Guru Nanak Institute of Technology

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Guru Nanak Institute of Technology
(NAAC 'A+' Accredited Autonomous Institute)
(Affiliated to Maulana Abul Kalam Azad University of Technology)

R25 [BCA]

Curriculum and Syllabus for BCA under Autonomy

(NEP-2020 implemented)

Dept. of Computer Applications

(Effective from 2025-26 admission batch)

Curriculum for Undergraduate Degree BCA (w.e.f. AY: 2025-26)

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R25 - BCA

GENERAL COURSE STRUCTURE
&
CREDIT DISTRIBUTION

GENERAL COURSE STRUCTURE

A. Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
1 Hour Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

B. Abbreviations and Course Code definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
COR	Core Courses
AEC	Ability Enhancement Courses
MDE	Multi-Disciplinary Elective course
VAC	Value added Courses
SEC	Skill Enhancement courses
DSE	Discipline Specific Elective
OE	Open Elective

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Course Name:

1. Bachelor in Computer Applications,
2. Bachelor in Computer Applications (Honours)
3. Bachelor in Computer Application (Honours with Research)

Course Level/Duration/System:

Course Level - Undergraduate
Duration - Three or Four years/Six or Eight Semesters with multiple entry and exit

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The following options will be made available to the students joining the BCA Research Program:

    a. **One year:** Undergraduate Certificate in Computer Applications
    b. **Two years**: Undergraduate Diploma in Computer Applications
    c. **Three years**: Bachelor in Computer Applications (BCA)
    d. **Four years**: Bachelor in Computer Applications with Honours: BCA (Honours) or Bachelor in Computer Application Honours with Research: BCA (Honours with Research)

Minimum Eligibility Criteria:

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

    1. For **BCA (Honours with Research):** BCA Degree

    2. For **BCA (Honours)**: **BCA Degree**

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

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SEMESTER-WISE CREDIT DISTRIBUTION:

Semester	Core Courses (COR)	Ability Enhancement Courses (AEC)	Multi-Disciplinary Elective Courses (MDE)	Value Added Courses (VAC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective Courses (DSE)	Total
I	8	2	2	2	5	0	19
II	12.5	0	0	2	7.5	0	22
III	13	0	0	0	4.5	3.5	21
IV	12.5	0	0	2	2	3.5	20
V	0	0	0	0	6	15	21
VI	4	1	0	0	4	10	19
BCA(Honours)							
VII	5	0	3	0	6	8	22
VIII	0	0	0	0	6	12	18
BCA(Honours with Research)							
VII	12	0	0	0	5	3	20
VIII	0	0	0	0	15	5	20

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Category-wise distribution

Description	Core Courses (COR)	Ability Enhancement Courses (AEC)	Multi-Disciplinary Elective Courses (MDE)	Value Added Courses (VAC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective Courses (DSE)	Total
BCA	50	3	2	6	29	32	122
BCA (Honours)	55	3	5	6	41	52	162
BCA (Honours with Research)	62	3	2	6	49	40	162

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Course duration and Credits

Course Name	Duration	Credit
BCA	3 Years	Total Credits = 122
BCA (Honours)	4 Years	Total Credits = 162
BCA (Honours with Research)	4 Years	Total Credits = 162

INDUCTION PROGRAM

➔ **The Student Induction Program is mandatory.**
➔ **The Student induction Program will be of duration three weeks**
➔ **Induction program for the students to be offered right at the beginning of the first year**
➔ **Events under Student Induction Program -**

- **Physical activity**

- **Creative Arts**

- **Universal Human Values**

- **Literary**

- **Proficiency Modules**

- **Lectures by Eminent People**

- **Visits to local Areas**

- **Familiarization with the Department/Branch**

- **Innovations**

Mandatory Visits/Seminars/Workshops/Expert Lectures:

1. **One industrial visit every semester for the students of each branch.**
2. **One-week workshop during the winter break after the fifth semester on professional/ industry/ entrepreneurial orientation.**

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3. **One expert lecture for the students to be organized in every semester by resource persons from domain specific industries.**

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CURRICULUM
Course: Bachelor of Computer Applications (BCA) **BCA(Honours)** **BCA(Honours with Research)**
Under Autonomy, following the NEP-2020 structure (Course Duration - 4 years)

SEMESTER-I						
3 WEEKS COMPULSORY INDUCTION PROGRAM(Universal Human Values-I)						
Sl. No.	Course Code	Course Title	L	T	P	Credit
THEORY						
1	BCAG25-COR101	Computer Organization and Architecture	3	0	0	3
2	BCAG25-COR102	Mathematical Foundation to Computer Science - I	3	0	0	3
3	BCAG25-SEC101	C Programming	3	0	0	3
4	BCAG25-AEC101	English and Professional Communications	2	0	0	2
5	BCAG25-MDE101	Indian Knowledge System **	2	0	0	2
6	BCAG25-VAC101	Environmental Science and Sustainability	2	0	0	2
PRACTICAL						
7	BCAG25-COR191	Computer Organization and Architecture Lab	0	0	4	2
8	BCAG25-SEC191	C Programming Lab	0	0	4	2
SESSIONAL						
9*	BCAG25-AEC181A	Indian or Foreign Language Other than Mother Tongue and English - I ***	1	1	0	0
	BCAG25-AEC181B	Sports	1	1	0	0
	BCAG25-AEC181C	Health and Wellness	1	1	0	0
TOTAL			16	1	8	19

Note:
* No Credit Course

** Indian Knowledge System: Indian Culture and Civilization, Indian Vision for Human Society, Indian Science. Indian Town Planning and Architecture, Indian Mathematics and Astronomy, Indian Aesthetics, Indian Health, Wellness

*** Indian Languages: Sanskrit/Hindi/All Regional languages
Foreign Languages: (not limited to) Spanish/German/French/Korean/Mandarin, etc.

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SI. No.	Course Code	Course Title	L	T	P	Credit
SEMESTER-II						
THEORY						
1	BCAG25-COR201	Data Structures and Algorithms	3	0	0	3
2	BCAG25-COR202	Operating Systems	3	0	0	3
3	BCAG25-COR203	Mathematical Foundation to Computer Science - II	3	0	0	3
4	BCAG25-SEC201	Python Programming	3	0	0	3
5	BCAG25-SEC202	Web Technologies	1	0	0	1
6	BCAG25-VAC201	Indian Constitution	2	0	0	2
PRACTICAL						
7	BCAG25-COR291	Data Structures and Algorithms Lab	0	0	4	2
8	BCAG25-COR292	Operating Systems Lab	0	0	3	1.5
9	BCAG25-SEC291	Python Programming Lab	0	0	4	2
10	BCAG25-SEC292	Web Technologies Lab	0	0	3	1.5
SESSIONAL						
11*	BCAG25-AEC281A	Indian or Foreign Language Other than Mother Tongue and English - II **	1	1	0	0
	BCAG25-AEC281B	Mental Health and Stress Management	1	1	0	0
	BCAG25-AEC281C	Critical Thinking	1	1	0	0
TOTAL			**16**	**1**	**14**	**22**

Note:
*   No Credit Course

**   Indian Languages: Sanskrit/Hindi/All Regional languages
        Foreign Languages: (not limited to) Spanish/German/French/Korean/Mandarin, etc.

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

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Sl. No.	Course Code	Course Title	L	T	P	Credit
		SEMESTER-III				
		THEORY				
1	BCAG25-COR301	Probability and Statistics	3	0	0	3
2	BCAG25-COR302	Database Management System	3	0	0	3
3	BCAG25-COR303	Artificial Intelligence	3	0	0	3
4	BCAG25-SEC301	Object Oriented Programming	3	0	0	3
5*	BCAG25-DSE301A	Basics of Data Analytics using Spreadsheet	2	0	0	2
	BCAG25-DSE301B	Feature Engineering	2	0	0	2
	BCAG25-DSE301C	Web Programming -I	2	0	0	2
		PRACTICAL				
6	BCAG25-COR392	Database Management System Lab	0	0	4	2
7	BCAG25-COR393	Artificial Intelligence Lab	0	0	4	2
8	BCAG25-SEC391	Object Oriented Programming Lab	0	0	3	1.5
9*	BCAG25-DSE391A	Basics of Data Analytics using a Spreadsheet Lab	0	0	3	1.5
	BCAG25-DSE391B	Feature Engineering Lab	0	0	3	1.5
	BCAG25-DSE391C	Web Programming -I Lab	0	0	3	1.5
		TOTAL	**14**	**0**	**14**	**21**

Note:

*   Professional Electives: To be selected from the Proposed Streams with Discipline-Specific Electives - Data Science/Artificial Intelligence and Machine Learning/Full Stack Development is proposed by Universities as indicated in Appendix A.

Students can choose their Discipline of specialization (Data Science/Artificial Intelligence and Machine Learning/Full Stack Development), i.e., Stream with Discipline Specific Elective [DSE] from Semester Three onwards, as indicated in Appendix A.

Students will select the Discipline first, then undergo the courses in the Semester Three and onwards from the same discipline only. Any change in discipline will NOT be allowed.

Disciplines -
A : Data Science
B : Artificial Intelligence and Machine Learning
C : Full Stack Development

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Sl. No.	Course Code	Course Title	L	T	P	Credit
		SEMESTER-IV				
		THEORY				
1	BCAG25-COR401	Computer Networks	3	0	0	3
2	BCAG25-COR402	Software Engineering	3	0	0	3
3	BCAG25-COR403	Design and Analysis of Algorithms	3	0	0	3
4	BCAG25-COR404	Entrepreneurship	2	0	0	2
5	BCAG25-SEC401	Design Thinking and Innovation	2	0	0	2
6*	BCAG25-DSE401A	Data Visualization	2	0	0	2
	BCAG25-DSE401B	Introduction to ML	2	0	0	2
	BCAG25-DSE401C	Web Programming -II	2	0	0	2
		PRACTICAL				
7	BCAG25-COR491	Computer Networks Lab	0	0	3	1.5
8*	BCAG25-DSE491A	Data Visualization Lab	0	0	3	1.5
	BCAG25-DSE491B	Introduction to ML Lab	0	0	3	1.5
	BCAG25-DSE491C	Web Programming -II Lab	0	0	3	1.5
		SESSIONAL				
9	BCAG25-VAC481A	Yoga	0	0	4	2
	BCAG25-VAC481B	National Cadet Corps (NCC)	0	0	4	2
	BCAG25-VAC481C	National Service Scheme (NSS)	0	0	4	2
	BCAG25-VAC481D	Disaster Management	0	0	4	2
		TOTAL	15	0	10	20

Note:

* Professional Electives: To be selected from the Proposed Streams with Discipline-Specific Electives - Data Science/Artificial Intelligence and Machine Learning/Full Stack Development is proposed by Universities as indicated in Appendix A.

At the end of the Fourth Semester, every student shall undergo Summer Training/ Internship/Capstone for Eight Weeks in the industry/Research, or Academic Institute. This component will be evaluated during the Fifth Semester.

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Sl. No.	Course Code	Course Title	L	T	P	Credit
SEMESTER-V					
	THEORY					
1*	BCAG25-DSE501A	Introduction to Data Science	3	0	0	3
	BCAG25-DSE501B	Neural Network	3	0	0	3
2*	BCAG25-DSE502A	Time Series Analysis	3	0	0	3
	BCAG25-DSE502B	Digital Image Processing	3	0	0	3
3*	BCAG25-DSE503A	Machine Learning	3	0	0	3
	BCAG25-DSE503B	Natural Language Processing	3	0	0	3
4	BCAG25-SEC501	Quantitative Techniques	0	2	0	2
	PRACTICAL					
5*	BCAG25-DSE591A	Introduction to Data Science Lab	0	0	4	2
	BCAG25-DSE591B	Neural Network Lab	0	0	4	2
6*	BCAG25-DSE592A	Time Series Analysis Lab	0	0	4	2
	BCAG25-DSE592B	Digital Image Processing Lab	0	0	4	2
7*	BCAG25-DSE593A	Machine Learning Lab	0	0	4	2
	BCAG25-DSE593B	Natural Language Processing Lab	0	0	4	2
8	BCAG25-SEC592	Internship/Capstone Project	0	0	4	2
9	BCAG25-SEC593	Major Project -I **	0	0	4	2
	TOTAL		**12**	**2**	**20**	**21**

Note:

*   Professional Electives: To be selected from the Proposed Streams with
        Discipline-Specific Electives - Data Science/Artificial Intelligence and
        Machine Learning is proposed by Universities as indicated in Appendix A.

**   To be started in the Fifth Semester and continued in the Sixth Semester.

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Sl. No.	Course Code	Course Title	L	T	P	Credit
SEMESTER-VI						
THEORY						
1	BCAG25-COR601	Generative AI	2	0	0	2
2*	BCAG25-DSE601A	Big Data Analytics	3	0	0	3
	BCAG25-DSE601B	Deep Learning for Computer Vision	3	0	0	3
3*	BCAG25-DSE602A	Exploratory Data Analysis	3	0	0	3
	BCAG25-DSE602B	Predictive Analysis	3	0	0	3
4	BCAG25-AEC601	Soft Skills	0	1	0	1
PRACTICAL						
5	BCAG25-COR691	Generative AI Lab	0	0	4	2
6*	BCAG25-DSE691A	Big Data Analytics Lab	0	0	4	2
	BCAG25-DSE691B	Deep Learning for Computer Vision Lab	0	0	4	2
7*	BCAG25-DSE692A	Exploratory Data Analysis Lab	0	0	4	2
	BCAG25-DSE692B	Predictive Analysis Lab	0	0	4	2
8	BCAG25- SEC691	Major Project -II **	0	0	8	4
\multicolumn{3}{c}{**TOTAL**}	**8**	**1**	**20**	**19**

Note:

* Professional Electives: To be selected from the Proposed Streams with Discipline-Specific Electives - Data Science/Artificial Intelligence and Machine Learning is proposed by Universities as indicated in Appendix A.

** To be started in the Fifth Semester and continued in the Sixth Semester.

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SEMESTER-VII - BCA (Honours)						
Specialization – Data Science / AI & ML						
THEORY						
Sl. No.	Course Code	Course Title	L	T	P	Credit
1	BCAH25-COR701A	Python for Data Science	3	0	0	3
	BCAH25-COR701B	Optimization of ML	3	0	0	3
2*	BCAH25-DSE701A	Business Intelligence and Analytics	3	0	0	3
	BCAH25-DSE701B	Explainable AI	3	0	0	3
3*	BCAH25-DSE702A	Data Mining and Warehousing	2	0	0	2
	BCAH25-DSE702B	Evolutionary Algorithm	2	0	0	2
4	BCAH25-MDE701A	Advanced Statistical Methods for Data Science	2	0	0	2
	BCAH25-MDE701B	Social Network Analysis	2	0	0	2
PRACTICAL						
5	BCAH25-COR791A	Python for Data Science Lab	0	0	4	2
	BCAH25-COR791B	Optimization of ML Lab	0	0	4	2
6*	BCAH25-DSE791A	Business Intelligence and Analytics Lab	0	0	4	2
	BCAH25-DSE791B	Explainable AI Lab	0	0	4	2
7*	BCAH25-DSE792A	Data Mining and Warehousing Lab	0	0	2	1
	BCAH25-DSE792B	Evolutionary Algorithm Lab	0	0	2	1
8	BCAH25-MDE791A	Advanced Statistical Methods for Data Science Lab	0	0	2	1
	BCAH25-MDE791B	Social Network Analysis Lab	0	0	2	1
9	BCAH25- SEC791	Dissertation work -I **	0	0	4	2
10	BCAH25- SEC792	Summer Internship	0	0	8	4
	TOTAL		**10**	**0**	**24**	**22**

Note:

*   Professional Electives: To be selected from the Proposed Streams with
        Discipline-Specific Electives - Data Science/Artificial Intelligence and
        Machine Learning is proposed by Universities as indicated in Appendix A.

**   To be started in the Seventh Semester and continued in the Eighth Semester.

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SEMESTER-VIII - BCA (Honours)						
Specialization – Data Science / AI & ML						
THEORY						
Sl. No.	Course Code	Course Title	L	T	P	Credit
1*	BCAH25-DSE801A	Advanced Data Visualization	3	0	0	3
	BCAH25-DSE801B	Time Series Analysis	3	0	0	3
2*	BCAH25-DSE802A	Cloud Computing for Data Analytics	3	0	0	3
	BCAH25-DSE802B	Data Visualization	3	0	0	3
3*	BCAH25-DSE803A	Data Security & Privacy	2	0	0	2
	BCAH25-DSE803B	Security aspects of ML	2	0	0	2
PRACTICAL						
4*	BCAH25-DSE891A	Advanced Data Visualization Lab	0	0	4	2
	BCAH25-DSE891B	Time Series Analysis Lab	0	0	4	2
5*	BCAH25-DSE892A	Cloud Computing for Data Analytics Lab	0	0	4	2
	BCAH25-DSE892B	Data Visualization Lab	0	0	4	2
6	BCAH25- SEC891	Dissertation work -II **	0	0	12	6
TOTAL			8	0	20	18

Note:

*   Professional Electives: To be selected from the Proposed Streams with Discipline-Specific Electives - Data Science/Artificial Intelligence and Machine Learning is proposed by Universities as indicated in Appendix A.

**   To be started in the Seventh Semester and continued in the Eighth Semester.

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\multicolumn{6}{c}{**SEMESTER-VII - BCA (Honours with Research)**}
\multicolumn{6}{c}{**THEORY**}

Sl. No.	Course Code	Course Title	L	T	P	Credit
1	BCAR25-COR701	Advanced Data Analysis Tools	2	0	0	2
2	BCAR25-COR702	Research Methodology and Computing Tools	2	2	0	4
3*	BCAR25-DSE701A	Data Mining & Warehousing	2	0	0	2
	BCAR25-DSE701B	Evolutionary Algorithm	2	0	0	2
PRACTICAL
4	BCAR25-COR791	Advanced Data Analysis Tools Lab	0	0	4	2
5	BCAR25-COR793	Research Internship Report and Viva–Voce	0	0	8	4
6*	BCAR25-DSE791A	Data Mining & Warehousing Lab	0	0	2	1
	BCAR25-DSE791B	Evolutionary Algorithm Lab	0	0	2	1
7	BCAR25-SEC791	Dissertation for Research Track -I **	0	0	10	5
\multicolumn{3}{c}{**TOTAL**}	6	2	24	20

Note:

* Professional Electives: To be selected from the Proposed Streams with Discipline-Specific Electives - Data Science/Artificial Intelligence and Machine Learning is proposed by Universities as indicated in Appendix A.

** To be started in the Seventh Semester and continued in the Eighth Semester.

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SEMESTER-VIII - BCA (Honours with Research)						
THEORY						
Sl. No.	Course Code	Course Title	L	T	P	Credit
1*	BCAR25-DSE801A	Advanced Data Visualization	3	0	0	3
	BCAR25-DSE801B	Time Series Analysis	3	0	0	3
PRACTICAL						
Sl. No.	Course Code	Course Title	L	T	P	Credit
2*	BCAR25-DSE891A	Advanced Data Visualization Lab	0	0	4	2
	BCAR25-DSE891B	Time Series Analysis Lab	0	0	4	2
3	BCAR25-SEC891	Dissertation for Research Track -II **	0	0	30	15
		TOTAL	**2**	**0**	**38**	**20**

Note:

** The Dissertation work will start from the beginning of the Seventh Semester of the BCA (Honours with Research) Program.

** To be started in the Seventh Semester and continued in the Eighth Semester.

Curriculum for Undergraduate Degree BCA (w.e.f. AY: 2025-26)

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Appendix - A

Proposed Streams with Discipline-Specific Electives (DSE)

Discipline #1 : Data Science

Sl. No	Semester	Course Code	Professional Elective Course Name
1	III	BCAG25-DSE301A	Basics of Data Analytics using a Spreadsheet
2	III	BCAG25-DSE391A	Basics of Data Analytics using Spreadsheet Lab
3	IV	BCAG25-DSE401A	Data Visualization
4	IV	BCAG25-DSE491A	Data Visualization Lab
5	V	BCAG25-DSE501A	Introduction to Data Science
6	V	BCAG25-DSE591A	Introduction to Data Science Lab
7	V	BCAG25-DSE502A	Time Series Analysis
8	V	BCAG25-DSE592A	Time Series Analysis Lab
9	V	BCAG25-DSE503A	Machine Learning
10	V	BCAG25-DSE593A	Machine Learning Lab
11	VI	BCAG25-DSE601A	Big Data Analytics
12	VI	BCAG25-DSE691A	Big Data Analytics Lab
13	VI	BCAG25-DSE602A	Exploratory Data Analysis
14	VI	BCAG25-DSE692A	Exploratory Data Analysis Lab
15	VII	BCAH25-DSE701A	Business Intelligence & Analytics
16	VII	BCAH25-DSE791A	Business Intelligence & Analytics Lab
17	VII	BCAH25-DSE702A	Data Mining & Warehousing
18	VII	BCAH25-DSE792A	Data Mining & Warehousing Lab
23	VII	BCAR25-DSE701A	Data Mining & Warehousing
24	VII	BCAR25-DSE791A	Data Mining & Warehousing Lab
25	VIII	BCAH25-DSE801A	Advanced Data Visualization
26	VIII	BCAH25-DSE891A	Advanced Data Visualization Lab
27	VIII	BCAR25-DSE801A	Advanced Data Visualization
28	VIII	BCAR25-DSE891A	Advanced Data Visualization Lab
29	VIII	BCAH25-DSE802A	Cloud Computing for Data Analytics
30	VIII	BCAH25-DSE892A	Cloud Computing for Data Analytics Lab
31	VIII	BCAH25-DSE803A	Data Security & Privacy

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Discipline #2 : Artificial Intelligence & Machine Learning (AI & ML)

Sl. No	Semester	Course Code	Professional Elective Course Name
1	III	BCAG25-DSE301B	Feature Engineering
2	III	BCAG25-DSE391B	Feature Engineering Lab
3	IV	BCAG25-DSE401B	Introduction to ML
4	IV	BCAG25-DSE491B	Introduction to ML Lab
5	V	BCAG25-DSE501B	Neural Network
6	V	BCAG25-DSE591B	Neural Network Lab
7	V	BCAG25-DSE502B	Digital Image Processing
8	V	BCAG25-DSE592B	Digital Image Processing Lab
9	V	BCAG25-DSE503B	Natural Language Processing
10	V	BCAG25-DSE593B	Natural Language Processing Lab
11	VI	BCAG25-DSE601B	Deep Learning for Computer Vision
12	VI	BCAG25-DSE691B	Deep Learning for Computer Vision Lab
13	VI	BCAG25-DSE602B	Predictive Analysis
14	VI	BCAG25-DSE692B	Predictive Analysis Lab
15	VII	BCAH25-DSE701B	Explainable AI
16	VII	BCAH25-DSE791B	Explainable AI Lab
17	VII	BCAH25-DSE702B	Evolutionary Algorithm
18	VII	BCAH25-DSE792B	Evolutionary Algorithm Lab
23	VII	BCAR25-DSE702B	Evolutionary Algorithm
24	VII	BCAR25-DSE792B	Evolutionary Algorithm Lab
25	VIII	BCAH25-DSE801B	Time Series Analysis
26	VIII	BCAH25-DSE891B	Time Series Analysis Lab
27	VIII	BCAR25-DSE801B	Time Series Analysis
28	VIII	BCAR25-DSE891B	Time Series Analysis Lab
29	VIII	BCAH25-DSE802B	Data Visualization
30	VIII	BCAH25-DSE892B	Data Visualization Lab
31	VIII	BCAH25-DSE803B	Security aspects of ML

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Discipline #3 : Full Stack Development

Sl. No	Semester	Course Code	Professional Elective Course Name
1	III	BCAG25-DSE301C	Web Programming -I
2	III	BCAG25-DSE391C	Web Programming -I Lab
3	IV	BCAG25-DSE401C	Web Programming -II
4	IV	BCAG25-DSE491C	Web Programming -II Lab

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Semester - 1

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R25 - BCA

Semester	1
Paper Code	BCA25-CC101
Paper Name	Computer Organization and Architecture
Credit	3
Total Contact Hours	36
Contact Hours/Week	3L + 0T + 4P

Course Objectives	
CO1:	To understand the basics of Digital Electronics and the Binary Number System
CO2:	To Learn the implementation of a Combinational Circuit.
CO3:	To Learn the implementation of a Sequential Circuit.
CO4:	To understand the Organization of Basic Computers.
CO5:	To understand the concept of Parallel Processing.
CO6:	To understand the concept of I/O and Memory Organization.

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R25 - BCA

Course Content:					
Module #	Topic	L	T	P	Total
1	**Digital Principles:**	3	0	0	3
	Definition for 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:	3	0	0	3
	Decimal, Binary, Octal, Hexadecimal, 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, The Gray Code.				
2	**Combinational Circuits:**	3	0	0	3
	Half Adder and Full Adder, Subtractor, Decoders, Encoder, Multiplexer, Demultiplexer				
3	**Sequential Circuits:**	3	0	0	3
	Latch and Flip-flops Flip-Flops- SR Flip- Flop, D Flip-Flop, J-K Flip-Flop, T Flip-Flop. J-K Master-Slave Flip-flop				
	Register:	3	0	0	3
	4 bit register with parallel load, Shift Registers- Bidirectional shift register with parallel load Binary Counters-4 bit synchronous Asynchronous binary counter.				

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4	**Basic Computer Organization and Design:**	4	0	0	4
	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:	4	0	0	4
	Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC), RISC Vs CISC.				
5	**Pipeline and Vector Processing:**	3	0	0	3
	Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline.				
6	**Input-Output Organization:**	3	0	0	3
	Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct memory Access, Input-Output Processor(IOP).				
	Memory Organization:	3	0	0	3
	Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory, Virtual Memory, Memory Management Hardware.				

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Text Books	
SL NO	Book Names
1	Donald P Leach, Albert Paul Malvino, Goutam Saha- "Digital Principles & Applications", Tata McGraw-Hill Education Private Limited,2011 Edition.
2	M. Morris Mano- "Computer System Architecture", Pearson/Phi, Third Edition.

Reference Books	
SL NO	Book Names
1	William Stallings- "Computer Organization and Architecture", Pearson/PHI, Sixth Edition,
2	Andrew S. Tanenbaum- "Structured Computer Organization", PHI /Pearson 4th Edition,
3	M.V . Subramanyam, "Switching Theory and Logic Design", Laxmi Publications (P) Ltd.
4	Ikvinderpal Singh, Computer Organization Architecture, Khanna Book Publishing.

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R25 - BCA

Semester	1
Paper Code	BCA25-CC102
Paper Name	Mathematical Foundation of Computer Science - I
Credit	3
Total Contact Hours	36
Contact Hours/Week	3L + 0T + 0P

Course Objectives	
CO1:	Provide a basic understanding of fundamental mathematical concepts such as sets, functions, matrix algebra, and discrete mathematics.
CO2:	Provide a basic understanding of the Counting Principle and the Recurrence relation
CO3:	Provide a basic understanding of matrix algebra and discrete mathematics.
CO4:	Provide a basic understanding of matrix algebra.
CO5:	Provide a basic understanding of discrete mathematics and elementary linear algebra

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Course Content:

Module #	Topic	L	T	P	Total
1	**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. Some useful functions for Computer Science: Exponential and Logarithmic functions, Polynomial functions, Ceiling and Floor functions.	6	0	0	6

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2	**Counting and Recurrence Relation**	6	0	0	6
	Basics of counting, Pigeonhole principle, permutation, combination, Binomial coefficients, Binomial theorem. Recurrence relations, modelling recurrence relations with examples, like Fibonacci numbers, the tower of Hanoi problem. Solving linear recurrence relation with constant coefficients using characteristic equation roots method.				
3	**Elementary Graph Theory**	10	0	0	10
	Basic terminologies of graphs, connected and disconnected graphs, subgraph, paths and cycles, complete graphs, digraphs, weighted graphs, Euler and Hamiltonian graphs. Trees, properties of trees, concept of spanning tree. Planar graphs. Definitions and basic results on the topics mentioned.				
4	**Matrix Algebra**	10	0	0	10
	Types of matrices, algebra of matrices–addition, subtraction, and multiplication of matrices, Determinant of a matrix, symmetric and skew-symmetric matrices, orthogonal matrix, rank of a matrix, inverse of a matrix, applications of matrices to solve system of linear equations, Eigen values and Eigen vectors, Caley-Hamilton theorem.				
5	**Matrix Algebra**	6	0	0	6
	Rank of a matrix, inverse of a matrix, applications of matrices to solve system of linear equations, Eigen values and Eigen vectors, Caley-Hamilton theorem.				

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Text Books	
SL NO	Book Names
1	Garg, Reena, Engineering Mathematics, Khanna Book Publishing Company, 2024. (AICTE Recommended Textbook)
2	Garg, Reena, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2023.
3	Kolman B., Busby R., and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015.
4	Deo Narsingh, Graph Theory with Application to Engineering and Computer Science, Prentice Hall, India, 1979.
5	Vasishtha A. R. and Vasishtha A. K., Matrices, Krishna Prakashan, 2022.

Reference Books	
SL NO	Book Names
1	Grimaldi Ralph P. and Ramana B. V., Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth 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, Second Edition, Pearson Education, 2015

Web Resources	
SL No	Link
1	https://nptel.ac.in/courses/106103205
2	https://nptel.ac.in/courses/111101115

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R25 - BCA

Semester	I
Paper Code	BCA25-SEC101
Paper Name	Programming for Problem Solving Through C
Credit	3
Total Contact Hours	36
Contact Hours/Week	3L + 0T + 0P

Course Objectives	
CO1:	Understand basic terminology of computers, problem solving, programming Languages, and their evolution (Understand)
CO2:	Create a specification from problem requirements by asking questions to disambiguate the requirement statement. (Create)
CO3:	Design the solution from the specification of a problem and write pseudo code of the algorithm using basic building blocks or structured programming constructs (Sequence, Selection, and Repetition statements). (Create)
CO4:	Translate an algorithm into a C computer program (Create)
CO5:	Testing and analyzing programs using debugging tools. (Analyze)

Course Content:					
Module #	Topic	L	T	P	Total
	Fundamentals: Problem Solving and Programming Languages	3	0	0	3
1	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.				

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2	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, 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 π, 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: Introduction To Programming Languages, Different Generations of Programming Languages. Typed Vs Typeless Programming Languages, History of the 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.				
3	Problems on Numbers: 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				

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4	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. C Language: Function Definition and Declaration (Prototype), Role of Return Statement, One Dimensional and Two-Dimensional Arrays. String Functions. Other Operators, Operator Precedence and Associativity. Debugging				

Text Books	
SL NO	Book Names
1	Venkatesh, Nagaraju Y, Practical C Programming for Problem Solving. Khanna Book Publishing Company, 2024.
2	AICTE's Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Company, 2024.
3	Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India, 2015.
4	R G Dromey, How to Solve It by Computer.

Reference Books	
SL NO	Book Names
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.

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R25 - BCA

Semester	I
Paper Code	BCA25-AEC101
Paper Name	English and Professional Communications
Credit	2
Total Contact Hours	24
Contact Hours/Week	1L:1T:0P

Course Objectives	
CO 1:	To provide a learning environment to practice listening, speaking, reading and writing skills.
CO 2:	To assist the students to carry on the tasks and activities through guided instructions and materials.
CO 3:	To effectively integrate English language learning with employability skills and training.
CO 4:	To provide hands-on experience through case-studies, mini-projects, group and individual presentations.
CO 5:	Develop Interpersonal Communication Competence
CO 6:	Apply Principles of Business Writing and Technical Communication

Course Content:					
Module #	Topic	L	T	P	Total
1	**Vocabulary Building**	2	2	0	4
	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.				
2	**Basic Writing Skills**	2	2	0	4
	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				
3	**Identifying Common Errors in Writing**	2	2	0	4
	Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies				

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4	**Nature and Style of sensible Writing**	2	2	0	4
	Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion, Module V: Writing Practices, Comprehension, Précis Writing, Essay Writing				
5	**Oral Communication (This Module involves interactive practice sessions in Language Lab)**	2	2	0	4
	Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations				
6	**Oral Communication (This Module involves interactive practice sessions in Language Lab)**	2	2	0	4
	Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations				

Text Books	
SL NO	Book Names
1	AICTE's Prescribed Textbook: Communication Skills in English (with Lab Manual), Anjana Tiwari, Khanna Book Publishing Co., 2023.
2	Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
3	Practical English Usage. Michael Swan. OUP. 1995.
4	Remedial English Grammar. F.T. Wood. Macmillan.2007
5	On Writing Well. William Zinsser. Harper Resource Book. 2001
6	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
7	Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011. 8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

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Alternative NPTEL/SWAYAM Course:			
S.No.	NPTEL/SWAYAM Course Name	Instructor	Host Institute
1	English language for competitive exams	Prof. Aysha Iqbal	IIT MADRAS
2	Technical English for engineers	Prof. Aysha Iqbal	IITM

Course Outcomes:	
The student will acquire basic proficiency in English, including reading and listening comprehension, writing, and speaking skills	

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R25 - BCA

Semester	I
Paper Code	BCA25-MDE101
Paper Name	Indian Knowledge System (#)
Credit	2
Total Contact Hours	24
Contact Hours/Week	2L:0T:0P

Course Objectives	
CO 1:	Explain the foundational concepts and scope of the Indian Knowledge System.
CO 2:	Identify the major contributions of ancient Indian scholars in science, technology, mathematics, and medicine.
CO 3:	Analyze the role of Indian philosophy and ethical systems in shaping individual and societal values.
CO 4:	Relate IKS concepts with contemporary knowledge and interdisciplinary applications.
CO 5:	Appreciate the holistic and sustainable outlook of traditional Indian practices.

SL NO	Book Names
1	**Kapil Kapoor**, *Text and Interpretation: The Indian Tradition*
2	**Subhash Kak**, *The Indian Mind – Essentials of Indian Philosophy and Culture*
3	**Michel Danino**, *The Indian Mind and Indian Knowledge Systems*
4	**Sanskrit Commission Report**, Government of India
5	Articles and publications from **Indian Knowledge Systems Division (IKS), AICTE**

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Course Content:					
Module #	Topic	L	T	P	Total
1	**Introduction to IKS**	8	0	0	8
	lecture on the **any eight** topics below: 1. Indian Knowledge System 2. Indian Culture & Civilization 3. Ancient Indian Chemistry 4. Ancient Indian Metallurgy 5. Ancient Indian Mathematics 6. Ancient Indian Astronomy 7. Indian Astronomical Instruments 8. Indian Knowledge System (Upveda: Ayurveda) 9. Indian Knowledge System (Upveda: Gandharveda) 10. Indian Knowledge System (Vedangas: Shiksha, Kalpa, Vyakrana) 11. Indian Knowledge System (Vedangas: Jyotisha, Nirukta, Chandas) 12. Indian Architecture I: Sthapatya-Veda 13. Indian Architecture II: Temples 14. Indian Architecture III: Town & Planning 15. Indian Philosophical System.				
2	**Introduction to Creative Practices**				

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(Twenty Lectures with at least five different topics in total sessions under Creative activity)

Introductory lecture on the topics below:

1. Dhatuvada: art of metallurgy
2. Akara jnana: art of mineralogy
3. Vastuvidya: art of engineering
4. Yantramatrika: art of mechanics
5. Takshana: art of carpentry
6. Chalitakayoga: art of practicing as a builder of shrines
7. Raupyaratnapariksha: art of testing silver and jewels
8. Maniraga jnana: art of tinging jewels
9. Sucivayakarma: art of needleworks and weaving
10. Vadya vidya: art of playing on musical instruments
11. Geet vidya : art of singing

12. Nritya vidya: art of dancing
13. Natya vidya: art of theatricals
14. Alekhya vidya: art of painting
15. Viseshakacchedya vidya: art of painting the face and body
16. with color
17. Udakavadya: art of playing on music in water
18. Manasi kavyakriya: art of composing verse
19. Bhushanayojana: art of applying or setting ornaments
20. Citrasakapupabhakshyavikarakriya: art of preparing varieties of delicious food
21. Dasanavasanangaraga: art of applying preparations for cleansing the teeth, cloths and painting the body
22. Utsadana: art of healing or cleaning a person with perfumes
23. Vastragopana: art of concealment of cloths
24. Balakakridanaka: art of using children's toys
25. Tandulakusumabalivikara: art of preparing offerings from rice and flowers
26. Pushpastarana: art of making a covering of flowers for a bed.

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Website: www.gnit.ac.in, Email: info@gnit.ac.in

R25 - BCA

Semester	I
Paper Code	BCAG25-VAC101
Paper Name	Environmental Science and Sustainability
Credit	2
Total Contact Hours	24
Contact Hours/Week	2L:0T:0P

Course Objectives	
CO 1:	Demonstrate an understanding of basic environmental concepts and their relevance to business operations.
CO 2:	Analyze the impact of environmental factors on business decisions and operations.
CO 3:	Apply sustainable practices in business management to mitigate negative environmental consequences.
CO 4:	identify and evaluate emerging environmental challenges and sustainability trends affecting businesses.
CO 5:	Develop strategies for integrating environmental considerations into organizational decision-making and long-term planning.

SL NO	Book Names
1	Poonia, M.P. *Environmental Studies* (3rd ed.), Khanna Book Publishing Co.
2	Bharucha, E. *Textbook of Environmental Studies* (3rd ed.) Orient Blackswan Private Ltd.
3	Dave, D., & Katewa, S. S. *Textbook of Environmental Studies*. Cengage Learning India Pvt Ltd.
4	Rajagopalan, R. *Environmental studies: from crisis to cure* (4th ed.). Oxford University Press.
5	Miller, G.T. & Spoolman S. *Living in the Environment*. (20th ed.). Cengage.
6	Basu, M., & Xavier Savarimuthu, S. J. *Fundamentals of environmental studies*. Cambridge University Press.
7	Roy, M. G. *Sustainable Development: Environment, Energy and Water Resources*. Ane Books.
8	Pritwani, K. *Sustainability of business in the context of environmental management*. CRC Press.
9	Wright, R.T. & Boorse, D.F. *Environmental Science: Toward A Sustainable Future* (13th ed,). Pearson.

Curriculum for Undergraduate Degree BCA (w.e.f. AY: 2025-26)

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Course Content:					
Module #	Topic	L	T	P	Total
1	**Understanding Environment, Natural Resources, and Sustainability**	6	0	0	6
	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, issues related to their overutilization, and strategies for their conservation. Sustainable practices in managing resources, including deforestation, water conservation, energy security, and food security issues. The conservation and equitable use of resources, considering both intergenerational and intergenerational equity, and the importance of public awareness and education.				
2	**Ecosystems, Biodiversity, and Sustainable Practices**	6	0	0	6
	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.				
3	**Environmental Pollution, Waste Management, and Sustainable Development**	6	0	0	6
	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.				

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4	**Social Issues, Legislation, and Practical Applications**	6	0	0	6
	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. Environmental justice, environmental refugees, and the resettlement and rehabilitation of affected populations; Ecological economics,				
	human population growth, and demographic changes in India.				

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R25 - BCA

Semester	I
Paper Code	BCAG25-COR191
Paper Name	Computer Organization and Architecture Lab

Unit	Topic
1	Basic gates and Universal gates.
2	Implementation of Half adder and Full adder. Implementation of Half subtractor and Full subtractor.
3	Implementation of a 4-bit logical unit, a 4-bit arithmetic unit
4	Implementation of BCD adder, 4-bit adder/ subtractor, Carry look-ahead adder
5	Design of ALU for multi-bit operation, comparators.
6	8:1 MUX IC verification, 16:1 MUX using IC 74151
7	Dual 2 to 4 Decoder/ Demultiplexer IC evaluation.
8	Design of Priority encoder
9	Read/ write operation using RAM IC
10	Cascading RAM ICs

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R25 - BCA

Semester	I
Paper Code	BCA25-SEC191
Paper Name	Programming for Problem Solving Through C Lab

Unit	Topic
UNIT 1	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 the number, square, and cube of numbers from 1 to n in a tabular format.
	4. Given an input positive integer number, display odd numbers in the range [1,n]?
	5. Display the first mathematical tables, each table up to 10 rows. Generalize this to display the first n (> 0) mathematical tables up to m (m > 0) rows?
	6. Display the following patterns of n rows (n > 0). For the below examples, n = 5? For each pattern, write a separate algorithm/program?
	7. Display the following patterns of n rows (n > 0), for the examples below, n = 5?
	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 the approximate value of π considering first n (n > 0) terms of the Taylor series for π?
	13. Compute the approximate value of e^x, considering first n (n > 0) terms of the Taylor series for e^x?

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	14. Compute approximate value of sin(x)/cos(x) considering first n (n > 0) terms of the Taylor series for sin(x)/cos(x)?

	1. Extract digits of an integer number (left to right and right to left)?
	2. Given a sequence of digits from 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 -1, the output number is 27329?
	3. Check if a given positive integer number is a palindrome or not?
	4. Compute character grade from the marks (0 ≤ marks ≤ 100) of a subject. Grading Scheme: 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?
	5. Compute the sum of a sequence of numbers entered using sentinel-controlled repetition.
	6. Check if a given positive integer is a prime number or not?
	7. Compute the prime factors of a positive integer number.
	8. Check if two positive integer numbers are amicable or not?
	9. Check if a given positive integer number is a perfect number or not?
	10. Check if a given positive integer number an Armstrong number or not?
	11. Converting a positive integer number (n > 0) from one base (inputBase) to another base (outputBase) (2 <= inputBase, outputBase <= 10). Input number should be validated before converting to make sure the number uses only digits allowed in the input base?
	12. 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"?
UNIT 2	13. Using the grading scheme described in question 4 (UNIT III), compute how many students were awarded each grade and display the frequency as a bar chart (horizontal) using a single "*" for each student. Use sentinel-controlled repetition (-1 as sentinel value) in reading the students' marks. Use an else-if ladder/switch case to compute the grade and the corresponding frequency. Sample bar chart when the class has 7-A, 10-B, 3-C, 7-D, and 1-F grades. A: ******* B: ********** C: *** D: ******* F: *
	14. Compute the maximum, minimum, sum, and average of a sequence of numbers that are read using sentinel-controlled repetition using only a few variables?

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	15. Compute body mass index, BMI = weight in kg / (Height in meters) *Height in meters, Both weight and height values are positive real numbers. Your Model curriculum for UG Degree in BCA 34 program should display BMI value followed by whether the person is Underweight, Normal, Overweight or Obese using the below ranges: BMI Values Underweight: less than 18.5 Normal: >=18.5 and <25 Overweight: >=25 and < 30 Obese: >= 30

UNIT 3	1. Design a modularized algorithm/program to check if a given positive integer number is a circular prime or not?
	2. Design a modularized algorithm/program to compute a maximum of 8 numbers?
	3. 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)?
	4. Design a modular algorithm/program that reads an array of n integer elements and outputs the median.
	5. Implement your own string length and string reversal functions?
	6. Design an algorithm/program to perform matrix operations, addition, subtraction, and transpose?
	7. Write a recursive program to count the number of digits of a positive integer number?
	8. 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 xy using only multiplication? d. To print a sequence of numbers entered using sentinel-controlled repetition in reverse order?

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Semester - 2

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R25 - BCA

Semester	II
Paper Code	BCA25-CC201
Paper Name	Data Structures and Algorithms
Credit	3
Total Contact Hours	60
Contact Hours/Week	3L:0T:4P

Course Objectives	
CO1:	Understand the fundamental concepts of Data Structures and their applications.
CO2:	Develop problem-solving skills using Data Structures.
CO3:	Implement Data Structures using the C programming language.
CO4:	Apply Problem-Solving Techniques Using Advanced Data Structures

Prerequisite:	
SL NO:	Topic
1	Programming Fundamentals: Understanding the basic syntax and semantics of C programming language.
2	Problem-Solving Skills: Ability to break down a problem into smaller steps and devise a step-by-step solution and familiarity with simple algorithms.

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Course Content:					

Module #	Topic	L	T	P	Total
1	**Introduction and Overview:**				
	Definition, Classification and Operations of Data Structures. Algorithms: Complexity, Time-Space Tradeoff.				
2	**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. Two-Dimensional Arrays, Representation of Two-Dimensional Arrays in Memory, Matrices and Sparse Matrices, Multi-Dimensional Arrays.				
3	**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.				
4	**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:				

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	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.				
5	**Graphs:**				
	Definition, Terminology, Representation, Traversal.				
6	**Trees:**				
	Definition, Terminology, Binary Trees, Traversal of Binary Tree, Binary Search Tree, Inserting, Deleting and Searching in Binary Search Tree, Height Balanced Trees: AVL Trees,				
	Insertion and Deletion in AVL Tree.				

Text Books	
SL NO	Book Names
1	R.B. Patel, "Expert Data Structures with C", Khanna Book Publishing Company, 2023 (AICTE Recommended Textbook)
2	Seymour Lipschutz, "Data Structures with C", Schaum's Outlines, Tata McGraw-Hill, 2011.
3	Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications, 2022.

Reference Books	
SL NO	Book Names
1	Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2014.
2	Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, Universities Press, 2007.

Web links:	

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SL No:	Links
1	GeeksforGeeks - Data Structures Tutorial
2	Khan Academy - Algorithms Course

SEMESTER	II
Paper Code	BCA25-CC202
Paper Name	Operating Systems
Credit	4
Total Contact Hours	48
Contact Hours/Week	3L:0T:2P

Course Outcomes	
CO1:	Explain the fundamentals of the operating system.

CO2:	Comprehend multithreaded programming, CPU scheduling, process management, process synchronization, memory, deadlocks, and storage management.
CO3:	Compare the performance of CPU scheduling algorithms
CO4:	Identify the features of I/O and File handling methods.
CO5:	Evaluate Operating System Security and Protection Mechanisms
CO6:	Apply Operating System Concepts in Real-World Scenarios

Course Content:					
Module #	Topic	L	T	P	Total
1	**Operating Systems 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:				

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	Operating system services and systems calls, system programs, operating system structure, and operating system generations.				
2	**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				

3	**Process Synchronization:**				
	Introduction, Inter-process Communication, Race Conditions, Critical Section Problem, Mutual Exclusion, Semaphores, Monitors.				
	Deadlocks:				
	System model, deadlock characterization, deadlock prevention, avoidance, Banker's algorithm, Deadlock detection, and recovery from deadlocks.				
4	**Memory Management:**				
	Logical and Physical address map, Swapping, Memory allocation, MFT, MVT, Internal and External fragmentation and Compaction, Paging, Segmentation.				

5	**Virtual Memory:**				
	Demand paging, Page Replacement algorithms, Allocation of frames, thrashing.				
6	**I/O Management:**				
	Principles of I/O Hardware: Disk structure, Disk scheduling algorithms.				

Text Books	
SL NO	Book Names
1	Ekta Walia, Operating Systems Concepts, Khanna Publishing House, 2022 (AICTE Recommended Textbook)
2	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2006), Operating System Principles, 7th edition OR Later edition, Wiley India Private Limited, New Delhi.

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3	Stallings (2006), Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.

Reference Books	
SL NO	Book Names
1	Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India.
2	Sumitabha Das, UNIX Concepts and Applications, 4th Edition, Tata McGraw-Hill.

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R25 - BCA

Semester	II
Paper Code	BCA25-CC203
Paper Name	Mathematical Foundation of Computer Science - II
Credit	3
Total Contact Hours	36
Contact Hours/Week	3L:0T:0P

Course Objectives	
CO1:	This course helps the students to understand correct lines of arguments and proofs.
CO2:	This course introduces mathematical techniques that are foundations for understanding advanced computational methods, including numerical methods and optimization.
CO3:	This course helps the students to understand various problem-solving strategies and methods to tackle both theoretical and practical challenges in computer science.
CO4:	Apply Graph Theory to Computational Problems
CO5:	Understand Probability and Its Applications in Computing
CO6:	Use Mathematical Induction and Recursion in Algorithm Analysis

Course Content:					
Module #	Topic	L	T	P	Total
1	**Logic and Methods of Proofs:**	3	0	0	3
	Propositions, logical operations (basic connectives), compound statements, construction of truth table, quantifiers, conditional statements, tautology, contradiction, contingency, logical equivalence. Conjunctive Normal Forms (CNF) and Disjunctive Normal Forms (DNF). Methods of proofs: Rules of inference for propositional logic, modus ponens, modus ponens, modus ponens, syllogism, proof by contradiction, and Mathematical Induction.				
2	**Algebraic Structures:**				
	Semi-group, Monoid, Group, Subgroup, Cyclic group.				

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3	**Numerical Methods:** Concept and importance of errors in numerical methods. Solution of algebraic and transcendental equations: Bisection method and Newton-Raphson methods.				
4	**Numerical Methods II:** Numerical Interpolation: Newton's Forward and Newton's Backward interpolation formula and Lagrange's formula. Numerical Integration: Trapezoidal rule and Simpson's 1/3 rule Only formula and problem solving for all the topics mentioned above.				
5	**Optimization Techniques:** Linear programming: Introduction, LP formulation, Graphical method for solving LPs with two variables, Special cases in graphical methods,				
6	**Optimization Techniques II:** 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.				

Text Books	
SL NO	Book Names
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.

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4	S.B. Singh, Discrete Structures, Khanna Book Publishing, 2023 (AICTE Recommended Textbook)

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Reference Books	
SL NO	Book Names
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, Macmilllan Publishers, 2007.

Web links:	
SL No:	Links
1	https://nptel.ac.in/courses/111107127
2	https://www.math.iitb.ac.in/~siva/si50716/SI507lecturenotes.pdf

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R25 - BCA

Semester	II
Paper Code	BCA25-SEC201
Paper Name	Python Programming
Credit	3
Total Contact Hours	60
Contact Hours/Week	3L:0T:3P

Course Outcomes	
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.
CO4:	Apply Object-Oriented Programming (OOP) Concepts in Python
CO5:	Work with Exception Handling and Debugging Techniques
CO6:	Develop Real-World Python Applications

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Prerequisite: Understanding of Problem solving techniques using a programming language and basic data structures.

Course Content:					
Module #	Topic	L	T	P	Total
1	**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.				
2	**Strings:**				
	Creating and Storing Strings, Built-in functions for strings; string operators, String slicing and joining; Formatting Strings.				
3	**Control Flow Statements:**				
	Conditional Flow statements; Loop Control Statements; Nested control Flow; continue and break statements, continue, pass, and exit.				

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4	**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 modules for lists of integers and arrays.					
5	**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.					
6	**Data visualization:**					
	Plotting various 2D and 3D graphics; Histogram; Pi charts; Sine and cosine curves					

Text Books	
SL NO	Book Names
1	Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House, 2021.
2	Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House, 2023.
3	Sheetal Taneja & Naveen kumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson, 2017.

Reference Books	
SL NO	Book Names
1	Think Python, by Allen Downey, 2 nd edition, 2015, O'Reilly. https://drive.google.com/file/d/1p9Pul6d5UvnQrO9-Q-LE2_p4YvMk5cIg/view
2	An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ.
3	Introduction to Computation and Programming using Python, by John Guttag, 2 nd edition, 2016, PHI India.

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Web links:	
SL No:	Links
1	https://www.learnpython.org/
2	https://www.w3schools.com/python/default.asp

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R25 - BCA

Semester	II
Paper Code	BCA25-SEC202
Paper Name	Web Technologies
Credit	2
Total Contact Hours	24
Contact Hours/Week	1L:0T:2P

Course Outcomes	
CO1:	To understand the concepts and architecture of the World Wide Web, Markup languages along with Cascading Style Sheets.
CO2:	To understand the concepts of event handling and data validation mechanisms.
CO3:	To understand the concepts of embedded dynamic scripting on client and server side Internet Programming and basic full stack web development.
CO4:	To develop modern interactive web applications

Prerequisite:	
SL NO:	Topic
1	Proficiency in at least one programming language, such as Python, Java, or C++. Understanding of programming concepts such as loops, conditionals, functions, and data structures like arrays, lists.
2	Familiarity with object-oriented programming (OOP) principles, including classes, objects, inheritance, and polymorphism.

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Course Content:					
Module #	Topic	L	T	P	Total
1	Introduction to HTML, history of HTML, Objective, basic Structures of HTML, Header Tags, body tags, Paragraph Tags. Tags for FORM Creation, TABLE, FORM, TEXTAREA, SELECT, IMG, IFRAME FIELDSET, ANCHOR. Lists in HTML,				
2	Introduction to DIV tag, NAVBAR Design. Introduction to CSS, types, Selectors, and Responsiveness of a web page. Introduction to Bootstrap, downloads/linking, using classes of Bootstrap, understanding the Grid System in Bootstrap.				
3	Introduction to www, Protocols and Programs, Applications and development tools, web browsers, DNS, Web hosting Provider, Setting up of Windows/Linux/Unix web servers, Web hosting in cloud, Types of Web Hosting.				
4	Introduction to JavaScript: Functions and Events, Document Object model traversing using JavaScript. Output System in JavaScript i.e. Alert, throughput, Input box, Console. Variables and Arrays in JavaScript.Date and String handling in JavaScript. Manipulating CSS through JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events and buttons, controlling your browser.Introduction to AJAX, Purpose, advantages and disadvantages, AJAX based Web applications and alternatives of AJAX. Introduction to XML: uses, Key concepts, DTD 8 schemas, XSL, XSLT,and XSL Elements and transforming with XSLT. Introduction to XHTML. JSON: Introduction to JSON, Keys and Values, Types of Values, Arrays, Objects				

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Text Books	
SL NO	Book Names
1	Laura Lemay, Mastering HTML, CSS & Java Script Web Publishing, BPB Publications, 2016
2	Thomas A. Powell, The Complete Reference HTML & CSS, Fifth Edition, 2017

Reference Books	
SL NO	Book Names
1	Silvio Moreto, Bootstrap 4 By Example, ebook, 2016.
2	Tanweer Alam, Web Technologies, Khanna Book Publishing, 2011.

Web links:	
SL No:	Links
1	www.javatpoint.com
2	www.w3schools.com
3	https://www.geeksforgeeks.org/web-technology/

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R25 - BCA

Semester	II
Paper Code	BCA25-VAC201
Paper Name	Indian Constitution
Credit	2
Total Contact Hours	24
Contact Hours/Week	2L:0T:0P

Course Outcomes	
CO1:	Constitutional Framework: Analyze the Indian Constitution's history, Preamble, Fundamental Rights, and basic structure.
CO2:	Union Government Structure: Describe the roles of the President, Prime Minister, and the legislative bodies (Lok Sabha and Rajya Sabha).
CO3:	State Government Mechanisms: Examine the powers of the Governor, Chief Minister, and the State Secretariat.
CO4:	Local Administration: Assess the functioning of local government bodies like District Administration, Municipal Corporations, and Zila Panchayats.
CO5:	Electoral Processes: Analyze the role of the Election Commission in conducting free and fair elections.

Course Content:					
Module #	Topic	L	T	P	Total
1	**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				
2	**Union Government** • Structure of the Indian Union • President – Role and Power • Prime Minister and Council of Ministers • Lok Sabha and Rajya Sabha				
	State Government				

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| 3 | • Governor – Role and Power
• Chief Minister and Council of Ministers
• State Secretariat | | | | |

| 4 | **Local Administration**
• District Administration
• Municipal Corporation
• Zila Panchayat | | | | |
| 5 | **Election Commission**
a. Role and Functioning
b. Chief Election Commissioner
c. State Election Commission | | | | |

Suggested Learning Resources:	
SL NO:	Topic
1	Ethics and Politics of the Indian Constitution by Rajeev Bhargava, Oxford University Press, New Delhi, 2008
2	The Constitution of India by B.L. Fadia Sahitya Bhawan; New edition (2017)
3	Introduction to the Constitution of India by DD Basu Lexis Nexis; Twenty-Third, 2018 edition

Suggested Software/Learning Websites:	
SL No:	Links
1	https://www.constitution.org/cons/india/const.html
2	http://www.legislative.gov.in/constitution-of-india
3	https://www.sci.gov.in/constitution
4	https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

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R25 - BCA

Semester	II
Paper Code	BCA25-CC291
Paper Name	Data Structures and Algorithms Lab

SL NO:	Topic
1	Write a program for insertion and deletion operations in an array.
2	Write a program to search for an element in an array using Linear Search and Binary Search.
3	Write a program to sort an array using Bubble Sort, Selection Sort and Insertion Sort.
4	Write a program to merge two arrays.
5	Write a program to add and subtract two matrices.
6	Write a program to multiply two matrices.
7	Write a program to insert an element into a Singly Linked List: (a) At the beginning (b) At the end (c) At a specified position
8	Write a program to delete an element from a Singly Linked List: (a) At the beginning (b) At the end (c) A specified element
9	Write a program to perform the following operations in a Doubly Linked List: (a) Create (b) Search for an element
10	Write a program to perform the following operations in a Circular Linked List: (a) Create (b) Delete an element from the end

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11	Write a program to implement stack operations using an array.
12	Write a program to implement stack operations using a linked list.
13	Write a program to add two polynomials using a linked list.
14	Write a program to evaluate a postfix expression using a stack.
15	Write a program to perform the following using recursion: (a) Find the factorial of a number (b) Find the GCD of two numbers (c) Solve Towers of Hanoi problem
16	Write a program to implement simple queue operations using an array.
17	Write a program to implement circular queue operations using an array.
18	Write a program to implement circular queue operations using a linked list.
19	Write a program to perform the following operations on a binary search tree. (a) Preorder Traversal (b) Inorder Traversal (c) Postorder Traversal
20	Write a program to perform an insertion operation in a binary search tree.

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Semester	II
Paper Code	BCA25-CC292
Paper Name	Operating Systems Lab

Course Outcomes	
CO1:	To implement scheduling of algorithms.
CO2:	Understanding the concept of critical section problems.
CO3:	Concepts of file allocation of frames.
CO4:	Concept of Page replacement algorithms.

SL NO:	Topic
1	Write C program to simulate the FCFS CPU Scheduling algorithm.
2	Write C program to simulate the SJF CPU Scheduling algorithm.
3	Write 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 the Paging memory management technique.
9	Write a C program to simulate the 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 the Dining-Philosophers problem.
13	Write a C program to simulate the MVT algorithm.
14	Write a C program to implement the FIFO page replacement technique.
15	Write a C program to write a C program for implementing sequential file allocation method.

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