PROGRAM STRUCTURE, CREDITS, AND SYLLABUS

Of

BACHELOR IN COMPUTER APPLICATIONS (BCA)

AS PER AICTE MODEL CURRICULUM-2024

(NATIONAL EDUCATION POLICY – 2020)

(To be effective from the session 2025-2026)

CHAUDHARY CHARAN SINGH UNIVERSITY, MEERUT

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THREE / FOUR-YEARS UG DEGREE
IN
BACHELOR IN COMPUTER APPLICATIONS WITH MULTIPLE ENTRY/ EXIT OPTIONS

UNDER GRADUATE CERTIFICATE IN COMPUTER APPLICATIONS

UNDER GRADUATE DIPLOMA IN COMPUTER APPLICATIONS

BACHELOR IN COMPUTER APPLICATIONS

BACHELOR IN COMPUTER APPLICATIONS (HONOURS)

BACHELOR IN COMPUTER APPLICATIONS (HONOURS WITH RESEARCH)

Bachelor in Computer Applications

Program Objectives:

The Program Objectives (POs) of a Bachelor in Computer Applications (BCA) typically intends to prepare students for professional careers and further studies. The main objectives are

1. **Foundational Knowledge**

   To equip students with a strong foundation in computer science, programming, mathematics, and information technology to enable them to develop computational solutions.

2. **Professional Skills Development**

   To train students in the latest tools, technologies, and programming languages to prepare them for careers in software development, system administration, and IT services.

3. **Problem Solving and Analytical Thinking**

   To foster the ability to analyze complex problems and develop logical and efficient solutions using appropriate algorithms and data structures.

4. **Ethical and Social Responsibility**

   to instil awareness of ethical, legal, and social issues in the computing profession, encouraging responsible and sustainable use of technology.

5. **Effective Communication and Teamwork**

   To develop interpersonal and communication skills to enable students to work effectively in teams and in diverse professional environments.

6. **Entrepreneurial and Innovative Thinking**

   To encourage creativity and innovation, enabling students to conceive new ideas, design novel solutions, and potentially start entrepreneurial ventures.

7. **Lifelong Learning and Higher Education**

   To prepare students for lifelong learning and advancement in computing disciplines, including pursuit of higher education such as MCA, MBA, or other professional courses.

8. **Industry Readiness and Employability**

   To align curriculum with industry needs to enhance students' employability and readiness to work in various IT roles such as software developers, testers, analysts, and support professionals.

Program Outcomes (Pos)

After the completion of the program students will be able to

PO 1 – Apply knowledge of computing fundamentals, mathematics, and domain-specific knowledge for the conceptualization of computing models from defined problems.

PO 2 – Identify, formulate, and analyze complex problems using principles of mathematics, computing, and domain knowledge to reach substantiated conclusions.

PO 3 – Use modern tools, techniques, and computing resources for modeling and solving real-world problems, with an understanding of their limitations.

PO 4 – Apply innovation and entrepreneurship practices to create and manage IT-based solutions or businesses.

PO 5 – Communicate effectively with the technical community and society at large by being able to write effective reports, design documentation, and make effective presentations.

PO 6 – Understand professional, ethical, legal, security, and social issues and responsibilities, and understand the impact of professional computing solutions in societal and environmental contexts and demonstrate knowledge of sustainable development.

PO 7 – Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary settings, and manage projects in a professional environment.

PO 8 – Equipped with skill to recognize administration and computing philosophy with computing acquaintance to supervise projects in multidisciplinary environments.

Program Specific Outcomes (PSOs)

BCA with Specialization in Artificial Intelligence and Machine Learning

1. **PSO 1 – AI/ML Proficiency:** Apply fundamental and advanced principles of Artificial Intelligence and Machine Learning to analyze data, design intelligent systems, and develop predictive models across various domains.

2. **PSO 2 – Practical Implementation Skills:** Build and deploy real-world applications using AI/ML frameworks and tools such as Python, TensorFlow, Keras, Scikit-learn, and other relevant libraries.

3. **PSO 3 – Data-Driven Decision Making:** Demonstrate the ability to preprocess, analyze, and interpret data using statistical and machine learning techniques to make informed, data-driven decisions.

4. **PSO 4 – Algorithmic Thinking for Intelligent Systems:** Design and evaluate machine learning algorithms, including supervised, unsupervised, and reinforcement learning techniques, to solve classification, regression, and clustering problems.

5. **PSO 5 – Research and Innovation:** Engage in innovation, research, and project development in AI/ML to address real-life challenges in sectors such as healthcare, agriculture, finance, education, and smart cities.

6. **PSO 6 – Ethical AI Practice:** Understand and apply ethical principles and societal considerations related to artificial intelligence, such as bias, fairness, transparency, and accountability in intelligent systems.

BCA with Specialization in Data Science

1. **PSO 1 – Data Science Foundations:** Apply core concepts of statistics, mathematics, and computer science to extract meaningful insights from structured and unstructured data.

2. **PSO 2 – Data Analytics and Visualization:** Use data analysis techniques and visualization tools to analyze large datasets and present data-driven insights effectively.

3. **PSO 3 – Machine Learning Applications:** Design and implement machine learning models to solve classification, regression, and clustering problems using tools such as Scikit-learn, TensorFlow, or similar frameworks.

4. **PSO 4 – Big Data Technologies:** Work with big data platforms and tools (e.g., Hadoop, Spark, Hive) to manage, process, and analyze large-scale datasets efficiently.

5. **PSO 5 – Business and Domain Knowledge:** Apply data science methods to real-world problems in domains such as business, healthcare, finance, education, and social media, supporting strategic decision-making.

6. **PSO 6 – Ethical Data Practice:** Demonstrate awareness of legal, ethical, and privacy issues related to data collection, storage, analysis, and sharing, adhering to data governance and responsible AI practices.

Contents

BCA COURSE STRUCTURE, CREDITS AND SYLLABUS

1. **Program Name:** Bachelor in Computer Applications
2. **Program Level/ Duration/ Semester:** Undergraduate/ Three or Four years/ 6 or 8 Semesters with multiple entry and exit.
3. **Maximum period to complete the degree:** Seven Years
4. **Options in Bachelor in Computer Applications (BCA) Degree Program:**
   - **4.1** One year (two semesters) Under Graduate Certificate in Computer Applications
   - **4.2** Two years (four semesters) Under Graduate Diploma in Computer Applications
   - **4.3** Three years (six semesters) Bachelor in Computer Applications (BCA)
   - **4.4** Four years (eight semesters) Bachelor in Computer Applications with Honours [BCA (Honours)]
   - **4.5** Bachelor in Computer Applications (Honours with Research) [BCA (Honours with Research)]
5. **Minimum Eligibility Criteria:**
   1) Mathematics at High school mandatory
   2) 10+2 (Arts with mathematics/ Agriculture/ Bio/ Science/ Commerce)
6. **Minimum eligibility criteria for the fourth year of BCA:**

   6.1 BCA (Honours): BCA Degree (and Summer Internship/ Capstone Project-II of 4 credits) as per the prescribed regulations

   6.2 BCA(Honours with Research): BCA Degree with 8 CGPA (and Summer Internship/ Capstone Project-II of 4 credits) as per the prescribed regulations

7. **Abbreviations and Definitions:**

TABLE-I

L+T	Lecture + Tutorial
TH	Theory
P	Practical
CC	Core Course
DSEC	Discipline Specific Elective Course
GEC	Generic Elective Course
SEC	Skill Enhancement Course
AEC	Ability Enhancement Course
VAC	Value Addition Course
	Skill-Based Course / Work-Based Vocational Course/ Social Responsibility & Community Engagement/ Internship/ Apprenticeship/ Capstone Project

8. Definition of Credit:

TABLE-II

1 Hr. Theory(TH), Lecture (L) or Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 Credit

9. Semester-wise Credit Distribution:

TABLE-III

Sem.	Core Course (CC)	Discipline Specific Elective Course (DSEC)	Generic Elective Course (GEC)	Skill Enhancement Course (SEC)	Ability Enhancement Course (AEC)	Value Addition Course (VAC)	Total Credits
I	8	-	2	5	2	2	19
II	12	-	-	7	-	2	21
III	11	3	-	4	-	2	20
IV	15	3	-	2	-	-	20
V	-	15	-	6	-	-	21
VI	4	10	-	4	1	-	19
BCA Honours							
VII	5	8	3	4	-	-	20
VIII	-	12	-	8	-	-	20
BCA Honours with Research							
VII	8	8	-	4	-	-	20
VIII		-	-	20	-	-	20

10. Category-wise Credit Distribution:

TABLE-IV

Certificate / Diploma / Degree	Core Course (CC)	Discipline Specific Elective Course (DSEC)	Generic Elective Course (GEC)	Skill Enhancement Course (SEC)	Ability Enhancement Course (AEC)	Value Addition Course (VAC)	Credits
UG Certificate in Computer Applications	20	0	2	12	2	4	40+4* *Credits through Summer Internship
UG Diploma in Computer Applications	46	6	2	18	2	6	80+4* *Credits through Summer Internship / Capstone Project-I
BCA Degree	50	31	2	28	3	6	120
BCA (Honours) Degree	55	51	5	40	3	6	160
BCA (Honours with Research) Degree	58	39	2	52	3	6	160

11. Additional Credits:

11.1 *A student who exits after first year will always carry additional 4 credits (not credited to SGPA/ CGPA), earned through a Summer Internship after second semester, mandatory for exit with UG Certificate in Computer Applications.

11.2 *A student who exits after second year will always carry additional 4 credits (not credited to SGPA/ CGPA), earned through a Summer Internship after fourth semester, mandatory for exit with UG Diploma in Computer Applications.

12. Category of Courses:

Three / Four-Years Under Graduate (Honours/ Honours with Research) Degree program will comprise following category of courses:

12.1 **Core Course (CC):** CC are the core credit courses of the specific discipline spreading across the semesters giving adequate knowledge of the Major Discipline.

12.2 **Discipline Specific Elective Course (DSEC):** DSEC are the discipline-specific open elective courses offered from a pool of courses by the department itself.

12.3 **Generic Elective Course (GEC):** GEC courses will provide multi-disciplinary or interdisciplinary knowledge to students.

12.4 **Skill Enhancement Course (SEC):** These courses are aimed at imparting practical skills, hands-on training, soft skills, etc., to enhance the employability of students. Except for the summer Internship mandatory for Certificate in Computer Application, all other Internships/ Projects/ Dissertations defined in the scheme will fall under SEC.

12.5 **Ability Enhancement Course (AEC):** Ability Enhancement Courses (AECs) are designed to broaden a student's knowledge and understanding beyond their core discipline, offering a variety of subjects to enhance their overall learning experience. These courses aim to improve communication skills, provide a deeper understanding of soft skill, and potentially explore other areas like literature, history, or specific languages.

12.6 **Value Addition Course (VAC):** These courses will be based on ethics, culture, Indian Knowledge systems, constitutional values, etc. to understand India, sports education, Yoga education, Health and Fitness education, environmental education, digital and technological solutions, and similar courses.

12.7 **Skill-Based Course/ Work-Based Vocational Course/ Social Responsibility & Community Engagement / Internship/ Apprenticeship/ Capstone project**

12.7.1 **Skill-Based Course:** A specialized course aimed at enhancing technical and practical expertise in computer applications.

12.7.2 **Work-Based Vocational Course:** A vocational course during the summer vacations, focused on building practical, industry-relevant skills.

12.7.3 **Social Responsibility & Community Engagement:** Involvement with an NGO or community-based organization, contributing to social initiatives and applying computer application knowledge to solve real-world challenges.

12.7.4 **Internship/Apprenticeship:** A professional internship or apprenticeship offering hands- on experience in a relevant field.

12.7.5 **Capstone Project:** A capstone project to integrate the skills and knowledge gained so far through the program.

12.8 **Major Project:** A substantial, independent work based on practical application and theoretical understanding that demonstrates proficiency in core CS concepts and skills.

12.9 **Research Project / Dissertation:** Research, analysis, and practical application contributing to a specific area of computer science.

13. Structure, Courses and Credits

Table V

Sem.	Level of Course	Core Course (CC) and credits	Discipline Specific Elective Course (DSEC) and credits	Generic Elective Course (GEC) and credits	Skill Enhancement Course (SEC) and credits	Ability Enhancement Course (AEC) and credits	Value Addition Course (VAC) and credits	Total Credits
I	Foundation or Introductory Level	CC-I Mathematical Foundation for Computer Science-I (TH ; 3) CC-II Computer Architecture (TH : P ; 3 : 2)	-	GEC-I Indian Knowledge System (TH : 2)	SEC-I Problem Solving Techniques (TH : P ; 3 : 2)	AEC - I General English–I (TH ; 2)	VAC - I Environmental Science and Sustainability (TH ; 2)	19
II		CC-III Mathematical Foundation for Computer Science-II (TH ; 3) CC-IV Data Structures (TH : P ; 3 : 2) CC-V Operating Systems (TH : P ; 3 : 1)	-	-	SEC-II Object Oriented Programming using Java (TH : P ; 3 : 2) SEC-III Web Technologies (TH : P ; 1 : 1)		VAC - II Indian Constitution (TH ; 2)	21
Note: Summer Internship of 8 weeks/ 120 hours to exit with Certificate (4 credits)								
Specializations: Group A- Artificial Intelligence & Machine Learning Group B-Data Science Group C- Full Stack Management								
III	Intermediate Level	CC-VI Probability and Statistics (TH ; 3) CC-VII Database Management Systems (TH : P ; 3 : 2) CC-VIII Software Engineering (TH ; 3)	**Group-A:** Elective-I: DSEC-I Feature Engineering (TH : P ; 1 : 2) **Group-B:** Elective-I: DSEC-II Basics of Data Analytics using Spreadsheet (TH : P ; 1 : 2) **Group-C:** Elective-I: DSEC-III Web Programming I (TH : P ; 1 : 2)	-	SEC-IV Python Programming (TH : P ; 2 : 2)	-	VAC – III- A/B/C/D/E Yoga and Physical Fitness/ Sports/ Disaster Management /NSS/ NCC (P ; 2)	20
IV		CC-IX Entrepreneurship and Startup Ecosystem	**Group-A:** Elective-II: DSEC-IV Introduction to	-	SEC-V Design Thinking and Innovation (TH ; 2)	-	-	20

		(TH : 2)	Machine Learning (TH : P ; 1 : 2)				
		CC-X Computer Networks (TH : P ; 3 : 2)					
		CC-XI Design and Analysis of Algorithms (TH ; 3)	**Group-B:** Elective-II: DSEC-V Data Visualization (TH : P ; 1 : 2)				
		CC-XII Artificial Intelligence (TH : P ; 3 : 2)	**Group-C:** Elective-II: DSEC-VI Web Programming-II (TH : P ; 1 : 2)				

Note:1. Summer Internship/ Capstone Project-I of 8 weeks/ 120 hours (4 credits) is mandatory for all.
2. Summer Internship/ Capstone Project-I is mandatory to exit with Diploma in Computer Application to continue for the fifth semester. In case of reentry or continuation of the degree, credits will be awa under predefined SEC in the fifth semester

V	Higher Level	-	**Group-A:** Elective-III: DSEC-VII Neural Network (TH : P ; 3 : 2) Elective-IV: DSEC-VIII Digital Image Processing (TH : P ; 3 : 2) Elective-V: DSEC-IX Natural Language Processing (TH : P ; 3 : 2)	-	SEC-VI Quantitative Techniques (TH : 2)	-	-
			Group-B: Elective-III: DSEC-X Introduction to Data Science (TH : P ; 3 : 2) Elective-IV: DSEC-XI Time Series Analysis (TH : P ; 3 : 2) Elective-V: DSEC-XII Machine Learning (TH : P ; 3 : 2)		SEC-VII Summer Internship/ Capstone Project-I [done in summer break after fourth semester] (P ; 4) Major Project [Evaluation in sixth semester]		

VI		CC-XIII Generative AI (TH : P ; 2 : 2)	**Group-A:** Elective-VI: DSEC-XIII Deep Learning for Computer Vision (TH : P ; 3 : 2) Elective-VII: DSEC-XIV Predictive Analysis (TH : P ; 3 : 2) **Group-B:** Elective-VI: DSEC-XV Big Data Analytics (TH : P ; 3 : 2) Elective-VII: DSEC-XVI Exploratory Data Analysis (TH : P ; 3 : 2)	-	SEC-VIII Major Project [Initiated in fifth semester] (4)	AEC - II Soft Skills (TH ; 1)	-	19

Note: 1. Student may exit with BCA degree
2. Summer Internship/ Capstone Project-II is mandatory to reenter or continue for the seventh semester. In case of reentry or continuation of the degree, credits will be awarded under predefined SEC in the seventh semester.

BCA (Honours)
Specialization: Artificial Intelligence & Machine Learning (Group A)
Data Science (Group B)

VII	(Honours) Advanced Level	**Group-A:** CC-XIV Optimization of Machine Learning (TH : P ; 3 : 2) **Group-B:** CC-XV Python for Data Science (TH : P ; 3 : 2)	**Group-A:** Elective-VIII: DSEC-XVII Explainable Artificial Intelligence (TH : P ; 3 : 2) Elective-IX: DSEC-XVIII Evolutionary Algorithm (T; 3) **Group-B:** Elective-VIII: DSEC-XIX Business Intelligence & Analytics (TH : P ; 3 : 2) Elective-IX: DSEC-XX Data Mining & Warehousing (TH ; 3)	**Group-A:** GEC-II Social Network Analysis (TH ; 3) **Group-B:** GEC-III Advanced Statistical Methods for Data Science (TH ; 3)	Dissertation [Evaluation in eighth semester] SEC-IX Summer Internship/ Capstone Project-II (P ; 4)	-	-	20
VIII		-	**Group-A:** Elective-X: DSEC-XXI Speech Recognition (TH : P ; 3 : 2)	-	SEC-X Dissertation [Started in seventh semester] (8)	-	-	20

			Elective-XI: DSEC-XXII Augmented Reality & Virtual Reality (TH : P ; 3 : 2) Elective-XII: DSEC-XXIII Security Aspects of Machine Learning (TH ; 2)				
			Group-B: Elective-X: DSEC-XXIV Advanced Data Visualization (TH : P ; 3 : 2) Elective-XI: DSEC-XXV Cloud Computing for Data Analytics (TH : P ; 3 : 2) Elective-XII: DSEC-XXVI Data Security & Privacy (TH ; 2)				
BCA (Honours with Research) **Specialization: Artificial Intelligence & Machine Learning (Group A)**							
VII	(Honours with Research) Advanced Level	CC-XIV Advanced Data Analysis Tools (TH : P ; 2 : 2) CC-XV Research Methodology (TH ; 4)	**Group-A** Elective – IX: DSEC-XXVII Evolutionary Algorithm (TH ; 3) Elective – X: DSEC-XXVIII Speech Recognition (TH : P ; 3 : 2)		SEC-XI Summer Internship/ Capstone Project-II (4)		
			Group-B Elective – IX: DSEC-XXIX Data Mining & Warehousing (TH ; 3) Elective – X: DSEC-XXX Advanced Data Visualization (TH : P ; 3 : 2)				
VIII					SEC-XII Research Project/ Dissertation (20)		

14. Semester-wise Structure, Courses, and Credits

Note: In Course Code 'T' denotes theory Paper Code, 'P' denotes practical Paper Code, and 'R' denotes Internship/Project/Dissertation Paper Code.

TABLE-VI

14.1. SEMESTER-I

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	CC-I	BCA 1001T	Mathematical Foundation for Computer Science – I	3	0	3
2	CC-II	BCA 1002T BCA 1002P	Computer Architecture	3	4	5
3	GEC-I	BCA 1003T	Indian Knowledge System	2	0	2
4	SEC-I	BCA 1004T BCA 1004P	Problem Solving Techniques	3	4	5
5	AEC-I%	BCA 1005T	General English – I	2	0	2
6	VAC-I	BCA 1006T	Environmental Science and Sustainability	2	0	2
TOTAL						**19**

Note: AEC$^{\%}$: Alternative NPTEL/SWAYAM Course

TABLE-VII

14.2 SEMESTER-II

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	CC-III	BCA 2001T	Mathematical Foundation for Computer Science – II	3	0	3
2	CC-IV	BCA 2002T BCA 2002P	Data Structures	3	4	5
3	CC-V	BCA 2003T BCA 2003P	Operating Systems	3	2	4
4	SEC-II	BCA 2004T BCA 2004P	Object Oriented Programming Using Java	3	4	5
5	SEC-III	BCA 2005T BCA 2005P	Web Technologies	1	2	2
6	VAC-II	BCA 2006T	Indian Constitution	2	0	2
TOTAL						**21**

14.2.1 To exit with Certificate in Computer Applications, additional 4 credits through a field relevant Skill-Based Course/ Work-Based Vocational Course/ Social Responsibility & Community Engagement/ Internship/ Apprenticeship of a minimum duration of 8 weeks/ 120 hours in the summer break after the second semester are mandatory. (Code – BCA 2007R)

TABLE-VIII

14.3 SEMESTER-III

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	CC-VI	BCA 3001T	Probability & Statistics	3	0	3
2	CC-VII	BCA 3002T BCA 3002P	Database Management Systems	3	4	5
3	CC-VIII	BCA 3003T	Software Engineering	3	0	3
4	DSEC-I	BCA 3004T BCA 3004P	**Group-A: Elective-I** Feature Engineering	1	4	3
5	DSEC-II	BCA 3005T BCA 3005P	**Group-B: Elective-I** Basics of Data Analytics using Spreadsheet	1	4	3
6	DSEC-III	BCA 3006T BCA 3006P	**Group-C: Elective-I** Web Programming-I	1	4	3
7	SEC-IV	BCA 3007T BCA 3007P	Python Programming	2	4	4
8	VAC-III	BCA 3008 P A/B/C/D/E	Yoga and Physical Fitness/ Sports/ Disaster Management/NSS/NCC	0	4	2
			TOTAL			**20**

Note: In third semester student will select either Group-A (Specialization in Artificial Intelligence and Machine Learning) or Group-B (Specialization in Data Sciences) or Group-C (Specialization in Full Stack Development). Once a group is selected, student must continue with the same group in every subsequent semester. Group once opted will not be changed.

TABLE-IX

14.4 SEMESTER-IV

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	CC-IX	BCA 4001T	Entrepreneurship and Startup Ecosystem	1	0	2
2	CC-X	BCA 4002T BCA 4002P	Computer Networks	3	4	5
3	CC-XI	BCA 4003T	Design and Analysis of Algorithms	3	0	3
4	CC-XII	BCA 4004T BCA 4004P	Artificial Intelligence	3	4	5
5	DSEC-IV	BCA 4005T BCA 4005P	**Group-A: Elective – II** Introduction to Machine Learning	1	4	3
6	DSEC-V	BCA 4006T BCA 4006P	**Group-B: Elective – II** Data Visualization	1	4	3
7	DSEC-VI	BCA 4007T BCA 4007P	**Group-C: Elective – II** Web Programming-II	1	4	3
8	SEC-V	BCA 4008T	Design Thinking and Innovation	2	0	2
Summer Internship/ Capstone Project-I* (to be done in the summer break after IVth semester and will be credited in fifth semester)						
			TOTAL			**20**

14.4.1 *To exit with UG Diploma in Computer Applications or continuing for Degree in Computer Applications, at the end of the Fourth Semester every student shall undergo a mandatory field relevant Summer Internship/ Capstone Project-I for Eight Weeks/ 120 hours in an Industry/ Research or Academic Institute.

14.4.2 *To continue the degree the earned credits of the Summer Internship/ Capstone Project-I will be awarded under predefined SEC in the fifth semester.

TABLE-X

14.5 SEMESTER-V

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	DSEC-VII	BCA 5001T BCA 5001P	**Group-A Elective – III:** Neural Network	3	4	5
2	DSEC-VIII	BCA 5002T BCA 5002P	**Group-A Elective – IV:** Digital Image Processing	3	4	5
3	DSEC-IX	BCA 5003T BCA 5003P	**Group-A Elective – V:** Natural Language Processing	3	4	5
4	DSEC-X	BCA 5004T BCA 5004P	**Group-B Elective – III:** Introduction to Data Science	3	4	5
5	DSEC-XI	BCA 5005T BCA 5005P	**Group-B Elective – IV:** Time Series Analysis	3	4	5
6	DSEC-XII	BCA 5006T BCA 5006P	**Group-B Elective – V:** Machine Learning	3	4	5
7	SEC-VI	BCA 5007T	Quantitative Techniques	2	0	2
8	SEC-VII	BCA 5008R	Summer Internship/ Capstone Project-I (done in the summer break after IVth semester)	0	8	4
9			Major Project (Evaluation in 6th Semester)	-	-	-
TOTAL						**21**

TABLE-XI

14.6 SEMESTER-VI

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	CC-XIII	BCA 6001T	Generative AI	2	4	4
2	DSEC-XIII	BCA 6002T BCA 6002P	**Group-A Elective – VI:** Deep Learning for Computer Vision	3	4	5
3	DSEC-XIV	BCA 6003T BCA 6003P	**Group-A Elective – VII:** Predictive Analysis	3	4	5
4	DSEC-XV	BCA 6004T BCA 6004P	**Group-B Elective – VI:** Big Data Analytics	3	4	5
5	DSEC-XVI	BCA 6005T BCA 6005P	**Group-B Elective – VII:** Exploratory Data Analysis	3	4	5
6	SEC-VIII	BCA 6006R	Major Project (Started in 5th Semester)	0	8	4
7	AEC-II	BCA 6007P	Soft Skills	0	2	1
		TOTAL				**19**

Note:

14.6.1 Student may exit with three-year Bachelor Degree in Computer Applications.

14.6.2 To re-enter or continue BCA (Honours/ Honours with Research) Degree program, one Skill Enhancement Course (SEC) in the form of Summer Internship/ Capstone Project-II of 4 credits of Eight Weeks/ 120 hours in the Industry/ Research or Academic Institute is mandatory. It is to be done in the summer break after sixth semester and will be evaluated in the seventh semester.

14.6.3 The earned credits of the Summer Internship/ Capstone Project-II will be awarded under predefined SEC in the seventh semester.

TABLE-XII

14.7 BCA (Honours) SEMESTER – VII Specialization: Group-A: Artificial Intelligence and Machine Learning

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	CC-XIV	BCA 7001T BCA 7001P	Optimization of ML	3	4	5
2	DSEC-XVII	BCA 7002T BCA 7002P	**Group-A Elective – VIII:** Explainable Artificial Intelligence	3	4	5
3	DSEC-XVIII	BCA 7003T	**Group-A Elective – IX:** Evolutionary Algorithm	3	0	3
4	GEC-II	BCA 7004T	Social Network Analysis	3	0	3
5	SEC-IX	BCA 7005R	Summer Internship/ Capstone Project– II (done in the summer break after VIth semester)	0	8	4
6			Dissertation Work (Evaluation in 8th Semester)	-	-	-
TOTAL						**20**

TABLE-XIII

14.8 BCA (Honours) SEMESTER – VII Specialization: Group-B: Data Science

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	CC-XV	BCA 7006T BCA 7006P	Python for Data Science	3	4	5
2	DSEC-XIX	BCA 7007T BCA 7007P	**Group-B Elective – VIII:** Business Intelligence & Analytics	3	4	5
3	DSEC-XX	BCA 7008T	**Group-B Elective – IX:** Data Mining & Warehousing	3	0	3
4	GEC-III	BCA 7009T	Advanced Statistical Methods for Data Science	3	0	3
5	SEC-IX	BCA 7010R	Summer Internship/Capstone Project– II (done in the summer break after VIth semester)	0	8	4
6			Dissertation (Evaluation in 8th Semester)	-	-	-
TOTAL						**20**

TABLE-XIV

14.9 BCA (Honours) SEMESTER – VIII

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	DSEC-XXI	BCA 8001T BCA 8001P	**Group-A Elective – X:** Speech Recognition	3	4	5
2	DSEC-XXII	BCA 8002T BCA 8002P	**Group-A Elective – XI:** Augmented Reality & Virtual Reality	3	4	5
3	DSEC-XXIII	BCA 8003T	**Group-A Elective – XII:** Security aspects of Machine Learning	2	0	2
4	DSEC-XXIV	BCA 8004T BCA 8004P	**Group-B Elective – X:** Advanced Data Visualization	3	4	5
5	DSEC-XXV	BCA 8005T BCA 8005P	**Group-B Elective – XI:** Cloud Computing for Data Analytics	3	4	5
6	DSEC-XXVI	BCA 8006T	**Group-B Elective – XII:** Data Security & Privacy	2	0	2
7	SEC-X	BCA 8007R	Dissertation (Started in 7th Semester)	0	16	8
TOTAL						**20**

TABLE-XV

14.10 BCA (Honours with Research) SEMESTER-VII Specialization: Group-A: AI & ML Group-B: Data Science

Sl. No.	Course Type	Course Code	Course Title	(L+T) TH	P	Credit
1	CC-XVI	BCA 7011T BCA 7011P	Advanced Data Analysis Tools	2	4	4
2	CC-XVII	BCA 7012T	Research Methodology	4	0	4
3	DSEC-XXVII	BCA 7013T	Group-A Elective – IX: Evolutionary Algorithm	3	0	3
4	DSEC-XXVIII	BCA 7014T BCA 7014P	Group-A Elective – X: Speech Recognition	3	4	5
5	DSEC-XXIX	BCA 7015T	Group-B Elective – IX: Data Mining & Warehousing	3	0	3
6	DSEC-XXX	BCA 7016T BCA 7016P	Group-B Elective – X: Advanced Data Visualization	3	4	5
7	SEC-XI	BCA 7017R	Summer Internship/ Capstone Project-II (done in the summer break after VIth semester)		8	4
8			Dissertation (Evaluation in 8th Semester)	-	-	-
TOTAL						**20**

TABLE-XVI

14.11 BCA (Honours with Research) SEMESTER-VIII

Sl. No.	Course Type	Course Type	Course Title	Credit
1	SEC-XII	BCA 8008R	Dissertation (Started in 7th Semester)	20
TOTAL				**20**

15. Syllabus

15.1 Semester I

Code: BCA-1001T	CC-I	Mathematical Foundation for Computer Science – I	3L+T:0P	3 Credits (45 hours theory)

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75)

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

CO1: Understand the fundamental mathematical concepts such as sets, functions, matrix algebra, And discrete mathematics.

CO2: This course enables the students to use mathematical models and techniques to analyse and Understand problems in computer science.

CO3: Understand how mathematical principles provide succinct abstractions of computer science Problems and help them to efficiently analysis.

CO4: Understand Eigen values, Eigen vectors, and the Cayley-Hamilton Theorem, and analyse Matrix transformations and their applications in various domains.

Unit	Topics	Purposed lectures
I	**Set, Relation, and Function:** Set, Set Operations, Properties of Set operations, Subset, Venn Diagrams, Cartesian Products. Relations on a Set, Properties of Relations, Representing Relations using matrices and digraphs, Types of Relations, Equivalence Relation, Equivalence relation and partition on set, Closures of Relations, Warshall's algorithm. Functions, properties of functions (domain, range), composition of functions, surjective (onto), injective (one-to-one) and bijective functions, inverse of functions. Exponential and Logarithmic functions, Polynomial functions, Ceiling and Floor functions.	11
II	**Counting and Recurrence Relation:** Basics of counting, Pigeonhole Principle, permutations, combinations, Binomial coefficients, and Binomial Theorem. Recurrence relations, their order, and methods for solving linear recurrence relations with constant coefficients using characteristic equation roots (real roots only). Non-linear recurrence relations and generating functions.	11
III	**Elementary Graph Theory:** Basic terminologies of graphs, connected and disconnected graphs, subgraphs, paths, and cycles. complete graphs, digraphs, weighted graphs, Euler and Hamiltonian graphs, as well as trees, their properties, the concept of spanning trees, and planar graphs, along with definitions and basic results related to these topics.	11
IV	**Matrix Algebra:** Types of matrices and their algebraic operations such as addition, subtraction, and multiplication. Determinants, symmetric and skew-symmetric matrices, orthogonal matrices, the rank and inverse of a matrix, and applications of matrices in solving systems of linear equations using Cramer's Rule. Eigen values, eigenvectors, Cayley-Hamilton Theorem.	12

Text Books:

1. Kolman B., Busby R., and Ross S., *Discrete Mathematical Structures*, 6th Edition, Pearson Educatio 2015.
2. Deo Narsingh, *Graph Theory with Application to Engineering and Computer Science*, Prentice Ha India, 1979.

3. Vasishtha A. R. and Vasishtha A. K., *Matrices*, Krishna Prakashan, 2022.
4. Garg R., *Engineering Mathematics*, Khanna Book Publishing Company, 2024.
5. Garg R., *Advanced Engineering Mathematics*, Khanna Book Publishing Company, 2023.

Reference Books:

1. Grimaldi Ralph P. and Ramana B. V., *Discrete and Combinatorial Mathematics: An Applied Introduction*, 5th Edition, Pearson Education, 2007.
2. Rosen Kenneth H. and Krithivasan Kamala, *Discrete Mathematics and its Applications*, McGraw Hill, India, 2019.
3. West Douglas B., *Introduction to Graph Theory*, 2nd Edition, Pearson Education, 2015.
4. Stephen Andrilli and David Hecker, *Elementary Linear Algebra*, 4th Edition, Elsevier Science, 2010.
5. Discrete Mathematics and it's applications" by Kenneth Rosen , MC Graw Hill

Code: BCA-1002T (For theory) BCA-1002P (For practical)	**CC-II**	**Computer Architecture**	**3L+T:4P**	**5 Credits (45 hours theory and 60 hours practical)**

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

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

CO1: Understand the basics of Digital Electronics and Binary Number System
CO2: Learn the implementation of Combinational Circuit.
CO3: Learn the implementation of Sequential Circuit.
CO4: Understand the Organization of basic computers.
CO5: Understand the concept of parallel processing.
CO6: Understand the concept of memory organization.

Unit	Topics	Purposed lectures
I	**Digital Principles:** Definition of digital signals, digital logic, digital computers, Von Neumann Architecture, Boolean Laws, and Theorems. **K-Map:** Truth tables to K-Map, 2, 3, and 4-variable K-Map, K-Map simplifications, Don't care conditions, SOP and POS. **Number Systems:** Decimal, Binary, Octal, Hexadecimal number systems, number system conversions, binary arithmetic, addition and subtraction of BCD, octal arithmetic, hexadecimal arithmetic. Binary Codes: Decimal codes, error detecting and correcting codes, ASCII, EBCDIC, Excess-3 Code, Gray Code.	11
II	**Combinational Circuits:** Half Adder, Full Adder, Subtractor, Decoders, Encoder, Multiplexer, Demultiplexer. **Sequential Circuits:** Flip-Flops-SR Flip-Flop, D Flip-Flop, J-K Flip-Flop, T Flip-Flop. **Registers:** 4-bit register with parallel load, shift registers – bidirectional shift register with parallel load. Binary Counters: 4-bit synchronous and asynchronous binary counter.	11
III	**Basic Computer Organization:** Instruction codes, computer registers, computer instructions, timing and control, instruction cycle, memory-reference instructions, input-output interrupt, complete computer description, design of basic computer, design of accumulator logic. **Central Processing Unit**: Introduction, general register organization, stack organization, instruction formats, addressing modes, data transfer and manipulation, program control, Reduced Instruction Set Computer (RISC), RISC vs CISC.	11
IV	**Pipeline and Vector Processing:** Parallel processing, pipelining, arithmetic pipeline, instruction pipeline, RISC pipeline. **Input-Output Organization:** Peripheral devices, input-output interface,	12

	asynchronous data transfer, modes of transfer, priority interrupt, direct memory access (DMA), input-output processor (IOP). **Arithmetic Algorithms:** Integer multiplication using shift and add, Booth's algorithm, integer division, floating-point representations. **Memory Organization:** Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory, memory management hardware.	
Lab Programs	**Experiments** **1.** Verify the logic behaviour of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert, and Buffer gates. **2.** Study and verify NAND as a Universal Gate. **3.** Verify De Morgan's theorem for two variables. **4.** Design and test an S-R flip-flop using NAND/NOR gates. **5.** Convert BCD to Excess-3 code using NAND gates. **6.** Convert Binary to Gray Code. **7.** Verify the truth tables of J-K Flip-Flop using NAND/NOR gates. **8.** Realize Decoder and Encoder circuits using basic gates. **9.** Design and implement a 4:1 MUX using gates. **10.** Implement a 4-bit parallel adder using the 7483 IC. **11.** Design and verify the operation of a half adder and full adder. **12.** Design and verify the operation of a half subtractor. **13.** Design and implement a 4-bit shift register using flip-flops. **14.** Implement Boolean functions using logic gates in both SOP and POS forms. **15.** Design and implement a 4-bit synchronous counter. **16.** Design and verify a 4-bit asynchronous counter. **Hardware Experiments** **17.** Familiarize with the computer system layout: identifying SMPS, motherboard, FDD, HDD, CD, DVD, and add-on cards. **18.** Identify the computer name and hardware specifications (RAM capacity, processor type, HDD, 32-bit/64-bit architecture). **19.** Identify and troubleshoot issues related to RAM, SMPS, and the motherboard. **20.** Configure BIOS settings: enable/disable USB and LAN. **21.** Expand RAM size by adding additional RAM to the system. **22.** Study the motherboard layout of a computer system. **23.** Demonstrate the assembly of a PC. **24.** Demonstrate various ports: CPU, VGA port, PS/2 (keyboard, mouse), USB, LAN, Speaker, Audio. **25.** Install and configure the Windows Operating System. **26.** Study printer installation and troubleshooting.	

Text Books:

1. Leach, Donald P., Albert Paul Malvino, and Goutam Saha. *Digital Principles and Applications.* T McGraw Hill Education, 2011.
2. Mano, M. Morris. *Computer System Architecture.* 3rd ed., Pearson/PHI, 2006.
3. Digital Logic and Computer Design, Morris Mano, Pearson/PHI
4. Digital Fundamentals : Floyd L. Thomas, Pearson

Reference Books:

5. Stallings, William., *Computer Organization and Architecture.* 6th ed., Pearson/PHI, 2003.
6. Tanenbaum, Andrew S. *Structured Computer Organization.* 4th ed., PHI/Pearson, 1999.
7. Subramanyam, M. V. *Switching Theory and Logic Design.* Laxmi Publications, 2008.

Code: BCA-1003T	GEC-I	Indian Knowledge System (IKS)	2L+T: 0P	2 Credits (30 hours theory)

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75)

Module : Indian Culture and Civilization

Course outcomes :

CO1: To introduce fundamentals of Ancient Indian Educations to understand the pattern and purpose of studying vedas, vedangas, upangas, upveda, purana & Itihasa

CO2: To help students to trace, identify and develop the ancient knowledge systems.

CO3: To help to understand the apparently rational, verifiable and universal solution from ancient Indian knowledge system for the holistic development of physical, mental and spiritual wellbeing

CO4: To build in the learners a deep-rooted pride in Indian knowledge, committed to universal human right, well-being and sustainable development.

Unit	Topics	Purposed lectures
I	**Introduction to IKS** Caturdaśa Vidyāsthānam, 64 Kalas, Shilpa Śāstra, Four Vedas, Vedāṅga, Indian Philosophical Systems, Vedic Schools of Philosophy (Sāṃkhya and Yoga, Nyaya and Vaiśeṣika, Pūrva-Mīmāṃsā and Vedānta), Non-Vedic schools of Philosophical Systems (Cārvāka, Buddhist, Jain), Puranas (Maha-puranas, Upa-Puranas and Sthala-Puranas), Itihasa (Ramayana, Mahabharata), Niti Sastras, Subhasitas	6
II	**Foundation Concept for Science & Technology** Linguistics & Phonetics in Sanskrit (panini's), Computational concepts in Astadhyayi Importance of Verbs, Role of Sanskrit in Natural Language Processing, Number System and Units of Measurement, concept of zero and its importance, Large numbers & their representation, Place Value of Numerals, Decimal System, Measurements for time, distance and weight, Unique approaches to represent numbers (Bhūta Saṃkhya System, Kaṭapayādi System), Pingala and the Binary system, Knowledge Pyramid, Prameya – A Vaiśeṣikan approach to physical reality, constituents of the physical reality, Pramāṇa, Saṁśaya	6
III	**Indian Mathematics & Astronomy in IKS** Indian Mathematics, Great Mathematicians and their contributions, Arithmetic Operations, Geometry (Sulba Sutras, Aryabhatiya-bhasya), value of $\pi\pi$, Trigonometry, Algebra, Chandah Sastra of Pingala, Indian Astronomy, celestial coordinate system, Elements of the Indian Calendar Aryabhatiya and the Siddhantic Tradition Pancanga – The Indian Calendar System Astronomical Instruments (Yantras) Jantar Mantar or Raja Jai Singh Sawal.	6
IV	**Indian Science & Technology in IKS** Indian S & T Heritage ,sixty-four art forms and occupational skills (64 Kalas) Metals and Metalworking technology (Copper, Gold, Zinc, Mercury, Lead and Silver), Iron & Steel, Dyes and Painting Technology), Town & Planning Architecture in India, Temple Architecture, Vastu Sastra,	6
V	**Humanities & Social Sciences in IKS** Health, Wellness & Psychology, Ayurveda Sleep and Food, Role of water in wellbeing Yoga way of life Indian approach to Psychology, the Triguṇa System Body-Mind-Intellect-Consciousness Complex. Governance, Public Administration & Management reference to ramayana, Artha Sastra, Kauṭilyan State	6

References:

1. Textbook on IKS by Prof. B Mahadevan, IIM Bengaluru.
2. Kapur K. and Singh A. K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of Shankaracharya, Central Chinmay Mission Trust, Bombay, 1995.
3. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008.
4. SK Das, The Education System of Ancient hindus, Gyan Publication House, India
5. BL Gupta,Value and Distribution System in India, Gyan Publication House, India

6. Reshmi ramdhoni, Ancient Indian Culture and Civilisation, Star Publication, 2018
7. Supriya Lakshmi Mishra, Culture and History of Ancient India (With Special Reference of Sudras), 2020.
8. Gambirananda, Swami, Tr. Upanishads with the Commentary of Sankarachrya. Kolkata: Advaita Ashram publication Department, 2002.
9. Ranganathananda, Swami. The Massage of the Upanishads. Bombay: Bharathya Vidya Bhaven, 1985.
10. Om Prakash, Religion and Society in Ancient India, Bhariya Vidhya Prakashan, 1985
11. J Auboyer, Daily Life in Ancient India from Approximately 200 BC to AD 700, Munshi Ram Manohar Publication, 1994.
12. DK Chakkrabarty, Makkhan Lal, History of Ancient India (Set of 5 Volumes), Aryan Book International publication, 2014
13. Dr. Girish Nath Jha, Dr. Umesh Kumar Singh and Diwakar Mishra, Science and Technology in Ancient Indian Texts, DK Print World limited,
14. Swami BB Vishnu, Vedic Science and History - Ancient Indian's Contribution to the Modern World, gosu publication, 2015
15. Chatterjee, S.C. The Nyaya Theory of Knowledge. Calcutta: University of Calcutta Press, 1950.
16. Dasgupta, Surendra. A History of Indian Philosophy. Motilal Banarsidass Publishing House, 1991.Vols. III I IV.
17. Mercier, Jean L. From the Upanishads to Aurobindo. Bangalore: Asian Trading Corporation, 2001.
18. M. Hiriyanna. Essentials of Indian Philosophy. London: Diane Publications, 1985.
19. Hume, Robert Ernest, Tr. The Thirteen Principal Upanishads. Virginia: Oxford.
20. Radhakrishnan, S. Principal Upanishads. New York: Harper Collins, 1963.
21. Satprakashananda. The Methods of Knowledge according to Advaita Vedanta. Calcutta: Advaita Ashram 2005.
22. Potter, K.H. Encyclopaedia of Indian Philosophies, Vol. III. Delhi: Motilal Banarsidass Publishing House 2015.

Code: BCA-1004T (For Theory) BCA-1004P (For Practical)	SEC-I	Problem Solving Techniques	3L+T:4P	5 Credits (45 hours theory and 60 hours practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

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

CO1: Understand basic terminology of computers, problem solving, programming languages and their evaluation

CO2: Develop algorithms, flowcharts and pseudo code to solve computational problems using structured \ approaches.

CO3: Implement structured programming concepts and control structures using the C language.

CO4: Solve numerical and statistical problems using control structures and C programming.

CO5: Apply modular programming, recursion, and array/matrix operations in C programs.

Unit	Topics	Purposed lectures
I	**Problem-Solving and Algorithm Development:** Problems And Problem Instances, Generalization and Special Cases, Types of Computational Problems, Classification of Problems, Analysis of Problems, Solution Approaches, Algorithm Development, Analysis of Algorithm, Efficiency, Correctness, Role of Data Structures in Problem Solving, Problem-Solving Steps (Understand the Problem, Plan, Execute, And Review), Breaking the Problem into Subproblems, Input/output Specification, Input Validation, Pre and Post Conditions.	11
II	**Structured Programming Concepts:** Sequence (Input/Output/Assignment); Selection (If, If-Else) And Repetition For, While, Do-While) Statements, Control Structure Stacking and Nesting. **Different Kinds of Repetitions:** Entry Controlled, Exit Controlled, Counter Controlled, Definite, Indefinite and Sentinel-Controlled repetitions. Pseudocode and Flowcharts. Definition And Characteristics of algorithms,	11

	Standard Algorithm Format. **Problems Involving Iteration and Nesting:** Displaying Different Patterns and Shapes Using Symbols and Numbers, Generating Arithmetic and Geometric Progression, Fibonacci and Other Sequences, Approximate Values For n, Sin(x), Cos(x), Etc. Using Taylor Series. Different Kinds of Data in The Real World and How They are Represented in The Computer Memory. Representation of Integers: Signed Magnitude Form, 1's Complement And 2's Complement. Representation of Real Numbers: IEEE 754 Floating Point Representation. Representation of Characters: ASCII, UNICODE. **C Language and Basic Programming Constructs:** Introduction To Programming Languages, Different Generations of Programming Languages. Typed Vs Typeless Programming Languages, History of C Language, An Empty C Program. C Language Counterparts For Input (scanf()), Output (printf()) Statements, Assignment, Arithmetic, Relational and Logical Operators. If, If-Else Statements, For, While, Do-While Statements. Data Types. Translating Pseudocode/Algorithm to C Program. Incremental Compilation and Testing of The C Program. Simple Problems Involving Input, Output, Assignment Statement, Selection and Repetition. Good Coding Practices.	
III	**Problems on Numbers and Basic Statistical Operations:** Extracting Digits of a Number (Left to Right and Right to Left), Palindrome, Prime Number, Prime Factors, Amicable Number, Perfect Number, Armstrong Number, Factorial, Converting Number from One Base to Another. Statistics (Maximum, Minimum, Sum and Average) on a Sequence of Numbers which are Read using Sentinel Controlled Repetition using only a few Variables. C Language: else-if Ladder, switch Case, Increment/Decrement Operators, break and continue Statements.	**11**
IV	**Modular Programming and Arrays :** Modular Programming, Top-Down and Bottom-Up Approaches to Problem Solving. Recursion. **Problems on Arrays:** Reading and Writing of Array Elements, Maximum, Minimum, Sum, Average, Median and Mode. Sequential And Binary Search. Any one Sorting Algorithm. Matrix Operations. **Implementation in C Language:** Function Definition and Declaration (Prototype), Role of Return Statement, Recursion, One Dimensional and Two-Dimensional Arrays. String Functions. Other Operators, Operator Precedence and associativity. **Debugging:** Identify and fix errors. Different types of debugging techniques.	**12**
Lab Programs	**UNIT-II- Basic Problem-Solving Techniques** 1. Converting degrees Celsius to Fahrenheit and vice versa? 2. Display three input numbers in sorted(non-decreasing) order? 3. Given a positive integer value n(>=0)display number, square and cube of numbers from 1 to n in a tabular format? 4. Given an input positive integer number, display odd numbers from in the range 1,n]? 5. Display first mathematical tables, each table upto10 rows? Generalise this to display first n (> 0) mathematical tables up to m (m > 0) rows? 6. Display following patterns of n rows(n>0) , For the below examples n = 5? For each pattern write a separate algorithm/program?	

$ $$ $$$ $$$$ $$$$$	$ $$ $$$ $$$$ $$$$$	12345 1234 123 12 1	12345 1234 123 12 1

7. Display the following patterns of n rows(n>0), for the below examples n=5?

Hollow square pattern:	Triangle Patterns with numbers:	Square with diagonals:	Diamond Pattern
##### # # # # # # #####	1 121 12321 1234321 123454321	* * * * * * * * * * * * * * * * * * * * *	* *** ***** *** *

8. Given the first term (a), difference/multiplier (d) and number of terms (n > 0), display the first n terms of the arithmetic/geometric progression?
9. Display the first n(n>0) terms of the Fibonacci sequence?
10. Display the first n(n>0) terms of the Tribonacci sequence?
11. Given two positive integer numbers n1 and n2 check if the numbers are consecutive numbers of the Fibonacci sequence?
12. Compute approximate value of n considering first n(n>0) terms of the Taylor series for n?
13. Compute approximate value of e^x considering first n(n>0) terms of the Taylor series for e^x
14. Computeapproximatevalueofsin(x)/cos(x)consideringfirstn(n>0)termsofthe Taylor series fo sin(x)/cos(x)?

UNIT-III Problems on Numbers:

15. Extract digits of an integer number(left to right and right to left)?
16. Given a sequence of digits form the number composed of the digits. Use sentinel Controlled repetition to read the digits followed by-1.For example, for the input 2 7 3 2 9 the output number is 27329?
17. Check if a given positive integer number is a palindrome or not?
18. Compute character grade from the marks (0 ≤ marks ≤ 100) of a subject. Grading Schem 80-100 : A, 60 - 79: B, 50 - 59: C, 40-49: D, 0-39: F? Solve this using both else-if ladder and switch case?
19. Compute the sum of a sequence of numbers entered using sentinel controlled repetition?
20. Check if a given positive integer number is a prime number or not?
21. Compute prime factors of a positive integer number?
22. Check if two positive integer numbers are amicable numbers or not?
23. Check if a given positive integer number is a perfect number or not?
24. Check if a given positive integer number Armstrong number or not?
25. Converting a positive integer number (n > 0) from one base (input Base) to another base (output Base) (2 <= input Base, output Base <= 10).Input number should be validated before converting to make sure the number uses only digits allowed in the input base?
26. Write a program to display a number in text form. For example If the number is 5432 the

output should be "FIVE FOUR THREE TWO"?

27. Using the grading scheme described in the question 4(UNIT III), Compute how many Students awarded each grade and display the frequency as a bar chart (horizontal) using Single "*" for each student. Use sentinel controlled repetition (-1 a sentinel value)in reading the students marks. Use else-if ladder/switch case to compute the grade and the corresponding frequency.

28. Sample bar chart when the class has 7-A, 10-B, 3-C, 7-D and 1-F grades.

```
A:
*******
B:
**********
C:***
D:
*******
F:*
```

29. Compute maximum, minimum, sum and average of a sequence of numbers which are read using sentinel controlled repetition using only few variables?

30. Compute body mass index, BMI=weight in KGs/(Height in Meters *Height in Meters), Both weight and height values are positive real numbers. Your program should display BMI value followed by whether the person is Underweight, Normal, Overweight or Obese using the below ranges:

    BMI Values
    Underweight:lessthan18.5 Normal: >=18.5 and <25
    Overweight:>=25and <30
    Obese:>=30

UNIT IV :

31. Design a modularized algorithm/program to check if a given positive integer number is a circular prime or not?
32. Design a modularized algorithm/program to compute a maximum of 8 numbers?
33. Design a modular algorithm/program which reads an array of n integer elements and outputs mean (average), range (max-min) and mode (most frequent elements)?
34. Design a modular algorithm/program which reads an array of n integer elements and outputs median?
35. Implement your own string length and string reversal functions?
36. Design algorithm/program to perform matrix operations addition, subtraction and transpose?
37. Write a recursive program to count the number of digits of a positive integer number?
38. Recursive solutions for the following problems:
    a. Factorial of a number
    b. Display digits of a number from left to right and right to left
    c. Compute x^y using only multiplication?
    d. To print a sequence of numbers entered using sentinel controlled repetition in reverse order?

Text Books:

1. Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India, 2015.
2. Dromey, R. G. How to Solve It by Computer. Pearson Education, 1982.
3. Programming in C- Balaguruswamy, Mc Graw Hills
4. Kanetkar, Yashavant. Let Us C. BPB Publications, 2020.
5. Venkatesh, Nagaraju Y., Practical C Programming for Problem Solving, Khanna Book Publis Company, 2024.

Reference Books:

1. Brian W. Kernighan and Dennis Ritchie, The C Programming Language, 2nd edition, Pearson, 2015.
2. Jeri Hanly and Elliot Koffman, Problem Solving and Program Design in C, 8th edition, Pearson, 2015.
3. Goyal K. K., Sharma M. K., and Thapliyal M. P., Concept of Computer and C Programming, Univer Science Press.
4. Exploring C – YashwantKanetkar, BPB Publications
5. Programming with C -K.R .Venugopal, TATA McGrawHill
6. Computer Programming in C, V. Rajaraman, PHI
7. Programming with C, Byron Gottfried, TATA McGrawHill

Code: BCA- 1005T	AEC-I	General English - I	2L+T: 0P	2 Credits (30 hours theory

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75)

Course Outcomes: Upon competition of the course, students will be able to

CO1: Develop a strong vocabulary foundation and understand word formation, prefixes, suffixes, synonym and antonyms to improve English language proficiency.

CO2: Apply basic writing skills, including sentence structures, paragraph organization, coherence, ar punctuation, to enhance written communication.

CO3: Identify and correct common grammatical errors in writing, including subject-verb agreemer misplaced modifiers, and redundancy.

CO4: Demonstrate the ability to write effectively using descriptive, definitional, and classificatory technique including providing examples and writing structured content.

CO5: Improve written communication through comprehension, précis writing, and essay writing techniques.

CO6: Develop oral communication skills, including pronunciation, intonation, workplace communication, ar formal presentations, through interactive language lab sessions.

Unit	Topics	Purposed lectures
I	**Vocabulary Building** The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.	6
II	**Basic Writing Skills** Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely.	6
III	**Identifying Common Errors in Writing** Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Tenses.	4
IV	**Nature and Style of Sensible Writing** Describing, Defining, Classifying, providing examples or evidence, Writing introduction and conclusion.	4
V	**Writing Practices** Comprehension, Précis Writing, Essay Writing.	4
VI	**Oral Communication** Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.	6

Text/ Reference Books:

1. Swan, Michael. *Practical English Usage.* Oxford University Press, 1995.
2. Wood, F.T. *Remedial English Grammar.* Macmillan, 2007.
3. Zinsser, William. *On Writing Well.* Harper Resource Book, 2001.
4. Hamp-Lyons, Liz, and Ben Heasly. *Study Writing.* Cambridge University Press, 2006.
5. Kumar, Sanjay, and Pushp Lata. *Communication Skills.* Oxford University Press, 2011.
6. *Exercises in Spoken English, Parts I-III.* CIEFL, Hyderabad, Oxford University Press.
7. Tiwari, Anjana. *Communication Skills in English (with Lab Manual).* Khanna Book Publishing Co., 2023.

Alternative NPTEL/SWAYAM Courses			
Sl. No.	**NPTEL/SWAYAM Course**	**Instructor**	**Host Institute**
1	English Language for Competitive Exams	Prof. Aysha Iqbal	IIT Madras
2	Technical English for Engineers	Prof. Aysha Iqbal	IIT Madras

Code: BCA -1006 T	**VAC-I**	**Environmental Science and Sustainability**	**2L+T:0P**	**2 Credits (30 hours theory)**

Max Marks: 100; Theory: 100; (External : 100 Marks)

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand the environmental concepts, sustainability, and impact of resource exploitation on Eco systems and communities.

CO2: Analyze the structure, function, and types of ecosystems, including ecosystem services and conservation strategies.

CO3: Evaluate the role of businesses in sustainable development and the significance of environmental legislation and social issues.

Unit	**Topics**	**Purposed lectures**
I	**Understanding Environment, Natural Resources, and Sustainability:** Fundamental environmental concepts and their relevance to business operations; Components and segments of the environment, the man-environment relationship, and historical environmental movements. Concept of sustainability; Classification of natural resources, Land resources: Minerals, soil, agricultural crops, natural forest products, medicinal plants, and forest-based industries and livelihoods; Land cover, land use change, land degradation, soil erosion, and desertification; Causes of deforestation; Impacts of mining and dam building on environment, forests, biodiversity, and tribal communities. Water resources: Natural and man-made sources; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts, and international & interstate conflicts over water. Energy resources: Renewable and non-renewable energy sources; Use of alternate energy sources; Growing energy needs; Energy contents of coal, petroleum, natural gas and bio gas; Agro-residues as a biomass energy source. The conservation and equitable use of resources, considering both intergenerational and intergenerational equity, and the importance of public awareness and education.	**10**
II	**Ecosystems, Biodiversity, and Sustainable Practices:** Various natural ecosystems, learning about their structure, functions, and ecological characteristics. The importance of biodiversity, the threats it faces, and the methods used for its conservation. Ecosystem resilience, homeostasis, and carrying capacity, emphasizing the need for sustainable ecosystem management. Strategies for in situ and ex situ conservation, nature reserves, and the significance of India as a mega diverse nation.	**5**

III	**Social Issues, Legislation, and Practical Applications:** Dynamic interactions between society and the environment, with a focus on sustainable development and environmental ethics. Role of businesses in achieving sustainable development goals and promoting responsible consumption. Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Development – Environment conflict (displacement, resettlement and rehabilitation) and compensation mechanism to project affected people (PAP); Sustainable Development Goals: India's National Action Plan on Climate Change and its major missions, human population growth, and demographic changes in India.	**10**
IV	**Environmental Pollution, Waste Management, and Sustainable Development:** Various types of environmental pollution, including air, water, noise, soil, and marine pollution, and their impacts on businesses and communities. Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management; Natural and man-made disasters, their management, and the role of businesses in mitigating disaster impacts.	**5**

Text Books:

1. Bharucha, E. *Textbook of Environmental Studies*. 3rd ed., Orient Blackswan Private Ltd., 2015.
2. Dave, D., and S. S. Katewa. *Text Book of Environmental Studies*. Cengage Learning India Pvt L 2018.
3. Rajagopalan, R. *Environmental Studies: From Crisis to Cure*. 4th ed., Oxford University Press, 2019.
4. Miller, G.T., and Scott Spoolman. *Living in the Environment*. 20th ed., Cengage, 2018.
5. Basu, M., and S. J. Xavier Savarimuthu. *Fundamentals of Environmental Studies*. Cambridge Univer Press, 2016.
6. Roy, M. G. *Sustainable Development: Environment, Energy and Water Resources*. Ane Books, 2017.
7. Pritwani, K. *Sustainability of Business in the Context of Environmental Management*. CRC Press, 2021
8. Wright, R.T., and Dorothy F. Boorse. *Environmental Science: Toward A Sustainable Future*. 13th Pearson, 2020.

15.2 Semester II

Code: BCA-2001 T	CC-III	Mathematical Foundation to Computer Science – II	3L+T: 0P	3 Credits (45 hours theory)

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75)

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

CO1: understand correct lines of arguments and proofs.

CO2: Understand mathematical techniques that are foundations for understanding advanced computational methods, including numerical methods and optimization.

CO3: understand various problem-solving strategies and methods to tackle both theoretical and practical challenges in computer science.

Unit	Topics	Purposed lectures
I	**Logic and Methods of Proofs** Propositions, logical operations (basic connectives), compound statements, construction of truth table, quantifiers, conditional statements, tautology, contradiction, logical equivalence. Conjunctive Normal Forms (CNF) and Disjunctive Normal Forms (DNF). **Methods of Proofs:** Rules of inference for propositional logic, modus ponens, modus tollens, syllogism, proof by contradiction, Mathematical Induction.	11
II	**Algebraic Structures** Semi-group, Monoid, Group, Abelian Group, Subgroup, Properties of Subgroup, Cyclic group.	11
III	**Numerical Methods** Concept and importance of errors in numerical methods. **Solution of algebraic and transcendental equations:** Bisection method and Newton-Raphson methods. **Numerical Interpolation:** Newton's Forward and Newton's Backward interpolation formula and Lagrange's formula. **Numerical Integration:** Quadrature Formula, Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule (only formulae and applications for all the topics mentioned in this unit)	11
IV	**Optimization Techniques** **Linear programming:** Introduction, LP formulation, Graphical method for solving LPs with two variables, Special cases in graphical methods, Simplex method, Duality. **Transportation problem:** Definition, Linear form, North-west corner method, least cost method, Vogel's approximation method for finding feasible solution, MODI method for finding optimum solution.	12

Text Books:

1. Kolman B., Busby R. and Ross S., *Discrete Mathematical Structures*, 6th Edition, Pearson Education, 2015.
2. Sastry S. S., *Introductory Methods of Numerical Analysis*, Fifth Edition, PHL, 2022.
3. Taha Hamdy A., *Operations Research: An Introduction*, Eighth Edition, Pearson Prentice Hall, 2003.

Reference Books:

1. Rosen Kenneth H. and Krithivasan Kamala, *Discrete Mathematics and its Applications*, McGraw Hill, India, 2019.
2. Chakravorty J. G. and Ghosh P. R., *Linear Programming and Game Theory*, Moulik Library, 2017.
3. Sharma J. K., *Operations Research: Theory and Applications*, Fourth Edition, Macmillan Publishers, 2007.
4. S.D. Sharma, *Operations Research (Theory Methods & Applications)*, 2014.
5. Discrete Mathematics and Structures, Satinder Bal Gupta, McGrawHill, 2010.

Code: BCA-2002T (For Theory) BCA- 2002P (For Practical)	CC-IV	Data Structures	3L+T: 4P	5 Credits (45 hou theory an 60 hou practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand the fundamental concepts of data structures and their classifications, including arrays and their operations.

CO2: Develop the ability to implement and manipulate linked lists and apply hashing techniques for efficient data storage and retrieval.

CO3: Apply stack, queue, and recursion concepts to solve complex computational problems in c programmin

CO4: Implement tree and graph data structures to solve real-world problems and optimize data organizatio

Unit	Topics	Purposed lectures
I	**Definition, Classification and Operations of Data Structures:** Definition of data structures, Types of Data Structures: Linear and Non-Linear Data Structure, Algorithms: Complexity, Time-Space Tradeoff. Difference between algorithm and programs. **Arrays:** Definition and Classification of Arrays, Representation of Linear Arrays in Memory, **Operations on Linear Arrays:** Traversing, Inserting, Deleting, Searching, Sorting and Merging. **Searching:** Linear Search and Binary Search, Comparison of Methods. **Sorting:** Bubble Sort, Selection Sort, and Insertion Sort. **Multi-Dimensional Arrays:** Representation of Two-Dimensional Arrays in Memory, Matrices and Sparse Matrices, Multi-Dimensional Arrays.	11
II	**Linked Lists and Hashing** **Linked Lists:** Definition, Comparison with Arrays, Representation, Types of Linked lists, Traversing, Inserting, Deleting and Searching in Singly Linked List, Doubly Linked List and Circular Linked List. **Applications of Linked Lists:** Addition of Polynomials. **Hashing and Collision:** Hashing, Hash Tables, Types of Hash Functions, Collision, Collision Resolution with Open Addressing and Chaining.	11
III	**Stacks, Queues, and Recursion** **Stacks:** Definition, Representation of Stacks using Arrays and Linked List, Operations on Stacks using Arrays and Linked List. **Application of Stacks:** Arithmetic Expressions, Polish Notation, Conversion of Infix Expression to Postfix Expression, Evaluation of Postfix Expression. **Recursion:** Definition, Recursive Notation, Runtime Stack. **Applications of Recursion:** Factorial of Number, GCD, Fibonacci Series and Towers of Hanoi. **Queues:** Definition, Representation of Queues using Array and Linked List, Types of Queue: Simple Queue, Circular Queue, Double-Ended queue, Priority Queue, Operations on Simple Queues and Circular Queues using Array and Linked List. **Applications of Queues:** Various use cases in problem-solving.	11
IV	**Graphs and Trees** **Graphs:** Definition, Terminology, Representation, Traversal. **Trees:** Definition, Terminology, Binary Trees, Traversal of Binary Tree, Binary Tree Representation: Array Representation and Pointer (Linked List) Representation. **Binary Search Tree:** Inserting, Deleting and Searching in Binary Search Tree. **Height Balanced Trees:** AVL Trees, Insertion and Deletion in AVL Tree.	12

Lab Programs

1. **Array Operations:**
   - Write a program for insertion and deletion operations in an array.
2. **Searching in an Array:**
   - Write a program to search for an element in an array using Linear Search and Binary Search.
3. **Sorting an Array:**
   - Write a program to sort an array using Bubble Sort, Selection Sort, and Insertion Sort.
4. **Merging Arrays:**
   - Write a program to merge two arrays.
5. **Matrix Operations:**
   - Write a program to add and subtract two matrices.
   - Write a program to multiply two matrices.
6. **Singly Linked List Operations:**
   - Write a program to insert an element into a Singly Linked List:
     - At the beginning
     - At the end
     - At a specified position
   - Write a program to delete an element from a Singly Linked List:
     - At the beginning
     - At the end
     - A specified element
7. **Doubly Linked List Operations:**
   - Write a program to perform the following operations in a Doubly Linked List:
     - Create
     - Search for an element
8. **Circular Linked List Operations:**
   - Write a program to perform the following operations in a Circular Linked List:
     - Create
     - Delete an element from the end
9. **Stack Operations:**
   - Write a program to implement stack operations using an array.
   - Write a program to implement stack operations using a linked list.
10. **Polynomial Addition:**
- Write a program to add two polynomials using linked lists.
11. **Postfix Evaluation:**
- Write a program to evaluate a postfix expression using a stack.
12. **Recursion Operations:**
- Write a program to perform the following using recursion:
  - Find the factorial of a number
  - Find the GCD of two numbers
  - Solve the Towers of Hanoi problem
13. **Queue Operations:**
- Write a program to implement simple queue operations using an array.
- Write a program to implement circular queue operations using an array.
- Write a program to implement circular queue operations using a linked list.
14. **Binary Search Tree (BST) Operations:**
- Write a program to perform the following operations on a binary search tree:
  - Preorder Traversal
  - Inorder Traversal
  - Postorder Traversal
- Write a program to perform insertion operation in a binary search tree.

Text Books:

1. Seymour Lipschutz, Data Structures with C, Schaum's Outlines, Tata McGraw-Hill, 2011.
2. Yashavant Kanetkar, Data Structures Through C, 4th Edition, BPB Publications, 2022.
3. Cormen T. H., Leiserson C. E., Rivest R. L., and Stein C., Introduction to Algorithms, PHI.(2011)
4. R. S. Salaria, "Data Structures &Algorithms ", Khanna Book
5. 5.Data Structures Through C in depth, S. K. Shrivastava, BPB Publications

Reference Books:

6. Reema Thareja, Data Structures Using C, Second Edition, Oxford University Press, 2014.
7. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, Fundamentals of Data Structures i Second Edition, Universities Press, 2007.
8. Expert Data Structures -RB Patel, Khanna Book Publishing

Code: BCA-2003T (For theory) BCA-2003P (For practical)	CC-V	Operating Systems	3L+T: 2P	4 Credit (45 hour theory an 30 hour practical

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand the components, services, and structures of operating systems and different types of O

CO2: Analyze process scheduling, multithreading, and CPU scheduling algorithms.

CO3: Apply concepts of process synchronization and solve deadlock problems using appropriate techniqu

CO4: Implement memory management techniques, file systems, and disk scheduling algorithms

LAB Outcomes:

CO1: Implement CPU scheduling algorithms.

CO2: Understand and solve critical section problems.

CO3: Apply file allocation and frame management techniques.

CO4: Implement page replacement algorithms.

Unit	Topics	Purposed lectures
I	**Operating Systems (OS) Overview** Definition, Evaluation of OS, Components & Services of OS, Structure, Architecture, types of Operating Systems, Batch Systems, Concepts of Multiprogramming and Time Sharing, Parallel, Distributed, and real-time Systems. **Operating Systems Structures:** Operating system services and system calls, system programs, operating system structure, operating systems generations.	11
II	**Process Management** Process Definition, Process states, Process State transitions, Process Scheduling, Process Control Block, Threads, Concept of multithreads, Benefits of threads, Types of threads. **Process Scheduling:** Definition, Scheduling objectives, Scheduling algorithms, CPU scheduling Preemptive and Non-preemptive Scheduling algorithms (FCFS, SJF and RR), Performance evaluation of the scheduling Algorithms.	11
III	**Process Synchronization** Introduction, Inter-process Communication, Race Conditions, Critical Section Problem, Mutual Exclusion, Semaphores, problems of synchronization, readers and writers problem, dining philosophers problem, Monitors. **Deadlocks:** System model, deadlock characterization, deadlock prevention, avoidance, Banker's algorithm, Deadlock detection, and recovery from deadlocks.	11
IV	**Memory Management** Logical and Physical address map, Swapping, Memory allocation, MFT, MVT, Internal and External fragmentation and Compaction, Paging, and Segmentation. **Virtual Memory:** Demand paging, Page Replacement algorithms, Allocation of frames, thrashing.	12

	I/O Management: Principles of I/O Hardware: Disk structure, Disk scheduling algorithms. **File system Interface:** File Concept, Access Methods, Directory Structure, File System Structure, Allocation Methods, and Free-Space Management. **System Protection:** Goals, Principles, Domain of Protection, Access Matrix, Access Control.	
Lab Programs	1. Write a C program to simulate the FCFS CPU Scheduling algorithm. 2. Write a C program to simulate the SJF CPU Scheduling algorithm. 3. Write a C program to simulate the Round Robin CPU Scheduling algorithm. 4. Write a C program to simulate Bankers Algorithm for Deadlock Avoidance. 5. Write a C program to implement the Producer – Consumer problem using semaphores. 6. Write a C program to illustrate the IPC mechanism using Pipes. 7. Write a C program to illustrate the IPC mechanism using FIFOs. 8. Write a C program to simulate Paging memory management technique. 9. Write a C program to simulate Segmentation memory management technique. 10. Write a C program to simulate the Best Fit contiguous memory allocation technique. 11. Write a C program to simulate the First Fit contiguous memory allocation technique. 12. Write a C program to simulate the concept of Dining-Philosophers problem. 13. Write a C program to simulate the MVT algorithm. 14. Write a C program to implement FIFO page replacement technique. 15. Write a C program for implementing sequential file allocation method.	

Text Books:

1. Silberschatz, Abraham, et al. *Operating System Principles*. 7th ed., Wiley India, 2006.
2. Stallings, William. *Operating Systems: Internals and Design Principles*. 5th ed., Pearson Education, 2006.
3. Silberschatz and Galvin, "Operating System Concepts ", Wiley
4. Operating Systems: A Concept-based Approach, Dhananjay M. Dhamdhere,McGrawHill

Reference Books:

1. Tanenbaum, Andrew S. *Modern Operating Systems*. 3rd ed., Prentice Hall India, 2007.
2. Das, Sumitabha. *UNIX Concepts and Applications*. 4th ed., Tata McGraw-Hill, 2014.

Code: BCA 2004T (For Theory) BCA 2004P (For Practical)	SEC-II	Object Oriented Programming Using Java	3L+T: 4P	5 Credits (45 hours theory and 60 hours practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand the fundamental concepts of Object-Oriented Programming (OOP) and Java language structure.

CO2: Apply decision-making, branching, looping, and operator usage in Java programming.

CO3: Implement concepts of classes, objects, inheritance, polymorphism, arrays, and strings in Java programs.

CO4: Develop Java programs using packages and exception handling mechanisms.

Unit	Topics	Purposed lectures
I	**Fundamentals of Object-Oriented Programming** – Basic Concepts of Object-Oriented Programming (OOP), Benefits and Applications of OOP. **Java Evolution** – Java Features, Difference between Java, C and C++, Java and Internet, Java Environment.	11

	Overview of Java Language – Setting up Java Development Environment (JDK, IDEs), Introduction to Simple Java Program, Use of Comments and Math functions, Application of two classes, Java Program Structure, Java Tokens and Statements, Implementing Java Program and JVM, Command Line Arguments.	
II	**Constants, Variables and Data Types** – Constants, Variables, Primitive & Non-Primitive Data Types, Declaration of Variables, Giving values to Variables, Symbolic Constants, Typecasting. **Operators & Expressions** – Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment & Decrement operators, Conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence & Associativity. **Decision Making, Branching & Looping** – Decision Making with Control Statements (if-else, switch-case), Looping Statements (for, while, do-while), Jump in loops, Labeled loops.	**11**
III	**Classes, Objects and Methods** – Java Keywords, Defining Class, Instance Variables & Methods, Creating Objects, Methods Declaration, Constructors, this keyword, Static Members (Variables & Methods). **Arrays, Strings and Vectors** – 1D Arrays, Creating an Array, 2D Arrays, Strings, Vectors, Wrapper Classes, Enumerated Types. **Inheritance** – Defining Classes & Objects, Access Modifiers, Extending Classes and Implementing Interfaces, Multiple Inheritance using Interfaces and Polymorphism (Method Overloading & Overriding Methods).	**11**
IV	**Packages** – Basics of Packages, System Packages, Creating and Accessing Packages, Creating User-Defined Packages, Adding Class to a Package. **Exception Handling** – Using the main keywords of exception handling: try, catch, throw, throws and finally; Nested try, Multiple catch statements, Creating User-Defined Exceptions.	**12**
Lab Programs	**1.** Write a program to read two numbers from the user and print their product. **2.** Write a program to print the square of a number passed through command line arguments. **3.** Write a program to send the name and surname of a student through command line arguments and print a welcome message for the student. **4.** Write a Java program to find the largest number out of *n* natural numbers. **5.** Write a Java program to find the Fibonacci series & Factorial of a number using recursive and non-recursive functions. **6.** Write a Java program to multiply two given matrices. **7.** Write a Java program for sorting a given list of names in ascending order. **8.** Write a Java program that checks whether a given string is a palindrome or not (e.g., MADAM is a palindrome). **9.** Write a Java program to read *n* number of values in an array and display them in reverse order. **10.** Write a Java program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the superclass. MulDiv should have methods to multiply and divide. A main function should access the methods and perform the mathematical operations. **11.** Create a JAVA class called Student with the following details as variables within it: USN, NAME, BRANCH, PHONE, PERCENTAGE. Write a JAVA program to create *n* Student objects and print the USN, Name, Branch, Phone, and Percentage of these objects with suitable headings. **12.** Write a Java program that displays the number of characters, lines, and words in a text. **13.** Write a Java program to create a class called Shape with methods called getPerimeter() and getArea(). Create a subclass called Circle that overrides the getPerimeter() and getArea() methods to calculate the area and perimeter of a circle.	

	14. Write a Java program to create a class Employee with a method called calculateSalary(). Create two subclasses Manager and Programmer. In each subclass, override the calculateSalary() method to calculate and return the salary based on their specific roles. 15. Write a Java program using an interface called 'Bank' having a function 'rate_of_interest()'. Implement this interface to create two separate bank classes SBI and PNB to print different rates of interest. Include additional member variables and constructors in classes SBI and PNB. 16. Write a Java package program for the class Book and then import the data from the package and display the result. 17. Write a Java program 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. 18. Write a Java program for demonstrating the divide by zero exception handling. 19. Write a Java program that reads a list of integers from the user and throws an exception if any numbers are duplicates. 20. Create an exception subclass UnderAge, which prints "Under Age" along with the age value when an object of UnderAge class is printed in the catch statement. Write a class ExceptionDemo in which the method test() throws UnderAge exception if the variable age passed to it as an argument is less than 18. Write the main() method to demonstrate the working of the program.	

Text Books:

1. Balaguruswamy, E. Programming with JAVA: A Primer. 7th ed. India: McGraw Hill Education, 2023.
2. Schildt, H. Java: The Complete Reference. 12th edition. McGraw-Hill Education, 2022.
3. Programming in Java 2,BySomasundaram, K,Jaico Publishing House

Reference Books:

4. Liang, Y. Daniel. Introduction to Java Programming. 7th ed., Pearson, 2008.
5. Malhotra, S., and S. Choudhary. Programming in Java. 2nd ed., Oxford UP, 2014.
6. Ivon Horton, "Beginning Java-2", SPD Publication4
7. Ramesh Bangia, Learning JAVA-2, Khanna Book Publishing Co (P) Ltd

Code: BCA-2005T (For theory) BCA-2005P (For practical)	SEC-III	Web Technologies	1L+T: 2P	2 Credits (15 hours theory and 30 hours practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand the concepts of webpage, mark up language along with CSS

CO2: Understand the core concepts of JavaScript including functions, events, DOM manipulation, and form validation.

CO3: Apply AJAX, XML, and JSON to create dynamic and interactive web applications.

Unit	Topics	Purposed lectures
I	**Introduction to HTML** History of HTML, objectives, basic structures of HTML, header tags, body tags, paragraph tags, and formatting tags. Tags for form creation: TABLE, FORM, TEXTAREA, SELECT, IMG, IFRAME, FIELDSET, ANCHOR, AUDIO, and VIDEO. Lists in HTML, introduction to the DIV tag, NAVBAR design. **Introduction to CSS** Types of CSS, selectors, and responsiveness of a web page. **Introduction to Bootstrap**	7

	Downloading/linking Bootstrap, using Bootstrap classes, understanding the grid system in Bootstrap. Bootstrap typography, Jumbotron, button group, Glyphicons, pagination, pager, list group, and carousel. **Introduction to WWW** Protocols and programs, applications and development tools, web browsers, DNS, web hosting providers. Setting up Windows/Linux/Unix web servers, web hosting in the cloud, and types of web hosting.	
II	**Introduction to JavaScript** Functions and events, Document Object Model (DOM) traversal using JavaScript. Output systems in JavaScript: alert, throughput, input box, and console. Variables and arrays in JavaScript, date, and string handling. **Manipulating CSS through JavaScript** Form validation techniques: required validator, length validator, and pattern validator. **Advanced JavaScript** JavaScript error handling, JavaScript Object-Oriented Programming (OOP), JavaScript libraries and frameworks, JavaScript Browser Object Model (BOM), and ES6 features. **Combining HTML, CSS, and JavaScript** Handling events and buttons, controlling the browser. **Introduction to AJAX** Purpose, advantages, disadvantages, AJAX-based web applications, and alternatives to AJAX. **Introduction to XML** Uses, key concepts, DTD & schemas, XSL, XSLT, XSL elements, and transforming XML using XSLT. **Introduction to XHTML** Key concepts and features. **Introduction to JSON** Keys and values, types of values, arrays, and objects.	8
Lab Programs	**PART – A** 1. Create your class time table using table tag. 2. Design a Webpage for your college containing a description of courses, departments, faculties, library, etc., using list tags, href tags, and anchor tags. 3. Create a web page using Frame with rows and columns where you will have a header frame, left frame, right frame, and status bar frame. On clicking in the left frame, information should be displayed in the right frame. 4. Create your resume using HTML, using text, link, size, color, and lists. 5. Create a Web Page of a supermarket using internal CSS. 6. Use inline CSS to format the resume that you have created. 7. Use external CSS to format your timetable created. 8. Use all the CSS (inline, internal, and external) to format the college web page that you have created. 9. Write an HTML program to create your college website for mobile devices. **PART – B** 1. Write an HTML/JavaScript page to create a login page with validations. 2. Develop a simple calculator for addition, subtraction, multiplication, and division operations using JavaScript. 3. Use regular expressions for validations in the login page using JavaScript. 4. Write a program to retrieve data from a text file and display it using AJAX. 5. Create an XML file to store Student Information like Register Number, Name, Mobile Number, DOB, and Email-ID. 6. Create a DTD for the XML file created.	

	7. Create an XML schema for the XML file created. 8. Create an XSL file to convert the XML file to an XHTML file. 9. Write a JavaScript program using a switch case. 10. Write a JavaScript program using any five events. 11. Write a JavaScript program using built-in JavaScript objects. 12. Write a program for populating values from JSON text. 13. Write a program to transform JSON text into a JavaScript object.	

Text Books:

1. Laura Lemay, *Mastering HTML, CSS & JavaScript Web Publishing*, BPB Publications, 2016.
2. Thomas A. Powell, *The Complete Reference HTML & CSS*, Fifth Edition, 2017.
3. Web Technologies, Shruti Kohli, BPB Publications
4. Web Technologies: Black Book, Dreamtech Press

Reference Books:

1. Silvio Moreto, *Bootstrap 4 By Example*, e-book, 2016.
2. Tanweer Alam, *Web Technologies*, Khanna Book Publishing, 2011.
3. Web Technologies, Jeffery CJackson, Pearson
4. Web Technologies, Uttam K.Roy, Oxford Higher Education
5. Web Technologies, Kogent Looring Solutions, Dreamtech

Code: BCA-2006T	VAC-II	Indian Constitution	2L+T:0P	2 Credits (30 hours theory)

Max Marks: 100; Theory: 100;(External : 100 Marks)

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand the history, structure, and interpretation of the Indian Constitution, including Fundamental Rights, Duties, and State Policy Principles.

CO2: Analyze the structure and functioning of the Union Government, including the roles and powers of the President, Prime Minister, and Parliament.

CO3: Explain the structure and working of the State Government and its administrative framework, including the Governor, Chief Minister, and State Secretariat.

CO4: Evaluate the role of local administration and the Election Commission in the functioning of democracy At the grassroots level.

Unit	Topics	Purposed lectures
I	The Constitution – Introduction, The History of the Making of the Indian Constitution, Preamble and the Basic Structure, and its interpretation, Fundamental Rights and Duties and their interpretation, State Policy Principles.	6
II	Union Government – Structure of the Indian Union, President – Role and Power, Prime Minister and Council of Ministers, Lok Sabha, and Rajya Sabha.	6
III	State Government – Governor – Role and Power, Chief Minister and Council of Ministers, State Secretariat.	6
IV	Local Administration – District Administration, Municipal Corporation, Zila Panchayat.	6
V	Election Commission – Role and Functioning, Chief Election Commissioner, State Election Commission.	6

Text Books:

1. Bhargava, Rajeev. *Ethics and Politics of the Indian Constitution.* Oxford University Press, 2008.
2. Fadia, B.L. *The Constitution of India.* Sahitya Bhawan, 2017.
3. Basu, D.D. *Introduction to the Constitution of India.* Lexis Nexis, 2018.

Cases

1. Rustom Cavasjee Cooper v. Union of India. (1970) 1 SCC 248.
2. State of Rajasthan v. Mohan Lal Vyas. AIR 1971 SC 2068.
3. Mithilesh Garg v. Union of India. (1992) 1 SCC 168: AIR 1992 SC 221.
4. Chintamanrao v. The State of Madhya Pradesh. AIR 1951 SC 118.
5. Cooverjee B. Bharucha v. Excise Commissioner, Ajmer. AIR 1954 SC 220.
6. T. B. Ibrahim v. Regional Transport Authority, Tanjore. AIR 1953 SC 79.

15.3 Semester III

Code: BCA-3001 T	CC-VI	Probability and Statistics	3L+T:0P	3 Credits (45 hours theory)

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75)

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand fundamental concepts of statistics, apply measures of central tendency, and analyze data using measures of dispersion, develop practical data analysis skills.

CO2: Understand the concept of correlation, compute and interpret correlation measures and understand the concept of regression.

CO3: Understand fundamental concepts of probability, analyze random variables and their distributions, and apply standard probability distributions.

CO4: Understand the concept of sampling and sampling distribution, apply concepts of statistical inference, perform hypothesis testing, chi square test and develop data-driven decision-making skills

Unit	Topics	Proposed Lecture
I	**Basic Concepts of Statistics**: Qualitative and Quantitative Data, Classification of Data, Construction of Frequency Distribution, Diagrammatic Representation of Data. **Measures of Central Tendency:** Arithmetic Mean, Median and Mode Their Properties. **Measures of Dispersion**: Range, Coefficient of Range, Quartiles, Quartile Deviations, Mean Deviations, Coefficient of Mean Deviations, Standard Deviation and Variance for All Types of Frequency Distribution.	12
II	**Correlation**: Definition, Scatter Diagram, Types of Correlation, Measures—Karl Pearson's Correlation Coefficient and Spearman's Rank Correlation Coefficient. **Regression**: Definition of Regression, Regression Lines, Regression Coefficients	10
III	**Concepts of Probability:** Experiment and Sample Space, Events and Operations with Events, Probability of an Event, Basic Probability Rules, Applications of Probability Rules, Conditional Probability. **Random Variables:** Discrete and Continuous Random Variable, Probability Distribution of a Random Variable, Probability Mass Function, Probability Density Function, Expectation and Variance of a Random Variable. **Standard Probability Distributions:** Binomial Distribution, Poisson Distribution, Mean and Variance of Binomial and Poisson Distribution, Normal Distribution. Exponential Distribution.	12
IV	**Sampling Distribution:** Concept of Population and Sample, Parameter and Statistic, Sampling Distribution of Sample Mean and Sample Proportion. **Statistical Inference:** Estimation and Hypothesis Testing (Only Concept). **Hypothesis Testing for a Single Population:** Concept of a Hypothesis Testing, Tests Involving a Population Mean and Population Proportion (Z Test and T Test). **Chi Square Test for Independence of Attributes and Goodness of fit.**	11

Text Books:

1. Das N.G., Statistical Methods, Combined Edition, Tata McGraw Hill,2010.
2. RossSheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 6th Editio Elsevier, 2021.
3. Miller Irwin and Miller Marylees, Mathematical Statistics with Applications, Seventh Edition, Pearso Education, 2005
4. Statistical Methods by S. P. Gupta, Sultan Chand Publication

Reference Books:

1. Pa INabendu and SarkarSahadeb, Statistics: Concepts and Applications, Second Edition, PHI, 2013.
2. Montgomery Douglas and Runger GeorgeC., Applied Statistics and Probability for Engineers, Wile 2016.
3. Fundamental of Applied Statistic by S.C. Gupta & V.K. Kapoor , Sultan Chand Publication.
4. Probability, random variables and stochastic processes by A. Papoulis and S.U. Pillai, TMH.

Code: BCA-3002T (For theory) BCA-3002P (For practical)	**CC-VII**	**Database Management Systems**	**3L+T:4P**	**5 Credits (45 hou theory and hours practical)**

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to

CO 1. Understanding Core Concepts of DBMS, keys, and ER model
CO 2. Proficiency in Database Design and SQL and normalization
CO 3. Application of Advanced Database Techniques and transactions
CO 4. Knowledge of No SQL database and Big data

Course Outcomes after Lab Programs:

CO 1. Understanding Core Concepts of DBMS
CO 2. Proficiency in Database Design and SQL
CO 3. Application of Advanced Database Techniques Prerequisite:
CO 4. Basic knowledge of Set Theory.

Unit	Topics	Proposed Lecture
I	**Introduction to Databases:** Definition and Importance Of DBMS, History and Evolution of DBMS, Characteristics of DBMS, Advantages and Disadvantages of DBMS, Roles of Database Users and Administrators **Data Models:** Introduction to Data Models, Types of Data Models (Hierarchical, Network, Relational, Object-Oriented), Importance of Data Models In DBMS **Database Design:** Keys: Primary Key, Candidate Key, Super Key, Foreign Key, Composite Key, Alternate Key, Unique Key, Surrogate Key, Constraints in A Table: Primary Key, Foreign Key, Unique Key, NOT NULL, CHECK, Entity-Relationship (ER) Model, Entities and Entity Sets, Attributes and Relationships, ER Diagrams, Key Constraints and Weak Entity Sets, Extended ER Features, Introduction to the Relational Model and Relational Schema	12
II	**Relational Algebra and Calculus:** Introduction to Relational Algebra. Operations: Selection, Projection, Set Operations, Join Operations, Division, Tuple and Domain Relational Calculus **Structured Query Language (SQL):** SQL Basics: DDL And DML, Aggregate Functions (Min(), Max(), Sum(), Avg(), Count()), Logical Operators (AND, OR, NOT), Predicates (Like, Between, Alias, Distinct), Clauses(Group By, Having, Order By, Top/Limit), Inner Join, Natural Join, Full Outer Join, Left Outer Join, Right Outer Join, Equi Join. **Advanced SQL:** Analytical Queries, Hierarchical Queries, Recursive Queries, Views, Cursors, Stored Procedures and Functions, Packages,	12

	Triggers, Dynamic SQL. **Normalization And Database Design:** Functional Dependencies: Armstrong's Axioms, Definition, Properties (Reflexivity, Augmentation, Transitivity), Types (Trivial, Non-Trivial, Partial and Full Functional Dependency), Closure of Functional Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF), Denormalization.	
III	**Transaction Management:** Acid Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Support In SQL, Introduction to Crash Recovery, 2pl, Serializability, And Recoverability, Introduction to Lock Management, Dealing with Deadlocks **Database Storage and Indexing:** Data on External Storage, File Organizations and Indexing, Index Data Structures, Comparison of File Organizations, Indexes and Performance Tuning, Guidelines for Index Selection	**11**
IV	**NoSQL Databases and Big Data:** Introduction to NoSQL, Data Models: Document, Key Value, Column Family, Graph. Uses and Features of NO/SQL MongoDB Operators, Overview of Big Data Technologies: Hadoop, MongoDB, Cassandra. **Database Security and Advanced Topics:** Introduction to Database Security, Access Control, Discretionary Access Control, Introduction to Data Ware housing, OLAP, Data Mining	**10**
Lab Programs	1. Draw an ER Diagram of Registrar Office 2. Draw an ER Diagram of Hospital Management System 3. Reduce the ER diagram in question no1 into tables 4. Reduce the ER diagram of question no2 into tables 5. Consider the following Schema Supplier (SID, Sname, branch, city, phone) Part (PID, Pname, color, price) Supplies (SID, PID, qty, date_supplied) **DDL Commands** 1. Create the above tables 2. Add a new attribute state in supplier table 3. Remove attribute city from supplier table 4. Modify the data type of phone attribute 5. Change the name of attribute city to address 6. Change a table's name, supplier to sup 7. Use truncate to delete the contents of supplies table 8. Remove the part table from database **DML Commands** 1. Insert at least 10 records in tables supplier, part, and supplies 2. Show the contents in tables supplier, part, and supplies 3. Find the name and city of all suppliers 4. Find the name and phone-no of all suppliers who stay in 'Delhi' 5. Find all distinct branches of suppliers 6. Delete the record of the supplier whose SID is 204001 7. Delete all records of supplier table 8. Delete all records of suppliers whose city starts with capital A. 9. Find the supplier names which have 'lk' in any position 10. Find the supplier name where 'R' is in the second position 11. Find the name of supplier whose name starts with 'V' and ends with 'A' 12. Change the city of all suppliers to 'BOMBAY' 13. Change the city of supplier 'Vandana' to 'Goa' **Queries with Constraints** 1. Create the supplier table with Primary Key Constraint 2. Create supplies table with Foreign key Constraint 3. Create a part table with UNIQUE Constraint 4. Create supplier Table with Check Constraints	

5. Create Supplier table with Default Constraint Queries on TCL
6. Create Save point
7. Rollback to Save point
8. Use Commit to save on Aggregate Functions:
9. Find the minimum, maximum, average and sum of costs of parts
10. Count the total number of parts present
11. Retrieve the average cost of all parts supplied by 'Mike' Queries on GROUP BY, HAVING AND ORDER BY Clauses
12. Display total price of parts of each color
13. Find the branch and the number of suppliers in that branch for branches which have more than 2 suppliers
14. Find all parts sorted by name in ascending order and cost in descending order
15. Find the branch and the number of suppliers in that branch Queries on Analytical, Hierarchical, Recursive nature.
16. Find out the 5th highest earning employee details.
17. Which department has the highest number of employees with a salary above $80,000, and what percentage of employees in that department have a salary above $80,000
18. Retrieve employee table details using the hierarchy query and display that hierarchy path starting from the top level indicating if it is a leaf and there exists a cycle.
19. What is the average salary for employees in the top 2 departments with the highest average salary, and what is the hierarchy of departments and sub-departments for these top 2 departments?
20. Use recursion to retrieve the employee table and display the result in breadth first and depth first order.
21. Write a recursive query to show the equivalent of level, connect_by_root, and connect_by_path.
22. Use recursion to retrieve the employee table and display the result in depth first order showing id, parentid, level, root_id, path and leaf.

Queries on Operators:

6. Find the pname, phoneno and cost of parts which have cost equal to or greater than 200 and less than or equal to 600.
7. Find the sname, SID and branch of suppliers who are in 'local' branch or 'global' branch
8. Find the pname, phoneno and cost of parts for which cost is between 200 and 600
9. Find the pname and color of parts, which has the word 'NET' anywhere in its pname.
10. Find the PID and pname of parts with pname either 'NUT' or 'BOLT'
11. List the suppliers who supplied parts on '1stmay2000' , '12JAN2021' , '17dec2000' , '10 Jan 2021'
12. Find all the distinct costs of parts

Join Operators

13. Perform Inner join on two tables
14. Perform Natural Join on two tables
15. Perform Left Outer Join on tables
16. Perform Right Outer join on tables
17. Perform Full Outer Join on tables Set Theory

Operators

18. Show the use of UNION operator with union compatibility
19. Show the use of Intersect operator with union compatibility
20. Show the use of minus operator with union compatibility
21. Find the Cartesian product of two tables

Queries on Set Theory Operators

22. List all parts except 'NUT' and 'BOLT' in ascending order of costs
23. Display all parts that have not been supplied so far
24. To display the supplier names who have supplied 'green' part with cost 500 Rupees

AND 'red' part with cost 400 Rupees.

25. To display the supplier names who have supplied 'green' part with cost 500 Rupees OR 'red' part with cost 400 Rupees.
26. To Display the name of suppliers who have supplied all parts that are 'red' in color.

PL/SQL Programs

27. Write a PL/SQL Code to add two numbers
28. Write a PL/SQL code for Fibonacci series
29. Write a PL/SQLCode for greatest of 3 numbers
30. Write a PL/SQL code for area and circumference of a circle

PL/SQL Programs on Cursors

31. Write a Program using CURSOR to display SID and city of 1st record of supplier
32. Write a program using cursors to display the SID and City of all suppliers and then print the count of suppliers.

PL/SQL Programs on Triggers, Procedures and Functions

33. Write a Program using TRIGGER on UPDATE
34. Write a command to See the effect of trigger
35. Write a Program using PROCEDURE to increase the cost by Rs.1000 for part whose PID is passed as an argument.
36. Write a procedure to update the city of a supplier whose SID and city are passed as arguments and the procedure returns the name of supplier whose city is updated.
37. Write a function to return the total number of suppliers
38. Write a function to return the PID of part, for which the part name is passed
39. Write a function to find the sum total of costs of all parts.

PL/SQL Programs on Implicit Cursors

40. Insert a record using %ROWTYPE
41. Write a code using %NOTFOUND, %FOUND, %ROWCOUNT
42. Write a code using %TYPE

MongoDB Queries

43. Create a collection and insert documents into it using insertOne() and insertMany()
44. Select all documents in collection
45. Find the count of all suppliers
46. Find all records that have city='Delhi'
47. Retrieve all documents that have color equal to 'red' or 'green'
48. Retrieve all documents where part_nameis 'P1' or price is less than 200.
49. Update the record of 'Geeta' ,set city='Bombay' and phoneno='11223344'
50. Delete all records where price is greater than 5000
51. Display only the name and city of the supplier
52. Sort all suppliers on city and display only the first two records.

Text Books:

1. Ramakrishnan, Raghu, and Johannes Gehrke. *Database Management Systems*. 3rd ed., McGraw-Hill, 2018.
2. Rosenzweig, Benjamin, and Elena Rakhimov. *Oracle PL/SQL by Example*. 5th ed., Prentice Hall, 2015.
3. Dayley, Brad. *NoSQL with MongoDB in 24 Hours*. 1st ed., Sams Publishing, 2024.
4. SQL, PL/SQL The Programming Language of Oracle, Ivan Bayross, BPB Publication
5. C. J. Date, Introduction to Database System, Pearson
6. Bipin Desai, "An Introduction to Database System ", Galgotia Publication
7. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, Addison-Wesley

Reference Books:

1. Korth, Henry F., et al. Database System Concepts. 7th ed., McGraw-Hill, 2019.
2. Oracle SQL&PL/SQL Programming Fundamentals, Djoni Darmawi karta

Code: BCA-3003T	CC-VIII	Software Engineering	3L+T:0P	3 Credits (45 hours theory)

Max Marks: 100; Theory (Int: 25; Ext: 75)

Course Outcomes: Upon competition of the course, students will be able to

CO 1. Acquire a comprehensive understanding of the software development lifecycle and its application in contemporary software engineering practices.

CO 2. Develop proficiency in project management methodologies and strategic decision- making for successful software project execution.

CO 3. Master the art of software design, development, and testing to produce robust and efficient software solutions.

Unit	Topics	Proposed Lecture
I	The Evolving Role of Software, Changing Nature of Software, Layered Technology, A Process Framework, Process Models: Waterfall Model, Incremental Process Models, Evolutionary Process Models, Unified Process. Spiral Model. **Agile Software Development**: Agility Principles, Agile Methods, Plan-Driven and Agile Development, Extreme Programming, Scrum, A Tool Set for The Agile Process.	12
II	**Software Requirements Engineering**: Functional and Non-Functional Requirements, The Software Requirements Document, Requirements Specification, Requirements Engineering Processes, Requirements Elicitation and Analysis, Requirements Validation, Requirements Management. **Risk Management:** Reactive Vs Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, RMMM, RMMM Plan. **Project Planning**- Software Pricing, Plan-Driven Development, Project Scheduling, Agile Planning, Estimation Techniques.	12
III	**Design:** Design Process and Design Quality, Design Concepts, The Design Model, Software Architecture, Data Design, Architectural Design, Basic Structural Modeling, Class Diagrams, Sequence Diagrams, Collaboration Diagrams, Use Case Diagrams, Component Diagrams. **Software Implementation-Relationship Between Design and Implementation:** Implementation Issues and Programming Support Environment; Coding the Procedural Design, Coding Style and Review of Correctness and Reliability. **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.	11
IV	**Quality Management:**Quality Concepts, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Statistical Software Quality Assurance, Software Reliability. **Release Management:** Release Planning, Development and Build Plans, Release Strategies, Risk Management, And Post-Deployment Monitoring. **Product Sustenance:** Maintenance, Updates, End of Life, Migration Strategies.	10

Text Books:

1. Somerville, Ian. *Software Engineering*. 10th ed., Pearson Education, 2015.
2. Pressman, Roger S., and Bruce R. Maxim. *Software Engineering: A Practitioner's Approach*. 8th ed McGraw Hill Education, 2015.
3. Gill, N.S. *Software Engineering*. Khanna Publishing House, 2023.
4. Fundamentals of Software Engineering, Rajib Mall, PHI

Code: BCA-3004T (For Theory) BCA-3004P (For Practical)	DSEC-I	Group-A: Elective-I Feature Engineering	1L+T:4P	3 credits (15 hours theory and 60 hours practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand the significance of feature engineering in the machine learning workflow and its role in enhancing model performance within the data science pipeline.

CO2: Apply data preprocessing techniques including handling missing values, outliers, and noise, as well as scaling and normalization, to prepare raw data for modeling.

CO3: Design and construct meaningful features through transformation techniques such as encoding, mathematical operations, and domain-specific methods; and perform feature extraction from text, image, and time-series data using advanced tools like PCA, TF-IDF, and HOG.

CO4: Implement and evaluate feature engineering strategies using Python tools (Pandas, NumPy, Scikit-learn), apply feature selection methods (filter, wrapper, embedded), and assess their impact on model performance using metrics and cross-validation in real-world scenarios.

Course Outcomes after Lab Programs

CO 1. Learn Basics of Python, Pandas, NumPy, Loading and Exploring Datasets.

CO 2. Learn data processing through data sets.

CO 3. Learn how to Extract features from text, image, and time-series data using advanced methods like PCA, TF-IDF, and HOG

Unit	Topics	Proposed Lecture
I	**Introduction to Feature Engineering** Introduction to Data and Features: Importance of Features in Machine Learning. Data types and features: Numerical, Categorical, Ordinal, Discrete, Continuous, Interval and Ratio. Basic Feature Preprocessing: Handling Missing Data, Data Cleaning, Feature Scaling, Normalization, and Transformation.	2
II	Feature Engineering Techniques Techniques for Numerical Data: Binning and Discretization, Polynomial and Interaction Features. Categorical Data Techniques: One Hot Encoding, Label Encoding. Feature extraction vs. feature selection, Steps in feature selection. Feature Selection Methods: Filter, Wrapper, and Hybrid. Feature Reduction: Introduction and application of Principal Components Analysis.	2
Lab Programs	The lab experiments can be implemented in Python usingrelevant libraries such as numpy, pandas, sklearn, nltk, matplotlib, and seaborn. Kaggle datasets, public repositories (e.g., UCI, Machine Learning etc.), or generated datasets can be used for conducting the experiments. Experiments may be conducted on numerical, image, or time-series datasets. 1. Handle missing values in column(s) of a dataset. For example, fill missing values with the mean/median/mode of the columns such as 'Age', 'Height', 'Weight', 'Grade' for a dataset. 2. Clean a dataset by identifying and removing invalid data entries. For example, a dataset having columns 'Name', 'Gender' and 'Age' where 'Name' contains 'invalid data'. 3. Scale numerical features using Min-Max normalization for a dataset with columns like 'Height', 'Weight'. 4. Perform exploratory data analysis and visualize data distributions using histograms and box plots.	

5. Compute and visualize the correlation matrix of a dataset with 2 or more columns.
6. Bin numerical data into discrete intervals for a dataset with a column containing numerical values.
7. Create polynomial and interaction features from numerical data in a dataset with two columns.
8. Apply logarithmic transformation to skewed numerical features in a dataset with column 'Distance'.
9. Perform one-hot encoding on categorical features in a dataset with column 'Category' containing categorical values. The distinct values in the Category feature are [Good, Better, Best] and Gender [Male, Female].
10. Preprocess text data (tokenization) for a dataset with a column 'Text'.
11. Preprocess text data (stemming) for a dataset with a column 'Text'.
12. Preprocess text data (lemmatization) for a dataset with a column 'Text'.
13. Convert text data into a Bag-of-Words representation for a dataset with a column 'Text'.
14. Apply TF-IDF transformation to text data for a column 'Text'.
15. Perform image augmentation (resizing, normalization, rotation, translation) for a set of images.
16. Perform image augmentation resizing for a set of images.
17. Perform image augmentation normalization for a set of images.
18. Perform image augmentation rotation for a set of images.
19. Perform image augmentation translation for a set of images.
20. Decompose a time series into trend, seasonal, and residual components for a dataset with a column 'TimeSeries'.
21. Perform Principal Component Analysis (PCA) on a dataset and visualize the first two principal components.

Text Books:

1. Nair, P. K. S. *Machine Learning with Python: A Practical Introduction.* Wiley India, 2020.
2. Kroese, Dirk P., et al. *Data Science and Machine Learning: Mathematical and Statistical Methods.* Pearson India, 2020.
3. Rao, R. Nageswara. *Python for Data Science.* Dreamtech Press, 2019.
4. Tripathy, B. K., and J. Anuradha. *Artificial Intelligence and Machine Learning.* Pearson India, 2020.

Reference Books:

1. Zheng, Alice, and Amanda Casari. *Feature Engineering for Machine Learning.* O'Reilly Media, 2018.
2. Gal, Soledad. *Python Feature Engineering Cookbook.* Packt Publishing, 2020.
3. Pankaj Jalote's, Software Engineering- A Precise Approach- WILEY Precise Text Book
4. Schach, Stephen. *Software Engineering.* 7th ed., McGraw-Hill, 2007.
5. Van Vliet, Hans. *Software Engineering: Principles and Practice.*3rd ed., Wiley, 2008.
6. Software Engineering (Third Edition) -KK Agarwal, Yogesh Singh, Newage International Publishers

Code: BCA-3005T (For theory) and BCA-3005P (For practical)	DSEC-II	Group-B: Elective-I Basics of Data Analytics using Spreadsheet	1L+T:4P	3 Credits (15 hours theory and 60 hours practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to
CO1: Understand the basics of data analytics and its applications.
CO2: Develop proficiency in using spreadsheet software for data manipulation and analysis.
CO3: Build and use spreadsheet models for decision making & Communicate data insights effectively

Course Outcomes after Lab Programs:
CO1: Implement and evaluate supervised learning techniques, including K-Nearest Neighbors, linear regression, and logistic regression, and measure model performance using accuracy, precision, recall, and F1 score.
CO2: Apply and visualize clustering algorithms such as K-Means, hierarchical clustering, and DBSCAN on datasets. This practical application helps you understand their real- world use.
CO3: Perform dimensionality reduction using Principal Component Analysis (PCA) and interpret the results.
CO4: Develop and assess classification models using random forests, support vector machines, and neural networks.
CO5: Demonstrate ensemble learning concepts through bagging with random forests and boosting with the AdaBoost algorithm.

Unit	Topics	Proposed Lecture
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, Introduction to Spreadsheet Tools (Excel/Google Sheets)	7
II	**Data, Ethics, and Industry : Case Studies** Data Collection Methods – Different Data Sources & Format – Data Cleaning and Transformation – Handling Missing Data and Outliers, Removing Duplicates – Ethical Considerations in Data Analytics.- Real-world Applications of Data Analytics- Industry-specific Applications (Finance, Marketing, Operations, Healthcare, Manufacturing/Supply Chain) – Case Study Note: Case study is for discussion not to be considered for evaluation.	8
Lab Programs:	**PART–A: Understanding and Describing the Data** **Introduction to Excel and its Basic Functions** Getting started with Excel: Workbook, Worksheet, Cells, and Ranges Data entry and basic format ting techniques Using basic arithmetic functions: SUM, AVERAGE, COUNT, MIN, MAX, ROUND, CEILING, FLOOR Introduction to cell referencing: relative, absolute, and mixed **Data Importing and Pre-processing** Importing data from various sources(CSV, text files, web data) Data cleaning: removing duplicates, handling missing data, and standardizing formats Data transformation: text-to-columns, data validation techniques Using the "Find & Replace" and "Text Functions"(LEFT,RIGHT, MID,CONCATENATE), Sorting and Filtering Data	

Descriptive Statistics Using Excel

9. Calculating measures of central tendency: mean, median, mode
10. Computing measures of dispersion: range, variance, standard deviation, Coefficient of Variation (CV)
11. Creating and interpreting frequency distributions and histograms
12. Using Excel's "Data Analysis Toolpak" for basic statistical analysis

PART-B:Beyond the Basics: Visualizing and Communicating Data

Advanced Spreadsheet Functions

1. Use logical functions: IF, AND, OR, IFERROR, ISNA
2. Lookup and reference functions: VLOOKUP, HLOOKUP, INDEX, MATCH
3. Data aggregation techniques: SUMIFS, COUNTIFS, AVERAGEIFS
4. Text functions for data manipulation: TRIM, CLEAN, TEXT, RIGHT, LRFT, MID

Data Visualization Techniques

5. Creating various chart types: bar, line, pie, scatter
6. Advanced charting techniques: combo charts, dual-axis charts
7. Datavisualizationbestpractices:choosingtherightchart,formatting,and styling
8. Creating and customizing Pivot Tables and Pivot Charts

Dashboard Creation

9. Introduction to dashboards: concepts and components
10. Use Pivot Tables and Pivot Charts for dashboard elements
11. Apply conditional formatting for dynamic visual cues
12. Create inter active dashboards with slicers and timeline

Text Books:

1. Mitchell, Tom M. *Machine Learning*. 1st ed., McGraw-Hill, 1997.
2. Kalita, J. K., D. K. Bhattacharyya, and S. Roy. *Fundamentals of Data Science: Theory and Practice*. Elsevier, 2023.
3. Jose, Jeeva. *Beginner's Guide for Data Analysis using R Programming*. Khanna Publishing House, 2024.
4. Nelson, Stephen L., and E. C. Nelson. *Excel Data Analysis for Dummies*. 3rd ed., John Wiley & Sons, 2016.
5. Middleton, Michael R. *Data Analysis Using Microsoft Excel*. 3rd ed., Thomson Brooks/Cole, 2004.

Reference Book:

6. Flach, Peter A. *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*. Cambridge University Press, 2012.
7. Duda, Richard O., Peter E. Hart, and David G. Stork. *Pattern Classification*. 2nd ed., John Wiley & Sons, 2007.
8. Haykin, Simon. *Neural Networks and Learning Machines*. 3rd ed., PHI Learning, 2009.
9. Chollet, François. *Deep Learning with Python*. Manning Publications, 2018.
10. Bishop, Christopher M. *Pattern Recognition and Machine Learning*. Springer, 2006.
11. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. *Deep Learning*. MIT Press, 2016.
12. Géron, Aurélien. *Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*. 1st ed., O'Reilly Media, 2017.
13. Alexander, Michael, Richard Kusleika, and John Walkenbach. *Excel 2019 Bible*. John Wiley & Sons, 25 Sept. 2018.
14. Ragsdale, Cliff T. *Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics*. Cengage Learning Asia, 2015.

Code: BCA- 3006T (for theory) BCA-3006P (for practical)	DSEC-III	Group-C: Elective-I Web Programming-I Full-Stack Fundamentals (Front-End + Basic Back-end)	1L+T:4P	3 Credits (15 hours theory and 60 hours practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to

CO1: Create well-structured and visually appealing web pages using HTML and CSS

CO2: Gain hands-on experience in writing JavaScript code to create interactive web pages.

CO3: Understand AJAX for real-time data fetching and be able to integrate third-party APIs into web applications

CO4: To building scalable front-end applications using React.js.

Unit	Topics for theory and Practical	Proposed Lecture
I	**Introduction to Web & Full-Stack Development** Web Development Overview, Types of Developers: Front-End, Back-End, Full-Stack, Client-Server Architecture, HTTP/HTTPS Protocols, Modern Full-Stack Stacks: MERN, MEVN, LAMP. **HTML5 – Structure of Web Pages** HTML Elements, Tags, Attributes, Semantic Tags (header, footer, section), Lists, Tables, Forms, Media Tags: <img>, <video>, <audio>, Form Validation (basic), Accessibility Basics (alt text, labels). **CSS3 – Styling Web Pages** Selectors, Properties, and Values, Box Model, Display: block, inline, inline-block, flex, grid, Positioning: static, relative, absolute, fixed, CSS Units (px, %, em, rem), Pseudo-classes and pseudo-elements, Transitions & Animations, CSS Frameworks: **Bootstrap**: Grid System, Components(Button, Form, Grid, Link, Nav Bar etc.), Utilities **Tailwind CSS** (basics)	5
II	**JavaScript – Programming for the Web** Variables: var, let, const, Data Types & Operators, Control Structures: if-else, switch, Loops: for, while, do-while, Functions & Arrow Functions, Arrays and Array Methods (map, filter, reduce), Objects and JSON, DOM Manipulation: querySelector, addEventListener, Events: onClick, onSubmit, onLoad, Basic Form Validation, Introduction to ES6 Features **Introduction to React.js (Front-End Library)** What is React? Why React?, JSX Syntax, Components: Functional vs Class (focus on functional), Props and State, Handling Events, Lists and Keys, Conditional Rendering, React Developer Tools (extension)	4
III	**Version Control with Git & GitHub** Git Installation & Configuration, Git Commands: init, add, commit, status, log, Branching and Merging, Using GitHub for Repositories, Collaboration Workflow: fork, pull request, dd GitHub Pages (deployment)	2
IV	**Introduction to Back-End with Node.js & Express.js** What is Node.js?, npm and Package Management, Setting Up a Server with Express, Handling Routes: GET, POST, Middleware (basic usage), Serving Static Files **Database Basics with MongoDB** Introduction to NoSQL, MongoDB vs SQL, Documents, Collections, Databases, CRUD Operations using: MongoDB Compass (GUI), Mongo Shell (CLI), Connecting MongoDB with Node.js, Mongoose Introduction and Schema Design **Mini Project :** Build a small full-stack application.	4

Suggested Readings:

1. Bayross, Ivan, and Sharanam Shah. *Web Designing and Development: HTML, CSS, JavaScript, jQuery, AJAX, PHP, and MySQL*. BPB Publications, 2010.

2. Crockford, Douglas. *JavaScript: The Good Parts.* O'Reilly Media, 2008.
3. Bibeault, Bear, and Yehuda Katz. *jQuery in Action.* Manning Publications, 2008.
4. Banks, Alex, and Eve Porcello. *Learning React: Functional Web Development with React and Redux.* O'Reilly Media, 2020.

Code: BCA- 3007T (For Theory) BCA-3007P (For Practical)	SEC-IV	Python Programming	2L+T:4P	4 Credits (30 hours of theory and 60 hours of practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to

CO1: Develop modular Python programs.

CO2: Apply suitable Python programming constructs, built-in data structures using Python libraries to solve a problem.

CO3: Understand basic Data visualization and File handling in Python.

Course Outcomes after Lab Programs

CO1: Learn Basics constructs of programming in Python.

CO2: Learn functions in python.

CO3: Learn file handling, exception handling and tkinter widgets and graphics.

Unit	Topics	Proposed Lecture
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; Nested Control Flow; Continue and Break Statements, Continue, Pass and Exit.	10
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 Arguments to Functions. Using Math and NumPy Module for List of Integers and Arrays. Python Classes/Object, Python Inheritance, Python Polymorphism, Python Regx,	10
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.	10

Python Tkinter, Widgets, Geometry Manager, GUI Application.
Data Visualization: Plotting Various 2Dand 3DGraphics; Histogram; Pi Charts; Sine and Cosine Curves.

Lab Programs:

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 up to n terms:1-2+3-4+5-6+7
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. Re shape 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 other half in the next line.
   b. Print all even values of t1 as another tuple t2.
   c. Concatenate a tuplet2=(11,13,15) with t1.
   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. Represent this data using a line plot. Generated line plot must include X axis label name = Month Number and Y axis label name = Total Profit.

Text Books:

1. Taneja, Sheetal, and Naveen Kumar. *Python Programming: 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. Python Programming Using Problem Solving Approach-ReemaThareja, Oxfored University Press latest edition

ReferenceBooks:

1. Downey, Allen. *Think Python*. 2nd ed., O'Reilly, 2015.
2. Dowling, Bob. *An Introduction to Python for Absolute Beginners*. Cambridge University Press, 2015.
3. Guttag, John. *Introduction to Computation and Programming Using Python*. 2nd ed., PHI India, 2016.
4. Python Programming- A Modern Approach Vamshi Khurana, Pearson,2010

Code: BCA-3008-A	VAC-III A	Yoga and Physical fitness Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.	0L+T: 4P	2 credits (6(hours practical)

Max Marks: 100; Practical: 100 marks

Course Outcomes: Upon competition of the course, students will be able to

CO 1. Understand yoga's significance and its practical applications for holistic well-being.
CO 2. Explore subtle energy systems and their role in enhancing health through yogic practices.
CO 3. Examine various paths of yoga to foster self-realization and spiritual growth.
CO 4. Master the Eight Limbs of Yoga for physical, mental, and spiritual harmony.
CO 5. Apply yogic principles to manage psycho-somatic ailments and promote resilience.

Unit	Topics	Proposed Lecture
I	**Yoga: Meaning and definition** Importance of yoga in 21st century, Introduction to Yogic Anatomy and Physiology, Yoga & sports, Yoga for healthy lifestyle, Types of Yoga:- Hathayaga, laya yoga, mantra yoga, bhaktiyoga, karma yoga, jnana yoga, raj yoga, Study of Chakras, Koshas, Pranas, Nadis, Gunas, Vayus and its application in Yogic practices, Ashtang Yoga:-Yama, niyama, asana, pranayama, Pratyahar, dharna, dhyan, Samadhi, :Benefits, Utilities & their psychological impact on body and mind. According to yoga concept of normality in modern psychology, concept of personality & its development, yogic management of psycho-somatic ailments: frustration, anxiety, depression	16
II	**Sports for Physical Fitness: Meaning and definition** Physical Activity–Concept, Benefits of Participation in Physical Activities, Components and Significance of Physical Fitness-Health, Skill and Cosmetic Fitness, Types of Physical Activities–Walking, Jogging, Running, Calisthenics, Rope Skipping, Cycling, Swimming, Circuit Training, Weight training, Adventure Sports, Principles of Physical Fitness, Warming Up, Conditioning, Cooling Down, Methods to Develop and Measure Health and Skill related components of Physical Fitness, Measurement of Health Related Physical Fitness (HRPF)	16
III	**Physical Wellness: Concept, Components** Types of wellness: psychological, social, emotional, and spiritual. Significance with reference to Positive Lifestyle, Concepts of Quality of Life and Body Image, Factors affecting Wellness, Wellness Programmes	12
IV	**Nutrition and Weight Management** Concept of Nutrients, Nutrition, Balanced Diet, Dietary Aids and Gimmicks, Energy and Activity-Calorie Intake, Energy Balance Equation, Obesity-Concept, Causes, Obesity Related Health Problems, Weight Management through Behavioural Modifications	16

Text Books / References:

- Anand O.P. Yog Dawra Kaya Kalp. Sewasth Sahitya Perkashan. Kanpur,2022.
- Brown, J.E. Nutrition Now Thomson-Wadsworth,2010.
- Corbinet. A.I. Fitness & Wellness-Concepts. McGrawHill. Publishers. New York.,2017
- Kamlesh, M.L. & Singh, M.K.(Physical Education(Naveen Publications) latest edition.
- Kansal, D.K. Textbook of Applied Measurement, Evaluation & Sports Selection. Sports & Spiritual Science Publications, New Delhi,2015.
- Kumari, Sheela, S., Rana, Amita, and Kaushik, Seema, Fitness, Aerobics and Gym Operations, Khel Sahitya, New Delhi,2020
- Lumpkin, A. Introduction to Physical Education, Exercise Science and Sports Studies,

McGraw Hill, New York, U.S.A.,2019
- Sarin N. Yoga Dawara Rogon Ka Upchhar. Khel Sahitya Kendra
- Savard, M. and C. Svec The Body Shape Solution to Weight Loss and Wellness: The Apples & Pears Approach to Losing Weight, Living Longer, and Feeling Healthier. Atria Books, Sydney, Australia.
- Siedentop, D. Introduction to Physical Education, Fitness and Sport, McGraw Hill Companies Inc., New York, USA.
- Sri Swami Ramas. Breathing. Sadhana Mandir Trust. Rishikesh.
- Swami Ram Yoga & Married Life Sadhana Mandir Trust. Rishikesh

Code: BCA-3008B	VAC-III B	Sports Management Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.	0L+T:4P	2 credits (6 hours practical)

Max Marks: 100; Practical: 100 marks

Course Outcomes: Upon competition of the course, students will be able to

CO1: Demonstrate a comprehensive understanding of sports management principles, including organizational structures, legal issues, and ethical considerations.

CO2: Evaluate marketing strategies and sponsorship opportunities in the sports industry, devising effective branding and promotional campaigns.

CO3: Apply financial management techniques to analyze revenue streams, control costs, and make informed investment decisions in sports organizations.

CO4: Utilize sports analytics tools and technology to enhance performance evaluation, strategic planning, and fan engagement initiatives.

CO5: Synthesize course concepts through practical applications, demonstrating the ability to address real-world challenges in sports management scenarios.

CO6: Apply theoretical knowledge to practical scenarios through case studies and projects, fostering critical thinking and problem-solving skills in sports management contexts.

Unit	Topics	Proposed Lecture
I	**Introduction to Sports Management** Definition and scope of sports management, Significance of sports, management in society and its evolution over time, Organizational structure of sports: amateur, professional, and non-profit entities, Roles and responsibilities of key personnel: managers, coaches, and agents, Governance bodies in sports: FIFA, IOC, and NCAA, Legal issues: contracts, negotiations, intellectual property rights, Ethical considerations: fair play and doping	16
II	**Sports Marketing and Sponsorship** Unique aspects of sports marketing, Fan engagement strategies, Target audience identification and segmentation, Branding strategies for sports teams and athletes, Sponsorship and endorsement deals, Negotiating and managing partnerships, Event management: planning, organizing, and promoting sports events	16
III	**Financial Management in Sports** Revenue generation in sports: ticket sales, broadcasting rights, merchandise sales, Financial models: budgeting and forecasting, Cost management: player salaries, facility expenses, operational costs, Investment opportunities in sports, Risk management techniques specific to sports organizations	12
IV	**Sports Analytics and Technology** Introduction to sports analytics, Evaluating player performance, Devising game strategies, Fan engagement through technology, Analytical techniques: statistical analysis, data visualization, predictive modeling, Key performance indicators(KPIs)in sports, Applications of analytics: talents counting, injury prevention, performance optimization.	16

Text Books:

1. Pedersen, P.M., Thibault, L., & Pedersen, P.M.(2019). Contemporary Sport Management. Human Kinetics.
2. Hoye, R., Smith, A. C. T., Nicholson, M., et al. (2021). Sports Management: Principles and Applications. Routledge.
3. Chelladurai, P., & Kerwin, S. (2017). Introduction to Sport Management: Theory and Practice. Human Kinetics.
4. Hoye, R., Cuskelly, G.,& Nicholson, M.(2019). Sports Governance: A Guide for Sport Organizations.

Routledge.

5. Conrad, M.(2018).The Business of Sports: A Primer for Journalists. Routledge.
6. Shank, M.D.(2019).Sports Marketing: A Strategic Perspective. Pearson.
7. Collett, P.,& Fenton, W.(2019).The Sponsorship Handbook: Essential Tools,Tipsand Techniques for Sponsors and Sponsorship Seekers. Kogan Page.
8. Fullerton, S. Jr., & Funk, D. C.(2019).Sports Marketing: A Practical Approach. Routledge.
9. Conrad, M.(2019). Winning in Sports Business: Essential Marketing, Finance, and Management Strategies. Routledge.
10. McCarty, L. A., & McPherson, G. (2019). Sports Event Management: The Caribbean Experience. Routledge.
11. Brown, M. T., Rascher, D., & Leeds, M.A.(2017). Financial Management in the Sport Industry. Routledge.
12. Winfree, J. A., & Rosentraub, M. S. (2017). Sports Finance and Management: Real Estate, Entertainment, and the Remaking of the Business. Taylor & Francis

Code: BCA-3008-C	VAC-III C	**Disaster Management** Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.	0L+T:4P	2 credits (60 hours of practical)

Max Marks: 100; Practical: 100 marks

Course Outcomes: Upon competition of the course, students will be able to

CO 1. Articulate the critical role of disaster management in reducing risks and enhancing resilience
CO 2. Identify and describe key institutional frameworks and processes in disaster management.
CO 3. Conduct risk assessments and develop disaster management plans for specific scenarios
CO 4. Activities in Emergency disaster Management and training

Unit	Topics	Proposed Practical hours
I	**Concepts and Terminologies** Understanding Key Concepts of Hazards, Disasters; Disaster Types and Causes (Geophysical, Hydrological, Meteorological, Biological and Atmospheric; Human-Made); Global Trends in Disasters - Impacts (Physical, Social, Economic, Political, Environmental and Psychosocial); Defining Vulnerability(Physical Vulnerability; Economic Vulnerability; Social Vulnerability)	16
II	**Key Concepts of Disaster Management Cycle** Components of Disaster Management Cycle (Phases: Response and Recovery, Risk Assessment, Mitigation and Prevention, Preparedness Planning, Prediction and Warning); Disaster Risk Reduction (DRR), Community Based Disaster Risk Reduction	16
III	**Initiatives At National and International Level** Disaster Risk Management in India and At International Level: Related Policies, Plans, Programs and Legislation; International Strategy for Disaster Reduction and Other Initiatives	12
IV	**Emergency Management** ExplosionandAccidents(Industrial,Nuclear,TransportandMining)- Spill(OilandHazardous Material); Threats (Bomb and Terrorist Attacks) - Stampede and Conflicts Training and Demonstration Workshops (At Least Two Workshops) Be Organized in Association with the NIDM, NDRF, NCDC, Param Military, Fire Brigade, CISF, Local Administration Etc.	16

Reference Books:

1. Clements, Bruce W. *Disasters and Public Health: Planning and Response.* Elsevier, 2009.
2. Duncan, K., and C. A. Brebbia, editors. *Disaster Management and Human Health Risk: Reducing Risk, Improving Outcomes.* WIT Press, 2009.
3. Singh, R. B., editor. *Natural Hazards and Disaster Management: Vulnerability and Mitigation.* Rawat Publications, 2006.
4. Ramkumar, Mu. *Geological Hazards: Causes, Consequences and Methods of Containment.* New India Publishing Agency, 2009.
5. Modh, S. *Managing Natural Disasters: Hydrological, Marine and Geological Disasters.* Macmillan, 2010.
6. Carter, Nick. *Disaster Management: A Disaster Manager's Handbook.* Asian Development Bank, 1991.

Code: BCA-3008-D	VAC-III D	**National Service Scheme (NSS)** Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.	0L+T:4P	2 credits (60 hours of practical)

Max Marks: 100; Practical: 100 marks

Course Outcomes: Upon competition of the course, students will be able to

CO1: Students will demonstrate an understanding of the history, philosophy, and objectives of the National Service Scheme (NSS), thereby fostering increased social awareness and patriotism among them.

CO2: Students will be able to organize and conduct various NSS programmes and activities effectively and through it understand the importance of leadership and team building.

CO3: Students will develop skills in community mobilization and partnership building.

CO4: Students will appreciate the importance of volunteerism and shramdan in societal development and thus, be able to understand role of community participation.

Unit	Topics	Proposed Practical Hours
I	**Introduction and Basic Concepts of NSS** National Service Scheme (NSS) - history, philosophy, and fundamental concepts, aims and objectives, providing clarity on the organization's overarching goals. Symbols of NSS - Emblem, flag, motto, song, and badge; Organizational structure of NSS	16
II	**NSS Programmes and Activities** Diverse programmes and activities conducted under the aegis of the National Service Scheme (NSS); Significance of commemorating important days recognized by the United Nations, Centre, State Government, and University; Examination of the methodology for adopting villages/slums and conducting surveys; Financial patterns of the NSS scheme	16
III	**Community Mobilization** Dynamics of community mobilization within the framework of the National Service Scheme (NSS); Functioning of community stakeholders; The conceptual lens of community development	12
IV	**Volunteerism and Shramdan in the Indian Context:** Roles and Motivations within the NSS Framework Ethos of volunteerism and shramdan (voluntary labor) within the cultural context of India and the framework of the National Service Scheme (NSS); Motivations and constraints shaping volunteer engagement; Role of NSS volunteers in initiatives such as the Swatch Bharat Abhiyan and Digital India	16

References:

1. Ministry of Youth Affairs and Sports, Government of India. (2022). National Service Scheme (NSS) Manual.
2. Agarwalla, S. (2021).NSS and Youth Development. Mahaveer Publications
3. Bhattacharya, P. (2024).Stories Of NSS(English Version). Sahityasree.
4. Borah, R. and Borkakoty, B. (2022). NSS in Socioeconomic Development. Unika Prakashan.
5. Wondimu, H., & Admas, G. (2024). The motivation and engagement of student volunteers in volunteerism at the University of Gondar. *Discover Global Society*, *2*(1), 1-16.
6. Saha, A. K. (2002). Extension Education–The Third Dimension Needs and Aspirations of Indian Youth. *Journal of Social Sciences*, *6*(3), 209-214.

Code: BCA-3008-E	VAC-III E	**National Cadet Corps (NCC)** Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.	0L+T:4P	2 credits (60 hours practical)

Max Marks: 100; Practical: 100 marks

Course Outcomes: Upon competition of the course, students will be able to

CO1: Mastery of Discipline and Leadership through Drill Learners would demonstrate the ability to effectively command a group, foster discipline, and work collaboratively towards achieving shared objectives.

CO2: Mastery of Grace and Dignity in Foot Drill Performance Learners would demonstrate an understanding of how these qualities enhance performance and foster teamwork within a group setting.

CO3: Proficient Weapon Handling and Safety Adherence Learners would showcase a thorough understanding of the criticality of safety measures, emphasizing accident prevention through strict adherence to safety protocols.

CO4: Enhanced Tactical Awareness and Strategic Decision-Making Learners would gain the ability to make informed decisions and effectively utilize terrain features to gain tactical advantage during operations.

Unit	Topics	Proposed Practical Hours
I	Overview of NCC, its history, aims, objectives, and organizational structure, Incentives and duties associated with NCC cadetship; Maneuvers: Foot drill, Word of Command, Attention, and stand at ease, and Advanced maneuvers like turning and sizing; Parade formations: Parade line, open line, and closed line; Saluting protocols, parade conclusion, and dismissal procedures. Marching styles: style march, double time march, and slow march	20
II	Weapon Training, Handling fire arms, Introduction and characteristics of the. 22 rifle; Handling Firearm techniques, emphasizing safety protocols and Best practices.	10
III	Map Reading (MR): Topographical forms and technical terms, including relief, contours, and gradients, crucial for understanding terrain features; Cardinal points , magnetic variation and grid convergence	10
IV	Field Craft & Battle Craft (FC & BC): Fundamental principles and techniques essential for effective field and battle craft operations; Methods of judging distance, including estimation, pacing, and visual cues	20

References:

1. DGNCC Cadet's Hand Book-Common Subjects-AllWings
2. Tiwari, R.(2019). NCC: Grooming Feeling of National Integration, Leadership and Discipline among Youth. Edwin Incorporation.
3. Chhetri, R. S.(2010).Grooming Tomorrows Leaders, The National Cadet Corps.
4. Directorate General National Cadet Corps(2003). National Cadet Corps, Youth in Action.
5. Vanshpal, Ravi(2024). The NCC Days, Notion Press.

15.4 Semester IV

Code: BCA-4001 T	CC-IX	Entrepreneurship and Startup Ecosystem	2L+T:0P	2 Credits (30 hours theory)

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75)

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand basic building blocks of creating a venture

CO2: Identify a business opportunity and translate it into a viable business model

CO3: Identify the elements of the Indian entrepreneurship eco system and take relevant benefits from the constituents

CO4: Know the legacy of family businesses and key differentiations from entrepreneurship stabilizing operations, build a team from scratch and scaling the business.

CO5: Understand then nuances of operating a startup – low budget marketing

Unit	Topics	Purposed lectures
I	**Introduction To Entrepreneurship & Family Business:** Definition and Concept of Entrepreneurship, Entrepreneur Characteristics Classification of Entrepreneurs, Role of Entrepreneurship in Economic Development–Start-Ups, Knowing the Characteristics of Family Business with Discussion on Few Indian Cases of Family Business like Murugappa, Dabur, Wadia, Godrej, Kirloskar etc.	7
II	**Evaluating Business Opportunity:** Sources of Business Ideas and Opportunity Recognition, Guesstimating the Market Potential of a Business Idea, Feasibility Analysis of the Idea, Industry, Competition and Environment Analysis	7
III	**Building Blocks of Starting Ventures:** Low-Cost Marketing using Digital Technologies, Team Building from Scratch, Venture Funding, Establishing the Value-Chain and Managing Operations, Legal Aspects like IPR and Compliances	8
IV	**Start-Up Ecosystem:** Components of the Start-Up Eco system Including Incubators, Accelerators, Venture Capital Funds, Angel Investors etc., Various Govt. Schemes like Start-Up India, Digital India, MSME etc., Sources of Venture Funding Available in India, Source of Technology, Intellectual Property Management	8

Text Books:

1. *Startup India Learning Program.* Start Up India, www.startupindia.gov.in.
2. Roy, Rajeev. *Entrepreneurship.* Oxford University Press, 2022.
3. Ireland, R. Duane, and Bruce R. Barringer. *Entrepreneurship: Successfully Launching New Ventures.* Pearson Publishing, 2020.
4. Agarwal, Rajiv. *Family Business Management.* Sage Publishing, 2022.
5. Tiwari, Anish. "Mapping the Startup Ecosystem in India." *Economic & Political Weekly,* 2003.
6. Ramachandran, K. *Indian Family Businesses: Their Survival Beyond Three Generations.* ISB Working Paper Series, 2011.

Code: BCA- 4002T (for theory) and BCA-4002P (for practical)	CC-X	Computer Networks	3L+T:4P	5 Credits (45 hours theory and 60 hours practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to
CO1: U n derstand the fundamental concepts of computer networks and their applications.
CO2: Develop problem-solving skills related to network design, implementation, and troubleshooting.
CO3: Implement Network Protocols
CO4: Configure Network devices.

Unit	Topics	Purposed lectures
I	**Introduction To Computer Networks:** Overview of Computer Networks: Definition and Objectives, Applications and Examples of Network Components and Architecture, Data Communication Components and Characteristics, Data Representation and Data Flow. **Network Models:** OSI Model: Layers and Functions, TCP/IP Model: Layers and Functions, Comparison Between OSI and TCP/IP Models. **Network Topologies:** Physical Vs. Logical Topologies, Common Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology. **Data Transmission:** Guided and Unguided Media, Analog Vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency. **Networking Devices:** Routers, Switches, Hubs, Bridges, Gateways, Functions and Configurations of Each Device.	11
II	**Data Link Layer and Networking Protocols:** Data Link Layer Fundamentals: Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms. **Ethernet:** Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods. **Network Protocols:** Introduction to TCP/IP Protocol Suite, IP Addressing: Ipv4 and Ipv6 Sub netting and CIDR Notation. Address Resolution Protocol (ARP):ARP Operation and Table, ARP Spoofing and Security Considerations. **Virtual LAN(VLAN):** Concept of VLAN, VLAN Tagging and Configuration, Benefits and Use Case.	11
III	**Network Layer and Transport Layer:** Network Layer: IP Routing: Static Vs. Dynamic Routing, Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT). **Transport Layer:** TCP Vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP. **Congestion Control Algorithms:** Techniques: Slow Start, Congestion Avoidance, Fast Retransmit, Fast Recovery, TCP Variants: TCP Reno, TCP Vegas. **Quality of Service (QOS):** QOS Principles and Mechanisms, Differentiated Services (DIFFSERV) And Integrated Services (INTSERV). Network Security Fundamentals: Threats and Vulnerabilities, Basic Security Mechanisms: Firewalls, VPNS, And Encryption.	11
IV	**Application Layer and Emerging Technologies:** **Application Layer Protocols:** HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and Resolution. **Network Applications:** Web Browsing, Email Communication, File Transfer, VOICE OVER IP (VOIP) And Streaming. **Emerging Technologies:** Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IOT) and its Impact on Networking, **Network Management:** SNMP: Simple Network Management Protocol, Network Monitoring Tools, and Techniques. **Future Trends in Networking:** 5G and Beyond, Network Automation and Artificial	12

	Intelligence in Networking.	
Lab Programs	***Configure Basic Network Settings:*** **1.** IP Address Configuration **2.** Subnet Mask and Gateway Settings ***Implement Network Protocols:*** **3.** Write a simple Python script to perform DNS resolution. **4.** Implement a basic HTTP client-server application. ***Network Simulation:*** **5.** Use network simulation tools (e.g.,Cisco Packet Tracer) to design and simulate network topologies. **6.** Configure routers and switches in a simulated environment. ***Performance Measurement:*** **7.** Measure network performance using tools like `ping`, `traceroute`, and `iperf`. **8.** Analyze network traffic using Wireshark. ***Implement VLANs:*** **9.** Configure VLANs on a switch and verify using simulation tools. ***Set Up a Simple Web Server:*** **10.** Deploy a basic web server and configure HTTP/HTTPS access. ***Network Security Lab:*** **11.** Implement basic firewall rules and VPN configurations. Perform vulnerability scanning and analyze results. ***Network Troubleshooting:*** **12.** Diagnose and resolve common network issues. **13.** Use troubleshooting commands and techniques to fix connectivity problems.	

Text Books:

1. Tanenbaum, Andrew S., and David J. Wetherall. *Computer Networks*. 5th ed., Pearson Education, 2011.
2. Kurose, James F., and Keith W. Ross. *Computer Networking: A Top-Down Approach*. 8th ed., Pearson, 2021.
3. Comer, Douglas E. *Computer Networks and Internets*. 6th ed., Pearson, 2014.
4. Shay, William A. *Understanding Communications and Networks*. 3rd ed., Cengage Learning, 2004.

Reference Books:

1. Forouzan, Behrouz A. *Data Communications and Networking*. 5th ed., McGraw-Hill Education, 2012.
2. Peterson, Larry L., and Bruce S. Davie. *Computer Networks: A Systems Approach*. 6th ed., Morgan Kaufmann, 2019.

Code: BCA-4003 T	CC-XI	Design and Analysis of Algorithms	3L+T:0P	3 Credits (45 hours theory)

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75)

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand the basic algorithm designing paradigms.

CO2: get the basic knowledge on how to analyze an algorithm.

CO3: Synthesize efficient algorithms in common design situations and real-life problems.

Unit	Topics	Purposed lectures
I	What is an algorithm? Design and performance analysis of algorithms, time complexity, space complexity. Asymptotic notations (O, Ω, Θ) to measure growth of a function and application to measure complexity of algorithms. Analysis of sequential search, bubble sort, selection sort, insertion sort, matrix multiplication. Recursion: Basic concept. Analysis of recursive algorithms, Master's theorem.	11
II	The Divide & Conquer Design Technique: The general concept. Binary search, finding the maximum and minimum, merge	11

	sort, quick sort. Best and worst case analysis for the mentioned algorithms. Strassen's matrix multiplication. Lower bound for comparison-based sorting. The Greedy Design Technique: The general concept. Applications to general Knapsack problem, finding minimum weight spanning trees: Prim's and Kruskal's algorithms, Dijkstra's algorithm for finding single source shortest paths problem.	
III	The Dynamic Programming Design Technique: Dynamic Programming with Examples Such as Knapsack. All Pair Shortest Paths –Warshal's and Floyd,'The general concept, all pair shortest paths problem (Floyd-Warshall's algorithm), 0/1 Knapsack problem, Resource Allocation Problem, Longest Common Sub-sequence. Graphs: Terminology used with Graph, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Adjacency. Graph Traversal: Depth First Search and Breadth First Search, Connected Component.	**11**
IV	Backtracking, Branch and Bound with Examples such as Travelling Salesman Problem.Computational Intractability: Overview of non-deterministic algorithms, P, NP, NP-Complete and NP-hard problems.	**12**

Text Books:

1. Cormen, Thomas H., et al. *Introduction to Algorithms*. 3rd ed., PHI Publication, 2009.
2. Horowitz, Ellis, et al. *Fundamentals of Computer Algorithms*. University Press (I) Pvt. Ltd., 2012.
3. Levitin, Anany. *Introduction to the Design and Analysis of Algorithms*. 3rd ed., Pearson, 2012.
4. Design And Analysis of Algorithm, Gajendra Sharma, Kanna Book Publishing, 2010

Reference Books:

1. Aho, Alfred V., John E. Hopcroft, and Jeffrey D. Ullman. *The Design & Analysis of Computer Algorithms*. Addison Wesley Publications, 1983.
2. Kleinberg, Jon, and Eva Tardos. *Algorithm Design*. Pearson Education, 2006.
3. Computer Algorithms, Sara Base, Allen Van Gelder, Pearson Education, 2003

Code: BCA-4004T BCA-4004P	**CC-XII**	**Artificial Intelligence**	**3L+T:4P**	**3 Credits (45 hours theory and 60 hours Practical)**

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75) ; Practical : 100

Course Outcomes: Upon competition of the course, students will be able to

CO1: Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents.

CO2: Gain insights about Uninformed and Heuristic search techniques and apply them to solve Search applications.

CO3: Appreciate the concepts of knowledge representation using Propositional logic and Predicate calculus and apply them for inference/reasoning.

CO4: Obtain insights about Planning and handling uncertainty through probabilistic reasoning and fuzzy sets.

CO5: Obtain a basic understanding of the AI domains and their applications and examine the legal and ethical issues of AI

Unit	**Topics**	**Purposed lectures**
I	**Introduction to AI** What is AI? Intelligent Agents: Agents and environment, the concept of Rationality, the nature of environment, the structure of Agents. Knowledge-Based Agents: Introduction to Knowledge-Based Agents, The Wumpus World as an Example World. Problem-solving: Problem-solving agents.	**9**
II	**Advanced Search Techniques** Uninformed Search: DFS, BFS, Iterative Deepening Search. Informed Search: Best First Search, A* search, AO* search. Adversarial Search & Games: Two-player zero-sum games, Minimax Search, Alpha-Beta pruning. Constraints and Constraint Satisfaction Problems (CSPs), Backtracking search for CSP. Evolutionary Search Techniques: Introduction to evolutionary algorithms, Genetic algorithms,	**12**

	Applications of evolutionary search in AI.	
III	**Logical Reasoning and Uncertainty** Logic: Propositional logic, First-order predicate logic, Propositional versus first-order inference, Unification and lifting. Inference: Forward chaining, Backward chaining, Resolution, Truth maintenance systems. Introduction to Planning: Blocks World problem, Strips; Handling Uncertainties: Non-monotonic reasoning, Probabilistic reasoning, Introduction to Fuzzy set theory.	12
IV	**Domains and Applications of AI** Domains in AI: Introduction to Machine Learning, Computer Vision, Robotics, Natural Language Processing, Deep Neural Networks, and their Applications. Expert Systems: The architecture and role of expert systems include two case studies. Legal and Ethical Issues: Concerns related to AI.	12

Text Books:

1. M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook).
2. Nilsson Nils J, Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.
3. Dan W Patterson, Introduction to Artificial Intelligence & Expert Systems, PHI Learning 2010.
4. Rajiv Chopra, Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Khanna Book Publishing Company, 2024.

Reference Books:

1. M.C. Trivedi, Introduction to AI and Machine Learning, Khanna Book Publishing Company, 2024.
2. Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall
3. Van Hirtum, A. & Kolski, C.(2020). Constraint Satisfaction Problems: Algorithms and Applications. Springer
4. Rajiv Chopra, Machine Learning and Machine Intelligence, Khanna Book Publishing Company, 2024.

Code: BCA- 4005T (For theory) BCA-4005P (For practical)	DSEC-IV	Group-A: Elective – II Introduction to Machine Learning	1L+T:4P	3 Credits (15 hours theory and 60 hours practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: Upon competition of the course, students will be able to

CO1: Define and explain machine learning concepts, types, and basic metrics.

CO2: Implement and apply supervised learning techniques (e.g., KNN, Linear Regression, and Logistic Regression) and un supervised learning methods (e.g., K-Means, Hierarchical Clustering, Association Rules).

CO3: Develop and evaluates implemachine learning models(e.g., Perceptron, single-layer neural networks) and analyze and apply appropriate machine learning algorithms depending on the problems with some real-world data.

Course Outcomes after Lab Programs:

CO1: Implement and evaluate supervised learning techniques, including K-Nearest Neighbors, linear regression, and logistic regression, and measure model performance using accuracy, precision, recall, and F1 score.

CO2: Apply and visualize clustering algorithms such as K-Means, hierarchical clustering, and DBSCA Non data sets. This practical application helps you understand their real- world use.

CO3: Perform dimensionality reduction using Principal Component Analysis (PCA) and interpret the results.

CO4: Develop and assess classification models using random forests, support vector machines, and neural networks.

CO5: Demonstrate ensemble learning concepts through bagging with random forests and boosting with the AdaBoost algorithm.

Unit	Topics	Proposed Lectures
I	**Introduction to Machine Learning:** Introduction: Definition, History and Application of Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabeled Dataset. Supervised Learning Tasks: Regression vs. Classification, Learning Framework: Training, Validation and Testing of ML models. Performance Evaluation Parameters: Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC.	7
II	**Supervised Learning and Unsupervised Learning:** Regression: Linear and Non-linear Regression, Logistic Regression. Classification: Naïve Bayes, K-Nearest Neighbors, Decision Trees. Linear model: Introduction to Artificial Neural Networks, Perceptron Learning Algorithm, Single Layer Perceptron, Introduction to Support Vector Machine for linearly separable data. Clustering: K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. ML Applications: Ethical Considerations in Machine Learning, Case Study and Real-world Applications.	8
Lab Programs	1. Implement linear regression on a data set and visualize the regression line. 2. Implement logistic regression on a binary classification data set and plot the decision boundary. 3. Implement and evaluate the performance of Decision tree ID3/Cart classifier for any given dataset. 4. Implement and evaluate the performance of the Naïve Bayes Classifier on a given dataset. 5. Build and evaluate a random forest classifier using a numerical dataset. 6. Implement a support vector machine for linearly separable classes and visualize the margins and decision boundary. 7. Implement K-Means clustering on a point dataset and visualize and evaluate the clusters. 8. Implement hierarchical clustering on a dataset and plot the	

	dendrogram. **9.** Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters. **10.** Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction. **11.** Build a single layer perceptron model to classify AND, OR, and XOR problems (may use TensorFlow/ Keras) and visualize their decision boundaries. Also evaluate its performance. **12.** Demonstrate the concept of boosting using the AdaBoost algorithm.	

Text Books:

1. Mitchell, Tom M. *Machine Learning*. 1st ed., McGraw-Hill, 1997.
2. Kalita, J. K., D. K. Bhattacharyya, and S. Roy. *Fundamentals of Data Science: Theory and Practice*. Elsevier, 2023.
3. Chopra, Rajiv. *Machine Learning and Machine Intelligence*. Khanna Publishing House, 2024.
4. Jose, Jeeva. *Introduction to Machine Learning*. Khanna Publishing House, 2023.

Reference Books:

1. Flach, Peter A. *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*. Cambridge University Press, 2012.
2. Duda, Richard O., Peter E. Hart, and David G. Stork. *Pattern Classification*. 2nd ed., John Wiley & Sons, 2007.
3. Haykin, Simon. *Neural Networks and Learning Machines*. 3rd ed., PHI Learning, 2009.
4. Chollet, François. *Deep Learning with Python*. Manning Publications, 2018.
5. Bishop, Christopher M. *Pattern Recognition and Machine Learning*. Springer, 2006.
6. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. *Deep Learning*. MIT Press, 2016.
7. Géron, Aurélien. *Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*. 1st ed., O'Reilly Media, 2017.

Code: BCA-4006T (for theory) and BCA-4006P (for practical)	DSEC-V	Group-B: Elective-II Data Visualization	1L+T:4P	3 Credits (15 hours theory and 60 hours practical)

Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100

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

CO1: Understand the fundamentals of data visualization and its importance.

CO2: Understand visual perception and its impact on data interpretation.

CO3: Explore the ethical considerations and challenges in data visualization.

CO4: Study different types of visualizations and their appropriate uses.

CO5: Utilize Power BI to create and customize various types of visualizations.

Unit	Topics	Proposed Lectures
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	5
II	**Visualization tools & Data Story telling** Overview of Visualization Tools (e.g., Excel, Tableau, PowerBI, Python)-Comparing and contrasting features and Use Cases among these tools. Principles of Data Story telling: Narrative and Context-Best Practices for Dashboard Layout and Interactivity	5
III	**Designing Effective Visualizations** Principles of Good Visualization Design - Understanding and Using Color in Visualizations – Importance of Data Modeling in Visualization	5
Lab Programs	**Introduction to PowerBI Interface and Basics** 1. Installation and interface overview 2. Exploring the Power BI workspace: Ribbon, panes, and canvas. 3. Importing data from Excel and CSV files. 4. Introduction to multiple data sources 5. Basic report creation: Adding visuals and saving a report. **Data Transformation and Preparation** 1. Using Power Query Editor 2. Cleaning data: Removing duplicates, handling missing values. 3. Transforming data: Splitting columns, changing data types, renaming columns. 4. Merging and appending queries. 5. Creating custom columns and calculated columns **Data Modeling** 1. Creating relationships between tables 2. Identifying and resolving data inconsistencies 3. Creating calculated columns and measures **Creating Basic Visualizations** 1. Creating various chart types (bar, column, line, pie, area, etc.,) 2. Formatting and customizing visualizations **Publishing and Sharing Reports**	

		1. Publishing a report to Power BI Service. 2. Sharing reports and dashboards with team members. 3. Setting up data refresh schedules and managing permissions.	

Text Books:

1. Knaflic, Cole Nussbaumer. *Storytelling with Data: A Data Visualization Guide for Business Professionals*. Wiley, 1st ed., 2015.
2. Tufte, Edward. *The Visual Display of Quantitative Information*. Graphics Press USA, 2nd ed., 2001.

Reference Books:

1. Healy, Kieran. *Data Visualization: A Practical Introduction*. Princeton University Press, 2018.
2. Ferrari, Alberto, and Marco Russo. *Analyzing Data with Power BI and Power Pivot for Excel*. Microsoft Press, 1st ed., 2017.
3. Knight, Devin, et al. *Microsoft Power BI Complete Reference*. Packt Publishing, 1st ed., 2018.

Code: BCA 4007T(for theory) and 4007P(for practical)	DSEC-VI	Group-C: Elective – II Web Programming-II Advanced Full-Stack Development	1L+T:4P	3 Credits (15 hours theory and 60 hours practical)

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75); Practical: 100

Course Outcomes: After competition of the course student will be able to

CO1: Understand and implement MongoDB as a NoSQL database for scalable applications.

CO2: Develop a deep understanding of Node.js and Express.js for server-side development.

CO3: Understand security best practices

CO4: Equip with modern DevOps practices such as CI/CD, environment variable management, and cloud deployment using Vercel, Netlify, Render, and Heroku

Unit	Topics	Proposed Lectures
I	**Advanced JavaScript & ES6+** Destructuring, Spread & Rest Operator, Template Literals, Promises and Fetch API, Async/Await, Closures and Scope, Hoisting and the Execution Context, Modules: import/export **Advanced React.js** useEffect Hook, React Router: BrowserRouter, Routes, Route, Link vs NavLink, Forms in React, Controlled vs Uncontrolled Components, Lifting State Up, Context API for Global State Management, Introduction to Redux (optional)	4
II	**Back-End API Development with Node.js + Express** RESTful API Principles, Route Parameters and Query Strings, Request/Response Cycle, Creating APIs with Express, Middleware (Morgan, BodyParser, Helmet), Error Handling Middleware ***Authentication and Authorization*** User Registration & Login, Hashing Passwords with bcrypt, JSON Web Tokens (JWT) for Auth, Protecting Routes, Session vs Token-Based Auth, Role-Based Access Control (RBAC)	4
III	**Advanced MongoDB + Introduction to SQL** Advanced Queries: $gt, $lt, $in, $or, Indexing in MongoDB., Aggregation Pipeline Basics, Relational Database Overview, Introduction to MySQL/PostgreSQL, CRUD Operations in SQL, SQL Joins, Group By, Order By, **Testing Tools & Practices** Postman for API Testing, Writing Unit Tests with Jest (Basics), Test-Driven Development (TDD) Basics, **Deployment & Hosting** Hosting Front-End on Vercel / Netlify, Hosting Back-End on:Render / Railway / Cyclic, Heroku (if available), CI/CD Concepts (basic intro only), Using .env for Environment Variables, Connecting Front-End and Back-End in Production	4
IV	**Web Security Basics** Common Web Vulnerabilities, XSS, CSRF, SQL Injection, Input Validation and Sanitization, HTTPS, CORS, and Secure Headers, Using Helmet and CORS in Express, Rate Limiting **Capstone Project** A full-stack application with:Front-End: React, Back-End: Express.js, Database: MongoDB (or with SQL integration), Auth: JWT or Sessions,Deployment: Live and Public **Project Ideas:** • E-Commerce Website • Job Board • Task/Project Management Tool • Blogging Platform	3

	• Real-Time Chat App (using Socket.io)	

Books:

1. Subramanian, Vasan, Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node. Apress, 2019.
2. Hoque, Shama. Full Stack Web Development with MERN. Packt Publishing, 2021.
3. Brown, Ethan. Web Development with Node and Express: Leveraging the JavaScript Stack. 2nd ed., O'Reilly Media, 2019.
4. Casciaro, Mario, and Luciano Mammino. Node.js Design Patterns. 3rd ed., Packt Publishing, 2020.
5. Mardan, Azat. Pro Express.js. Apress, 2014.

Code: BCA 4008T	SEC-V	Design Thinking and Innovation	2L+T:0P	2 Credits (30 hours theory)

Max Marks: 100; Theory: 100 (Int: 25; Ext: 75)

Course Outcomes:

CO1: Propose real-time innovative product designs and choose appropriate frameworks, strategies, techniques during prototype development.

CO2: Observe and assimilate unstructured information to well framed solvable problems.

CO3: Know wicked problems and how to frame them in a consensus manner that is agreeable to all stake holders using appropriate frameworks, strategies, techniques during prototype development.

CO4: Analyze emotional experience and inspect emotional expressions to better understand users while designing innovative products

Unit	Topics	Proposed Lectures
I	**Basics of Design Thinking:** Concept of Innovation and its Significance in Business, Creative Thinking Process and Problem Solving Approaches, Design Thinking Approach and its Objective, 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, Discussion on Global Success Stories like Airbnb, Apple, Ideo, Netflix etc., Four Stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement.	8
II	**Learning to Empathize and Define the Problem:** Know the Importance of Empathy in Innovation Process – How can students Develop Empathy Using Design Tool ?, Observing and Assimilating Information, Individual Differences & Uniqueness Group Discussion and Activities to Encourage the Understanding, Acceptance and Appreciation of Individual Differences, Wicked Problems, Identification of Wicked Problems around us and the Potential Impact of their Solutions.	7
III	**Ideate, Prototype, and Implement:** Templates of Ideation like Brainstorming, Systems Thinking, Concept of Brainstorming–How to Reach Consensus on Wicked Problems?, Mapping	8

	Customer Experience for Ideation, Know the Methods of Prototyping, Purpose of Rapid Prototyping, Implementation.	
IV	**Feedback, Re-Design & Re-Create:** Feedback Loop, Focus on User Experience, Address Ergonomic Challenges, User Focused Design, Final Concept Testing, Final Presentation – Solving Problems through Innovative Design Concepts & Creative Solution	**7**

Text Books:

1. Brown, Tim. *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation.* Harvard Business Review Press, 2008.
2. Krishnan, R. T., and V. Dabholkar. *8 Steps to Innovation.* Collins Publishing, 2013.
3. Balaguruswamy, E. *Developing Thinking Skills (The Way to Success).* Khanna Book Publishing Company, 2023.

Reference Book:

1. Cross, Nigel. *Design Thinking.* Bloomsbury, 2011.

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