character from a string.

6. Write a program that accepts two strings and returns the indices of all the occurrences of the second string in the first string as a list. If the second string is not present in the first string, then it should return -1
7. Using Numpy module write menu driven program to do following

a. Create an array filled with 1's.
b. Find maximum and minimum values from an array
c. Dot product of 2 arrays.
d. Reshape a 1-D array to 2-D array.

8. Write a function that takes a sentence as input from the user and calculates the frequency of each letter. Use a variable of dictionary type to maintain the count.
9. Consider a tuple t1=(1,2,5,7,9,2,4,6,8,10). Write a program to perform following operations:

a. Print contents of t1 in 2 separate lines such that half values come on one line and otherhalf in the next line.
b. Print all even values of t1 as another tuple t2.
c. Concatenate a tuple t2=(11,13,15) witht1.
d. Return maximum and minimum value from t1..

10. Write a function that reads a file file1 and copies only alternative lines to another file file2.

Alternative lines copied should be the odd numbered lines.

11. Write a Python program to handle a Zero Division Error exception when dividing a number by zero.
12. Write a program that reads a list of integers from the user and throws an exception if any numbers are duplicates.
13. Write a program that makes use of a function to display sine, cosine, polynomial and exponential curves.
14. Take as input in the months and profits made by a company ABC over a year. Representthis data using a line plot. Generated line plot must include X axis label name = Month Number and Y axis label name = Total profit.

BCA Semester-III

DSC (Paper IV)
BCA3T12
SOFTWARE ENGINEERING

Credits: 2 **Duration: 30 Hours**

Course Objectives:

1. To provide the idea of decomposing the given problem into Analysis, Design, Implementation, Testing and Maintenance phases
2. To understand software process models such as waterfall and evolutionary models and software requirements and SRS document.
3. To understand different software design and architectural styles & software testing approaches such as unit testing and integration testing.
4. To understand quality control and how to ensure good quality software through quality assurance.
5. To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in an object oriented software projects

Course Outcomes:

1: Understand software engineering principles and software development life cycle models.
2: Apply software requirement engineering techniques to gather and analyze user requirements.
3: Design software systems using appropriate architectural and design patterns.
4: Implement software solutions using suitable programming languages and tools.
5: Evaluate and validate software using testing methodologies and tools.
6: Work effectively as part of a team and demonstrate project management skills.
7: Understand ethical and professional responsibilities in software engineering.

UNIT I

Introduction to Software Engineering : The evolving role of software, Changing Nature of Software, Software myths. A Generic view of process : Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models. Process models : The waterfall model, Incremental process models, Evolutionary process models, The Unified process. Software Requirements **:** Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document.

UNIT II

Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. System models: Context Models, Behavioral models, Data models, Object models, structured methods. Modeling with UML, Design Engineering: Design process and Design quality, Design concepts, the design model. Creating an architectural design : Software architecture, Data design, Architectural styles and patterns, Architectural Design.

UNIT III

Object-Oriented Design: Objects and object classes, An Object-Oriented design process, Design evolution. Performing User interface design: Golden rules, User interface analysis and design, interface analysis, interface design steps, Design evaluation. Testing Strategies: A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging. Product metrics **:** Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance.

UNIT IV

Metrics for Process and Products**:** Software Measurement, Metrics for software quality. Risk management**:** Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk

projection, Risk refinement, RMMM, RMMM Plan. Quality Management: Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards.

Books:

1.Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition. McGrawHill International Edition.

2. Software Engineering- Sommerville, 7th edition, Pearson education.

Reference Books:

1. Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers

2. Software Engineering an Engineering approach- James F. Peters, Witold Pedrycz, John Wiely.

3. Systems Analysis and Design- Shely Cashman Rosenblatt,Thomson Publications.

4. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill.

BCA Semester-III

DSC (Paper V)

BCA3T13

BASICS OF DATA ANALYTICS USING SPREADSHEET

Credits: 2 **Duration: 30 Hours**

Course Objectives

1. To understand the basics of data analytics and its applications.
2.To develop proficiency in using spreadsheet software for data manipulation and analysis.
3.To build and use spreadsheet models for decision making & Communicate data insights effectively

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand the fundamental concepts of data analytics and the role of spreadsheets in data analysis.
2. Perform data cleaning, formatting, and manipulation using spreadsheet tools.
3. Apply basic statistical functions and formulas in spreadsheets for descriptive analytics.
4. Create and interpret charts, graphs, and pivot tables to visualize data.
5. Solve real-world problems by applying data analysis techniques using spreadsheets.
6. Demonstrate the ability to communicate data-driven insights effectively.

UNIT I

Introduction to Data Analytics Understanding data and its types (structured, unstructured, semi-structured)-What is Data Analytics- Types of data Analytics-Importance of Data Analytics- Applications of Data Analytics, Role of Spreadsheets in Data Analytics, Overview of Microsoft Excel / Google Sheets, Basic Spreadsheet Functions, and Interface

UNIT II

Data Handling and Formatting, Importing and Entering Data in Spreadsheets, Data Cleaning Techniques (Removing Duplicates, Handling Missing Data), Formatting Cells, Conditional Formatting, Sorting and Filtering Data, Essential Functions and Formula, Basic Functions: SUM(), AVERAGE(), COUNT(), MIN(), MAX(), Logical Functions: IF(), AND(), OR(), IFERROR(), Text Functions: LEFT(), RIGHT(), LEN(), CONCATENATE(), Lookup Functions: VLOOKUP(), HLOOKUP(), INDEX(), MATCH()

UNIT III

Data Visualization Using Charts and Graphs, Creating Bar Charts, Line Charts, and Pie Charts, Using Pivot Tables for Data Summarization, Conditional Formatting for Visualization, Introduction to Dashboards in Spreadsheets, Data Analysis Technique, Data Sorting and Filtering for Insights, Using Pivot Tables for Analysis, Introduction to Data Validation and Drop-Down Lists, Performing Basic Statistical Analysis (STDEV(), VAR(), CORREL())

UNIT IV

Introduction to Automation Using Macros, Recording and Running Macros in Excel, Basics of VBA for Spreadsheet Automation, Simple Scripting in Google Sheets, Spreadsheet Tools: Moving between Spreadsheets, Selecting Multiple Spreadsheets, Inserting and Deleting Spreadsheets Renaming Spreadsheets, Splitting the Screen, Freezing Panes, Copying and Pasting Data between Spreadsheets, Hiding. Data Security & Protection: Protecting worksheets and cells, Restricting editing rights, Data Validation & Dynamic Drop-down Lists

Text Books

1. "Beginner's Guide for Data Analysis using R Programming" by Jeeva Jose,Khanna Publishing House, 2024.
2. "Data Analytics" by V.K. Jain, Khanna Book Publishing Company, 2024.
3. "Excel Data Analysis For Dummies" by Stephen L. Nelson and E. C. Nelson, John Wiley & Sons; 3rd edition, 2016
4. "Data Analysis Using Microsoft Excel" by Michael R. Middleton, Thomson, Brooks/Cole, 3rd edition , 2004

Reference Books

1. "Excel 2019 Bible" by Michael Alexander, Richard Kusleika, and John Walkenbach, John Wiley & Sons, 25 Sept 2018
2. "Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics" by Cliff T Ragsdale, Cegage learning asia pet. 2015
3. Excel Formulas & Functions For Dummies– Ken Bluttman
4. Microsoft Excel 2019 Data Analysis and Business Modeling – Wayne L. Winston
5. Storytelling with Data: A Data Visualization Guide for Business Professionals – Cole Nussbaumer Knaflic
6. Hands-On Data Visualization: Interactive Storytelling from Spreadsheets to Code – Jack Dougherty and Ilya Ilyankou
7. "Mastering Excel" by WebTech Solutions, Khanna Publishing House, 2024.

Credits: 2 **PRACTICAL LIST (BCA3P08)** **Duration: 60 Hours**

1. Explore and differentiate between structured, unstructured, and semi-structured data using sample datasets.
2. Familiarization with Microsoft Excel / Google Sheets interface — entering, saving, and navigating a spreadsheet.
3. Use basic spreadsheet functions: SUM(), AVERAGE(), MIN(), MAX(), COUNT(), etc., on a sample sales dataset.
4. Import data from external sources (CSV, TXT) into Excel / Google Sheets and perform data cleaning (remove duplicates, handle missing values).
5. Apply formatting and **conditional formatting** to highlight specific data conditions (e.g., top 10%, below average).
6. Use logical functions (IF(), AND(), OR(), IFERROR()) on a dataset for decision-making scenarios.
7. Use text functions: LEFT(), RIGHT(), LEN(), CONCATENATE() to manipulate customer data.
8. Apply lookup functions: VLOOKUP(), HLOOKUP(), INDEX(), MATCH() to retrieve data from structured tables.
9. Create bar charts, line graphs, and pie charts to visualize sales or survey data.
10. Generate and analyze a **pivot table** from a multi-column dataset to summarize sales by region or category.
11. Use conditional formatting to visualize performance trends (e.g., color scales for marks/ratings).
12. Perform **basic statistical analysis** using: STDEV(), VAR(), and CORREL() on a dataset (e.g., height vs weight).
13. Implement **data validation** with dropdown lists for consistent data entry in a form-like setup.
14. Record a **macro** to automate a repetitive task (e.g., formatting a report layout).
15. Write a simple **VBA script** to highlight all rows with sales above a certain threshold (Excel only).
16. Implement **simple Google Apps Script** (JavaScript-based) to auto-fill today's date in a

selected cell.

17. Work with multiple spreadsheets move data between sheets, rename, freeze panes, split screens.
18. Apply **worksheet and cell protection**, and restrict editing using passwords and protected ranges.
19. Create **dynamic drop-down lists** with dependent values (e.g., country > state > city).
20. **Mini Project**: Choose a real-world dataset (e.g., survey data, sales data, COVID-19 stats, etc.) and:

- Clean the data
- Perform analysis using formulas
- Visualize results using charts and pivot tables
- Automate part of the process using macros or scripts
- Apply data protection and validation

BCA Semester-III

SEC (Paper VI)

BCA3P09

SQL AND PL/SQL

Credits: 2 **Duration: 60 Hours**

Course Objectives:

The objective of this course is to provide students with a comprehensive understanding of database management systems (DBMS) and their role in modern information management. The course aims to develop students' skills in designing, querying, and managing relational databases.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Design and create relational databases using SQL.
2. Query and manipulate data using SQL commands.
3. Understand and implement the concept of Views
4. Utilize control structures, cursors, and exception handling
5. Implement and execute Function and trigger

UNIT I

CODD'S Rules, Oracle Database Objects, Sub Languages of SQL, Data types, Operators. **DDL Statement**: Creating Tables, Deriving Table from existing table, Altering, Dropping Tables. Integrity Constraints, Specifying Names for the Constraints, Viewing Integrity Constraints, Adding and Dropping Constraints. DML Statements: SELECT statement, Insert, Update, Delete, Working with Sequences and Synonyms. Built-in functions: Arithmetic, Date, Character, Conversion, Single row, Aggregate, Decode. Joins, Set Operators and Sub queries. DCL and TCL Statements: Grant, Revoke, Commit, Rollback and Savepoints.

UNIT II

VIEWS: Creating Views, Dropping Views, Inserting, Updating and Deleting Data using Views, Types of Views. PL/SQL Programming: PL/SQL Data Types, Identifiers, Operators and Expressions, Iterative Statements, Conditional Statements, emphasis on Problems.

UNIT III

Exception Handling: Predefined Exceptions, User defined Exceptions. Cursors: Declaring Cursors, Opening and Retrieving Records, Closing cursors. Attributes of Explicit and Implicit Cursors, Parameter Passing in Cursors. Procedures: Create and Drop Procedure, Creating Procedures with Parameters, Calling Procedures, Granting the EXECUTE Permission Problems on Exception Handling, Cursors and Procedures.

UNIT IV

Function: Creating and Dropping Function, Purity Levels in Functions, Executing Functions. **Triggers:** Create Triggers, Type of Triggers, Creating BEFORE and AFTER Triggers, INSTEAD-OF Triggers, Trigger Predicates, Inserting, Updating and Deleting Triggers, Enabling, Disabling and Dropping Triggers. Problems on Functions and Triggers

Text Books:

1. Understanding ORACLE By Ivan Bayross [BPB Publication]

Reference:

1. Database System Using Oracle: A Simplified Guide to SQL & PL-SQL: Nilesh Shah, PHI Publication.
2. Database Management Systems (Complete practical approach) by Sharad Maheshwari & Ruchin Jain, Firewall media
3. Dr. P. S. Deshpande SQL & PL/SQL for Oracle 10g Black Book
4. Scott Urman Programming PL/SQL TMH

Credits: 2 **PRACTICAL LIST(BCA3P09)** **Duration: 60 Hours**

1) DDL Statements :

1.a) **Create the table Invoice** with fields inv_no(char, Primary key), mv_no(number), cust_id(char), issue_date(date), return_date(date).

Insert data in the table invoice as follows:

Inv_no	mv_no	cust_id	issue_date	return_date
I01	1	a01	21-Dec-24	25-Dec-24
I02	3	a02	19-Oct-24	30-Oct-24
I03	5	a03	14-Jul-24	1-Aug-24
I04	5	a04	15-Sep-24	30-Sept-24
I05	6	a05	19-Oct-24	21-Oct-24
I06	7	a06	1-Jan-24	15-Jan-24
I07	8	a07	15-Aug-24	30-Aug-24
I08	2	a05	1-Oct-24	15-Oct-24
I09	4	a01	12-sep-24	19-Sep-24
I10	9	a02	1-Dec-24	15-Dec-24
I11	6	a05	2-feb-24	14-feb-24
I12	3	a06	1-Jan-24	10-Jan-24

1.b) Modifying Table Structure by adding the new field price (number) and increasing the size of inv_no.

1.c) Add and Drop Constraints

i) Add primary key constraint
ii) Drop primary key constraint
iii) Add Unique key constraint
iv) Drop Unique key constraint
v) Add check constraint

2) DML Statements:

2.a) Add records in above table

2.b) i)Change inv_no of I12 with 'I111'.
ii)Change issue_date of customer of cust_id 'a01' to '22-Dec-24'.
iii)Change movie no of cust_id 'a05' to 11.
iv)Display all movies with issue_date between 01-jan-24 to 01-sep-24
v)Display information for cust_id 'a01' & 'a02'.

2.c) i) Delete records with inv_no 'I11'from invoice table.
ii)Delete records having return date <='20-Jan-24'.

3) DCL and TCL Statements

i) Grant insertion and deletion privileges on invoice table to another user XYZ.
ii) Revoke the deletion privileges from user XYZ.
iii) After insertion of 2 records in invoice table create savepoint A.
iv) Delete a record and create savepoint B.
v) Rollback to A

4) Create the table **Movie** with fields mv_no(number, Primary Key), title(Char), Type(char), star(char), price(number), releasedate(date)

i) Add few records in above table
ii) Count total number of customers
iii) Calculate total price of all the movies.
iv) Calculate average price of all the movies.
v) Determine the maximum & minimum movies prices and rename the title as MAX-PRICE and MIN-PRICE.

vi) Count the number of movies having price greater than or equal to 150.
vii) Display total number of movies released in the current year.
viii) Display all the movie which start with letter 'K'.

5) i) **Create a View** of table Invoice with following column inv_no(char, Primary key), mv_no(number), cust_id(char)
ii) Insert and delete records
iii) Drop view

6) PL/SQL Programming:
Write a PL/SQL block
i) To find largest of 2 numbers
ii) To reverse the number

7) **Cursor**
i) Write a Cursor to fetch all rows of table invoice
ii) Write a Cursor to display all movies with issue_date between 01-jan-24 to 01- sep-24. If no record found then use Exception to display proper message.
iii) Write a Pl/SQL to accept the name and age of student and insert into table STUD after validating age not less than 18 otherwise raise exception

8) **Create Procedure**
i) To swap two values
ii) To display the cust_id, mv_no and call the procedure through main program

9) **Create Function**
i) To find gcd of two numbers.
ii) To find the total price of all the movie start with letter 'K' and call the function through main program

10) **Create Trigger**
i) That restricts the user from performing a DML on movie table on 'Monday'
ii) Covert all the movie name into the upper case on insertion of each row.

SEMESTER – IV

BCA Semester-IV

DSC (Paper I)

BCA4T14

ARTIFICIAL INTELLIGENCE

Credits: 3 **Duration: 45 Hours**

Course Objectives

1. To provide a comprehensive understanding of the key concepts, technologies, and applications of Artificial Intelligence (AI), including its history, capabilities, and ethical considerations.
2. To explore the different types of AI agents, environments, and decision-making processes, helping students understand how AI systems function and interact with their surroundings.
3. To introduce students to key problem-solving concepts in AI, including problem formulation, state spaces, and various search algorithms
4. To provide students with a deep understanding of advanced search algorithms, including A*, AO*, and Minimax, and to introduce evolutionary search techniques (e.g., Genetic Algorithms), allowing them to apply these techniques in real-world AI applications.

To provide a comprehensive understanding of the role of logic in Knowledge Representation

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Describe the fundamental principles of AI**,** its technologies, types, and applications, as well as understand the role of AI agents in decision-making and problem-solving.
2. Effectively use problem-solving strategies, search algorithms, and optimization methods like Genetic Algorithms to solve real-world AI problems.
3. Apply appropriate logical models and inference rules to develop intelligent systems capable of reasoning and answering complex queries.
4. Clear understanding of AI Tools and Techniques for Real world applications

UNIT I

Introduction: What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Risks and Benefits of AI.

Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit II

Solving Problems by Searching: Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

Search in Complex Environments: Local Search and Optimization Problems, Local Search in Continuous Spaces, Search with Nondeterministic Actions, Search in Partially Observable Environments, Online Search Agents and Unknown Environments.

Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems

Unit III

Knowledge and reasoning

Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic.

First-Order Logic: Representation Revisited Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.

Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining, Backward Chaining Resolution .

Unit IV

Knowledge Representation: Ontological Engineering, Categories and Objects, Events Mental Objects and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information

Automated Planning: Definition of Classical Planning, Algorithms for Classical Planning, Heuristics for Planning Hierarchical Planning, Planning and Acting in Nondeterministic Domains,

Time, Schedules, and Resources, Analysis of Planning Approaches.

Books

1. Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall.
2. Problem-Solving Methods in Artificial Intelligence by Nils J. Nilsson, McGraw-Hill Pub.
3. A Classical Approach to Artificial Intelligence by Munesh Chandra Trivedi Khanna Publishing House
4. Artificial Intelligence: Principles And Applications By Chandra S.S.,Vinod ,Hareendran S, Anand
5. Artificial Intelligence for Dummies by John Paul Mueller , Luca Massaron
6. Artificial Intelligence with Python By Prateek Joshi
7. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition ,by Aurélien Géron ,Publisher(s): O'Reilly Media, Inc.

Credits: 2 **PRACTICAL LIST (BCA4P10)** **Duration: 60 Hours**

1. Write a Python program simulating a simple **intelligent agent** (e.g., vacuum cleaner agent).
2. Create a basic **AI application demo** showing scope—like face detection using OpenCV or a chatbot interface.
3. Implement PEAS descriptions for different agents (e.g., self-driving car, thermostat).
4. Simulate a simple **goal-based agent** in a grid environment.
5. **Implementing a Problem-Solving Agent for the 8-Puzzle Problem**
6. Implement **Depth-First Search (DFS)** on a graph.
7. Implement **Breadth-First Search (BFS)** on a graph.
8. Implement **Uniform Cost Search (UCS)**.
9. Implement a **Hill Climbing** algorithm for solving an optimization problem (e.g., N-Queens problem).
10. Implement **A* algorithm** with a heuristic function (e.g., 8-puzzle or pathfinding on a map).
11. Create a **Tic-Tac-Toe game** using the **Minimax algorithm**.
12. Represent knowledge using **Propositional Logic** and perform inference manually and using code.
13. Implement **semantic networks** or **frame-based knowledge representation** using dictionaries in Python.
14. Use **state-space search** to solve a problem like the Missionaries and Cannibals or Water Jug problem.
15. Simulate **Partial Order Planning (POP)** using planning libraries or manual encoding.

BCA Semester-IV

DSC (Paper II)

BCA4T15

COMPUTER NETWORKS

Credits: 2 **Duration: 30 Hours**

Course Objective:

• To learn the fundamental concepts of networks and OSI layers.

To analyze various routing algorithms and security algorithms in networks.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

• To understand the fundamentals of network and transmission media.

• To understand the error detection, correction codes and datalink layer protocols.

• To understand the various routing algorithms and Internetworking.

• To enhance the knowledge of sockets and congestion control techniques.

• To enhance the knowledge in IDS and cryptographic techniques.

UNIT I

Introduction- Uses, Network Hardware, Software, Reference Models (OSI model and TCP/IP model) **PHYSICAL LAYER:** Theoretical Basis for Communication - Electromagnetic Spectrum, Radio Transmission, Digital Modulation, Baseband Transmission -Transmission Media, Wireless Transmission.

UNIT II

DATA LINK LAYER: Design Issues - Services, Framing, Error Control, Flow Control - Error Detection and Correction Codes, Hamming Code, Cyclic Redundancy Check - Data Link Layer Protocols, Simplex Protocol, Sliding Window Protocols - Medium Access Control Sublayer, Wireless LAN Protocols - Ethernet MAC Sublayer Protocol, 802.11 MAC Sublayer Protocol, Data Link Layer Switching, Repeaters, Hubs, Bridges, Switches, Routers and Gateways.

UNIT III

NETWORK LAYER: Design Issues- Routing Algorithms, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing - Congestion Control Approaches, Traffic-Aware Routing, Admission Control, Traffic Throttling, Load Shedding - Internetworking, Tunneling, Internetwork Routing, IPv4, IP Addresses, IPv6.

UNIT IV

TRANSPORT LAYER: Services- Berkeley Sockets, Example - Elements of Transport Protocols Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, UDP – TCP Segment Header, Connection Establishment, Connection Release, Sliding Window, Timer Management - Congestion Control. **APPLICATION LAYER:** DNS, E-Mail, WWW, Architecture, HTTP

Text Books:

1. A. S. Tanenbaum and D. J. Wetherall, Computer Networks, Pearson, 6th Edition, 2021.
2. Behrouz A. Ferouzon Data Communication and Networking with TCP/IP Protocol Suite, McGraw Hill, 6th Edition, 2022.

References:

1. J. F. Kurose and K.W. Ross, Computer Networking: A Top-down approach, Pearson, 7 th Edition, 2017.
2. Larry L. Peterson and Bruce S. Davie, Computer Networks- A System Approach, Elsevier, 5th Edition, 2012.

BCA Semester-IV

DSC (Paper III)
BCA4T16
PHP

Credits: 3 **Duration: 45 Hours**

Course Objectives:

1. Fundamental understanding of PHP
2. **Working with Forms and User Input**
3. Integration with database
4. Understanding principles of OOPs in PHP
5. Introduce session and cookies

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Master PHP Syntax and Basic Programming Concepts
2. Implement Data Handling with Forms
3. Perform Database Operations
4. Apply Object-Oriented Programming (OOP) Principles
5. Implement Sessions and Cookies for User Management

UNIT I

Introduction to PHP: A Brief History of PHP, Installing and Configuring PHP on Windows and Linux Platforms **Language Basics:** Lexical Structure, Data Types, Variables, Constant, Expressions and Operators, Flow-Control Statements, Including Code, Embedding PHP in Web Pages. **Functions:** Calling a Function, Defining a Function, Variable Scope, Function Parameters, Return Values, Variable Functions, Anonymous Functions.

UNIT II

Strings: Quoting String Constants, Printing Strings, Accessing Individual Characters, Cleaning Strings, Encoding and Escaping, Comparing Strings, Manipulating and Searching Strings, Regular Expressions **Arrays:** Indexed Versus Associative Arrays, Identifying Elements of an Array, Storing Data in Arrays, Multidimensional Arrays, Extracting Multiple Values, Converting Between Arrays and Variables, Traversing Arrays, Sorting, Acting on Entire Arrays, Using Arrays

UNIT III

Working With Forms: Form Elements, Text Box, Text Area, Password, Radio Button, Check Box, Combo Box, Hidden Field, Image, Submit and Reset Buttons, Adding Elements to a Form **Uploading Files to the Web Server:** The move_uploaded_file() Function **Working With Database:** Mysql database Basics, Execute SQL Queries In PHP, Connecting to the MYSQL DB Engine, Selecting The Database, Executing Commands, Closing Database Connection.

UNIT IV

Object Oriented Programming: Objects, Defining a Class, Instantiation and Accessing Methods and Properties, Constructor, Destructor, Class Constant, $this Keywords, Scope Resolution Operator (::), self and parent Keywords, Extending a Class, Class Abstraction, Object Interfaces, Object Cloning, Object Comparison, final Keyword, Introspection, Serialization **Web Techniques:** HTTP Basics, Variables, Server Variables, Server Information, Processing Forms, Setting Response Headers, Session, cookies, files, Maintaining State, SSL.

Reference Books:

1. Programming PHP by Rasmus Lerdorf and Kevin Tatroe, Orilly Publications
2. PHP 5.1 for beginners by Evan Bayross and Sharman Shah, SPD Publications

Credits: 2	PRACTICAL LIST (BCA4P11)	Duration: 60 Hours

1) Write a program in PHP, to check whether a person is eligible for voting or not (check for nationality and age)?
2) Write a program in PHP, to compute and print the factorial of a number?
3) Write a program in PHP, Illustrating use of switch case statement?
4) Write a program in PHP, to swap and print the values of two variables without using third variable? (Use function swap())
5) Write a program in PHP, illustrating concept of function returning multiple values (array of values)?
6) Write a program in PHP, illustrating string operations which changes case of a string?
7) Create an array of files names Ex10.php, ex1.php, ex5.php, Fact.php and demo.php, print the array, sort the array and print sorted array again.
8) Write a program in PHP to create user login form.
9) Write a program in PHP for collecting user's personal information and print the same on the webpage.
10) Program in PHP, illustrating use of PHP server variable.
11) Program in PHP, to redirect browser using HTTP header.
12) Program in PHP, Illustrating concept of class and object.
13) Program in PHP, Illustrating concept of constructor.
14) Program in PHP, Illustrating use of final keyword.
15) Program in PHP, Illustrating concept of self and parent keyword.
16) Program in PHP, Illustrating concept of multilevel inheritance.
17) Program in PHP, Illustrating concept of Interface.
18) Program in PHP, Illustrating concept of introspection.
19) Program in PHP to connect to the mysql database and execute commands insert, delete and update on a database table.
20) Program in PHP to connect to the mysql database and insert multiple records in the database using prepared statemen

BCA Semester-IV

DSC (Paper IV)
BCA4T17
DESIGN AND ANALYSIS OF ALGORITHM

Credits: 3 **Duration: 45 Hours**

Course Objectives:

1. This course envisions to impart to students the understanding of basic algorithm designing paradigms.
2. This course introduces the basic knowledge on how to analyze an algorithm.
3. This course expects to enable a student to synthesize efficient algorithms in common design situations and real-life problems.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand the basic concepts of algorithms and analyse their performance using time and space complexity.
2. Apply the divide and conquer technique to solve recursive problems like sorting, searching, and matrix multiplication.
3. Apply greedy algorithms to optimization problems like spanning trees, knapsack, and job sequencing.
4. Use dynamic programming for solving complex problems like shortest paths, knapsack, and TSP efficiently.
5. Demonstrate problem-solving using backtracking and branch & bound techniques, and understand NP-completeness.

UNIT I

What is an algorithm? **Design and performance analysis of algorithms:** space complexity, time complexity, Amortized Complexity, Asymptotic notations (O, Ω, Θ) to measure growth of a function and application to measurecomplexity of algorithms, Performance measurement.

UNIT II

The Divide & Conquer Design Technique: General method, Defective chessboard, Binary search, finding the maximum and minimum, merge sort, quick sort, Selection sort, Best and worst-case analysis for the mentioned algorithms, Strassen's matrix multiplication. **The Greedy Design Technique:** The general method, Knapsack problem, Job sequencing with deadlines. **Minimum cost spanning trees:** Prim's and Kruskal's algorithms, Dijkstra's algorithm for finding single source shortest paths problem.

Unit III

The Dynamic Programming Design Technique:

The general concept, Multistage graph, all pair - shortest paths problem (Floyd-Warshall's algorithm), single source shortest paths (Bellman and Ford Algorithm), Optimal Binary Search Trees (Star), 0/1 Knapsack problem, The traveling salesperson problem. **Techniques for Graphs:** Breadth First Search and Traversal, Depth First Search and Traversal, connected components and Spanning Trees.

Unit IV

Backtracking Method: The general method, n-Queen problem, sum of subsets, Hamiltonian cycles, Knapsack problem. **Branch and Bound:** List cost (LC) search, 0/1 Knapsack problem. Traveling salesperson (*) Computational Intractability: Overview of non-deterministic algorithms, P, NP, NP-Completeand NP-hard problems.

Text Books

1. Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, Second Edition University Press (I) Pvt. Ltd., 2014.
2. Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook)
3. Fundamentals of Algorithmics by Gilles Brassard & Paul Bratley, Pearson Publication.
4. Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009.
5. Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson,2012

Reference Books

1. Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston, 1983.
2. Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education, 2006.

Web Resources

1. https://nptel.ac.in/courses/106101060
2. https://www.cs.umd.edu/~mount/451/Lects/451lects.pdf

BCA Semester-IV

SEC (Paper V)
BCA4T18
DATA VISUALIZATION

Credits: 2 **Duration: 30 Hours**

Course Objectives

1. Understand the fundamentals of data visualization and its importance.
2. Learn about visual perception and its impact on data interpretation.
3. Explore the ethical considerations and challenges in data visualization.
4. Study different types of visualizations and their appropriate uses.
5. Utilize Power BI to create and customize various types of visualizations.

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Understand the fundamentals of data visualization, including data types, the visualization process, and the importance of visualization in decision-making also analyse the strengths and limitations of various data visualization tools (Excel, Tableau, Power BI, Python) and select appropriate tools for specific use cases.
2. Apply the principles of visual storytelling to effectively communicate insights using data narratives, dashboards, and structured frameworks.
3. Use Tableau to connect data sources, build basic and advanced visualizations, apply filters and calculations, and design interactive dashboards.
4. Utilize Power BI for data import, cleaning, transformation, and visualization, and write basic DAX expressions for custom calculations and time-based analysis.

UNIT I

Introduction to Data Visualization Definition and importance of data visualization-Role of data visualization in decision making Types of data (numerical, categorical, temporal, geographical)- Data visualization process (data collection, exploration, analysis, visualization, interpretation)- Challenges and limitations of data visualization, **Visualization tools:** Overview of Visualization Tools (e.g., Excel, Tableau, Power BI, Python)- Comparing and contrasting features and Use Cases among these tools.

UNIT II

Visual Storytelling: Introduction, Why Storytelling Matters, Science behind Storytelling, Presentation Types, Death by Presentation Storytelling Framework: Introduction, Importance of Business Storytelling, Storytelling Frameworks, Data Storytelling, Narrative Types, Dimensions of Narrative Storytelling, Data Story Types, Analytics Dashboard.

UNIT III

What is Tableau, Getting started with Tableau Software using Data file formats, connecting your Data to Tableau, Foundations for building visualizations: Measures and dimensions, Discrete and continuous fields Visualizing data: Bar charts, Line charts, Geographic visualizations, Using Show Me, putting everything together in a dashboard, Connecting to Data in Tableau, filtering data, Moving Beyond Basic Visualizations, Introduction to calculation, Row level calculation, Aggregate calculation, an overview of table calculations, Creating and editing table calculations, Quick table calculations.

UNIT IV

Introduction to Business Intelligence & Data Visualization: What is Business Intelligence (BI)?, Importance of data visualization in decision-making, Power BI vs. Excel vs. Tableau, Power BI components (Power BI Desktop, Service, Mobile), Installing and setting up Power BI Desktop, Understanding the Power BI Interface, Connecting and Importing Data: Importing from Excel, CSV, databases, cloud sources, Data transformation basics using Power Query, Data Cleaning and Preparation: Removing duplicates, handling missing values, filtering data, Data types and formatting in Power BI. **Introduction to DAX (Data Analysis Expressions), Basic DAX syntax and functions**: Aggregation functions (SUM, AVERAGE, COUNT, DISTINCTCOUNT), Logical functions (IF, SWITCH), Time intelligence functions (DATEADD, SAMEPERIODLASTYEAR)

Text Books:

1. Mastering Data Visualization with Tableau, Empowering business decisions with Tableau Dr. Arpana Chaturvedi Prof. Praveen Malik, bpb publication
2. Data Visualization: Storytelling Using Data, **Sharada Sringeswara, Purvi Tiwari, U. Dinesh Kumar**
3. "Storytelling with Data: A Data Visualization Guide for Business Professionals" Cole Nussbaumer Knaflic, Wiley; 1st edition, 2015.
4. ***Learning Tableau 2022*** Joshua N. Milligan, Packt Publishing, Fifth Edition
5. *Power BI Cookbook* by Brett Powell
6. "Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017.

Reference Books:

1. "The Visual Display of Quantitative Information" by Edward Tufte, Graphics Press USA; 2nd edition, 2001.
2. "Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press, 2018.
3. ***Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software*** Daniel G. Murray, Wiley
4. "Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018.

Web Resources

1. https://learn.microsoft.com/en-us/power-bi/
2. https://www.storytellingwithdata.com/
3. https://jpsm.umd.edu/sites/jpsm.umd.edu/files/syllabi/Syllabus_Introduction%20to%20Data%20Visualization_Spring%202024.pdf

Credits: 2	PRACTICAL LIST (BCA4P12)	Duration: 60 Hours

1. **Identify Data Types**
   - Classify a given dataset into numerical, categorical, temporal, and geographical types.
2. **Data Visualization Workflow**
   - Collect a small dataset from a public source (e.g., Kaggle, government portal), clean it in Excel, and create basic charts.
3. **Tool Comparison**
   - Create a simple bar chart using Excel, Tableau, and Power BI. Compare features (ease of use, customization, interactivity).
4. **Storytelling with Charts**
   - Build a visual story using a dataset (e.g., COVID-19 data, sales data). Present a narrative using charts with annotations.
5. **Dashboard Narrative**
   - Design a mockup for a dashboard that tells a story for a business scenario (e.g., sales trends or HR attrition).
6. **Presentation Analysis**
   - Analyze a poorly designed presentation ("Death by PowerPoint") and redesign it with a storytelling approach.
7. **Connecting to Data**
   - Load Excel/CSV data into Tableau and explore data fields.
8. **Create Basic Visualizations**
   - Build a bar chart, line graph, and map using “Show Me”.
9. **Create a Dashboard**
   - Combine multiple visualizations into an interactive dashboard with filters.
10. **Use Calculations**
    - Apply row-level and aggregate calculations to create custom fields.
11. **Quick Table Calculations**
    - Use built-in functions like Running Total, Percent Difference, etc.
12. **Power BI Setup and Data Import**
    - Install Power BI Desktop and import data from Excel and CSV.
13. **Basic Visualizations**
    - Create bar, pie, and line charts using Power BI visuals.
14. **Data Cleaning in Power Query**
    - Remove duplicates, handle missing values, change data types.
15. **Create a Dashboard**
    - Develop a multi-page dashboard with slicers and visuals.
16. **DAX Formulas**
    - Write simple DAX expressions using:
      - SUM, AVERAGE, COUNT
      - IF, SWITCH
      - DATEADD, SAMEPERIODLASTYEAR

BCA Semester-IV

VAC

BCA4P13

DESIGN THINKING AND INNOVATION

Credits: 1 **Duration: 15 Hours**

Course Objectives:

Operating under turbulent and uncertain business environment, 'innovation' has become the key driver of organizational success for all companies. Managers are expected to be leading this change by navigating companies into rapid evolution of new products/services and business models.

The primary focus of Design Thinking and Innovation (DTI) is to help learners develop creative thinking skills and apply design-based approaches/tools for identifying and implementing innovation opportunities into implementable projects. Following a learning-by-doing approach, the objectives of the course are:

1. Introduce students to design-based thinking approach to solve problems
2. Observe and assimilate unstructured information to well framed solvable problems
3. Introduce student to templates of ideation
4. Understand the importance of prototyping in the innovation journey
5. Implementing innovation projects

Course Outcomes: After completing this course satisfactorily, a student will be able to:

1. Propose real-time innovative product designs and Choose appropriate frameworks, strategies, techniques during prototype development.
2. Know wicked problems and how to frame them in a consensus manner that is agreeable to all stakeholders using appropriate frameworks, strategies, techniques during prototype development.
3. Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products

Unit I

Basics of Design Thinking

1. Understand the concept of innovation and its significance in business
2. Understanding creative thinking process and problem solving approaches
3. Know Design Thinking approach and its objective
4. Design Thinking and customer centricity – real world examples of customer challenges, use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product.
5. Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc.
6. Explain the four stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement

Unit II

Learning to Empathize and Define the Problem

1. Know the importance of empathy in innovation process – how can students develop empathy using design tools
2. Observing and assimilating information
3. Individual differences & Uniqueness Group Discussion and Activities to encourage the understanding, acceptance and appreciation of individual differences.
4. What are wicked problems

Identifying wicked problems around us and the potential impact of their solutions

UNIT III

Ideate, Prototype and Implement

1. Know the various templates of ideation like brainstorming, systems thinking
2. Concept of brainstorming – how to reach consensus on wicked problems
3. Mapping customer experience for ideation
4. Know the methods of prototyping, purpose of rapid prototyping.
5. Implementation

UNIT IV

Feedback, Re-Design & Re-Create

1. Feedback loop, focus on User Experience, address ergonomic challenges, user focuseddesign
2. Final concept testing,
3. Final Presentation – Solving Problems through innovative design concepts & creativesolution

Text Books (Latest Edition):

1. E Balaguruswamy (2023), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company
2. Tim Brown, (2008), "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", *Harvard Business Review*
3. 8 steps to Innovation by R T Krishnan & V Dabholkar, Collins Publishing

Reference Book

1. Design Thinking by Nigel Cross, Bloomsbury